TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

YANLING YUE

ANALYZING PLATFROM EVOLUTION IN THE NEW DIGITAL ERA – CASE INDOOR POSITIONING IN CHINA

Master of Science thesis

Examiner: Prof. Saku Mäkinen and Dr. Jouni Lyly-Yrjänäinen
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ABSTRACT

YANLING YUE: Analyzing platform evolution in the new digital era – case indoor positioning in China

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In recent years, a number of technological firms, including well established ones and startups, bring into the market a range of new technologies and applications, leading to the emergence of new industries and business fields. To obtain a first-mover advantage, companies operating in the new businesses choose to act as early as possible. However, due to the unclear feature of the new technology and the uncertainty of emerging business area, it is not easy to find an appropriate expansion strategy. In the meantime, technological advancements in different industries have been converging into four areas: social media & social networking, mobile/mobility, analytics, and cloud computing, resulting in the formation of a new term – SMAC. In this context, a World 2.0 new digital era is emerging to reshape the whole business world, and some digital platforms become powerful not only to win in their own industry but also to start offering services in other industries, including sometimes the emerging industries. In this respect, platforms are connected to the relevant new business fields and may become useful for helping companies to expand. Nonetheless, as the digital environment is highly dynamic and the platforms are always evolving, it is difficult to find an effective tool to estimate to which degree those platforms could be useful.

The aim of this thesis is thus to discuss whether SMAC can be used as a tool to assess the platform ecosystem and evaluate the platform evolution, the results of which enable the companies to identify more easily the potential collaborators in each vertical or horizontal market and to define their expansion strategy more adequately. Based on a literature review, frameworks were created, summarizing the characteristics of digital platforms, illustrating the effects of SMAC stack on the platform ecosystem, and presenting the additional factors which are influential besides SMAC components. In order to test the validity of the proposals, the main research method applied is case study, in which a Chinese social networking platform – WeChat was studied in the Chinese market with a focus on emerging indoor positioning field.

The outcome of research proved the effectiveness of the proposed solution from two aspects. On the one hand, WeChat was studied through a lens of SMAC stack to show how it has evolved and has become an all-in-one platform. Moreover, taking into consideration of additional elements, such as the platform strategy and new technological trends apart from SMAC, companies are likely to estimate the most possible outlook of WeChat. On the other hand, based on the results of interviews with the managers of case company, the connection between WeChat evolution and new market strategy is confirmed, and the use of SMAC stack is indeed helpful for a better understanding of the platform and its evolution. Also, it is agreed that SMAC could be a useful tool for the analysis of other platforms. Therefore, the outcome of this thesis not only proves the effectiveness of proposals for the case company, but also confirms the usefulness of SMAC stack as a tool to analyze varying platforms, and shed light on the expansion strategy adopted by technological companies that want to provide services in relevant fields.

PREFACE

This paper discusses the rise of a new digital era driven by SMAC stack, and the potential of using SMAC as a tool to evaluate the platform evolution. Managers can use this tool to help decide if the platforms can be leveraged for the making of expansion strategy, especially in the emerging business fields. To make a logical and effective proposal, a variety of business and technological concepts are explained, and some new trends in the current economy are described, leading to a topic that has been rarely discussed before. As a result, this thesis not only makes contribution to the managerial theory in terms of platform evolution and platform-based strategy making, but also provides practical insights for people working in different areas, including R&D and sales & marketing.

I want to express my gratitude to many great people for the completion of this thesis. First, I would like to thank Dr. Jouni Lyly-Yrjänäinen, my supervisor in the university. His supervision and suggestions have guided me throughout the whole process. I also want to express my thanks to my examiner, Prof. Saku Mäkinen, for his time and effort in the reading of the thesis. Second, I am so grateful to my line manager and supervisor in the company, Jari Syrjärinne, for his constant guidance and support; Third, I am indebted for the help of many colleagues in the company: Denis Shamanin, Daniel Abel, Charles Yang, Lauri Wirola, etc., who helped me for understanding the company's technology and business solutions and supported me during the whole research process. Finally, I would like to thank my family, who is the source of my spirit and energy.

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Yue Yanling

CONTENTS

LIST OF SYMBOLS AND ABBREVIATIONS

3CPP	China Cloud Computing Promotion and Policy Forum
AI	Artificial Intelligence
AR	Augmented Reality
BAT	Baidu, Alibaba, and Tencent
BBS	Bulletin Board System
BLE	Bluetooth Low Energy
CAGR	Compound Annual Growth Rate
CNNIC	China Internet Network Information Center
CRM	Customer Relationship Management
ERP	Enterprise Resource Planning
GNSS	Global Navigation Satellite System
GPS	Global Positioning Systems
ICT	Information and Communication Technology
IoT	Internet of Things
IPS	Indoor Positioning System
LBS	Location-Based Service
MAU	Monthly Active Users
MIIT	Ministry of Information and Industry Technology
MIRC	Mobile Informatization Research Center
NDRC	National Development and Reform Commission
O2O	Online to Offline
OS	Operating System
RFID	Radio Frequency Identification
RTLS	Real-Time Locating System
SDKs	Software Development Kits
VR	Virtual Reality
WeChat OA	WeChat Official Account

1. INTRODUCTION

1.1 Background

A new digital era, defined as "World 2.0", is impacting the whole business world around us. According to Karakas (2009), World 2.0 is an open, innovative, flexible, borderless, global mega-platform where people share experience of collaboration, inspiration, immersion and interaction in multimedia with people of other industries and countries. In this context, technologies and business models are undergoing significant transformation influenced by the paradigm shifts in the internet, mobile technologies, and telecommunications. Meanwhile, the convergence of an array of new technological trends, including social media and networking, mobile technology, analytics, and cloud computing, known as "SMAC" in acronym, are reshaping all the enterprises (Singh et al., 2016). According to Frank (2012), the dematerialization and unbundling of knowledge processes is at the core of many industrial transformation. Driven by a proper implementation of SMAC technologies, significant transition is occurring in various industries, leading to the emergence of various digital platforms.

Platforms have been created and developed with varying purposes, e.g. Wikipedia for knowledge creation and sharing, Second Life for fun and entertainment, Facebook and Skype for network connection, InnoCentive for Innovation and collaboration (Karakas, 2009). Whatever the purpose is, the emergence of those platforms has led to a similar outcome: digital platform owners have taken over the "widget winners', and become new leaders in a variety of traditional businesses. The digitalization breaks down the industry barriers, destroys some long-lasting business models, and creates new opportunities (Weill and Woerner, 2015). The result of such disruption could be dramatic, causing the reshaping of the whole business world. The transformation from traditional business model to platform-based mode can have various effects, one of which is the introduction of new solutions and new services on the market. Another effect is related to the capability reconfiguration of companies (Eisenhardt and Martin, 2000), especially the ones that have been active for a long time in the traditional industries.

Driven by the technological advancements in the new digital era, a number of technological firms, including well established ones and startups, bring into the market a range of new technologies and applications, leading to the emergence of new industries and business fields. To obtain a first-mover advantage, companies operating in the new businesses choose to act as early as possible. However, due to the unclear feature of the new technology and the uncertainty of emerging business area, it is not easy to find an appropriate

expansion strategy. On the other hand, given the growing importance and increasing ubiquity of platforms, these new technologies are sometimes incorporated into them. In this regard, it becomes interesting to know if there is a connection between the emerging business fields and platforms, and if the connection is confirmed, how can the companies analyze the connection and take advantage of it?

1.2 Motivation and Objectives of Research

As discussed previously, a digitalized "World 2.0" is reshaping the whole business world, leading to the popularity of digital platforms which have taken over traditional business winners. Simultaneously, new technologies are always emerging and are often applied in platforms for offering integrated services. Under this condition, the study of platform can pave a path directing the applications of new technologies. However, the study of platform evolution is not an easy task because platforms, unlike static objects, are always evolving for adapting to changes occurring in themselves and in the dynamic environment. Moreover, the evolution of platform involves many players: platform owners, various elements or actors that are connected to the platform ecosystem, and the macro environment which can either promote or constrain the development. In this context, a methodology is necessary for studying platform and its evolution.

Nonetheless, it is difficult to find a method in platform-based managerial discipline since the its research has a short history. It is until very recently that a growing interest in software platform research has emerged with a focus on innovation dynamics and platform evolution among academics. For instance, Bush et al. (2010) studied the coevolution of platform architecture, governance, and environmental dynamics. Tilson et al. (2012) made a comparison of several mobile app platforms in terms of innovation dynamics. Ghazawneh and Henfridsson (2013) discussed the role of boundary resources for platform owners to benefit from contributions of complementors. Wareham et al. (2014) conducted a research on platform governance. Eaton et al. (2015) explored further by explaining platform innovation as distributed process of resource tuning between boundaries. Those researches, as well as some other scattered studies, have enriched the collection of extant platform literature. Despite of it, the research is still significantly limited in contrast to other disciplines. Not only the amount of literature but also the scope of studies is insufficient, resulting in a lack of methodology for studying the platform evolution, especially from a digitalized environmental perspective.

In the search of an effective tool for analyzing platform, a term SMAC, which is an acronym representing the major technological trends in recent years, becomes interesting. Under the impacts of SMAC, the whole business world has been transformed, facilitating the emergence of varying digital platforms, some of which have successfully become new leaders in different industries (Frank, 2012). Under this condition, it is reasonable to suggest: if SMAC stack has helped to drive the emergence of platforms, why cannot it be used purposefully for the study of platforms? Therefore, the objective of this thesis is to…

...discuss the feasibility of using SMAC stack as a tool to analyze platform and its evolution.

To achieve this objective, several research questions are to be answered:

- What is platform evolution, and what factors can affect the evolution of platforms?
- How can the four dimensions of SMAC, social media & networking, mobile/mobility, analytics, and cloud computing, shape the new digital era?
- What are the impacts of SMAC stack on the emergence and evolution of platforms? How will those impacts affect the strategy and decision-making of management?
- How to rank the four dimensions of SMAC regarding the future evolution of an individual platform?
- In addition to SMAC stack, are there other technological trends that are critical for platform future evolution?

The findings of this study can make contribution to managerial discipline from two angles. First is referred to the management theory. It is known that the respective studies of platform and SMAC stack have been started very recently, and few have purposefully discussed the connections between those two concepts, or at least not in a systematic way, thus the findings of this new research can add good points to the theoretical study. Meanwhile, in this new digital area when all organizations are going through a digital transformation and when the convergence of technologies is becoming common, enterprises, CIOs (Chief Information Officers), and other involved actors must be aware of the changes and make appropriate decisions in the near future. Therefore, this topic is also interesting in a sense that practical advices can be proposed to people who are hesitant in a context that is full of new technologies and applications.

1.3 Structure of Thesis

This thesis is structured as follows. Chapter 1 is the introduction to the background, the motivation, and the objective of the thesis. Next, the following three chapters describe the theoretical background based on which a literature framework can be built. Among them, Chapter 2 explains the types and characteristics of platform, the management of platform ecosystem, as well as the platform evolution. Chapter 3 is the presentation of the new digital era – "World 2.0" which is shaped by the SMAC stack. After the discussion showing how SMAC stack has driven the change and transition of business models in various industries, a theoretical framework is proposed in Chapter 4. Afterwards, Chapter 5 describes research methods, summarizing how data is collected and how research is conducted.

Chapter 6 is the discussion of empirical case, in which case company and its problems are first described, followed by the introduction to the indoor positioning technologies

and application in general. Afterwards, it is the description of the Chinese indoor positioning market in which the case company requires a solution. Prior to the introduction of WeChat platform evolution, the connection between indoor positioning applications and WeChat platform is examined. Next, Chapter 7 discusses the impacts of SMAC on WeChat and verifies the effectiveness of proposal based on the results of interviews conducted in the case company. Finally, conclusions are made in Chapter 8, including the discussion of the thesis's implications to managerial theory and practices, as well as the limitations and potential for future research.

2. DIGITAL PLATFORMS

2.1 Literature Review of Platform Research

Platforms exist in various industries, especially in the high-tech domain driven by information and communication technologies. Depending on the context, platforms have different forms. For example, mobile phones, consumer electronic devices, computers, as well as the hardware and software contained in those products serving for various purposes, are all examples of industry platforms (Gawer and Cusumano, 2014). Platforms have been studied by a growing number of scholars from different perspectives. (Sorensen et al., 2015).

Ciborra (1996) saw an organization as a platform and emphasized its strategic importance for tinkering and improvisation, and focused on the need for short-term and adaptive behavior. Subsequently, Gawer and Cusumano (2002) tried to understand the coordination and innovation of distributed processes from industrial innovation perspective. Later, based on the hierarchy of product systems, from a combination of economic and engineering design perspective, Gawer (2014) categorized platforms into three types: internal platform, supply chain platform, and industry platform. Meanwhile, according to the externalities and architectural openness, Gawer and Cusumano (2014) suggested two predominant types of platforms: internal or company-specific platforms, and external or industry-wide platforms. Internal platforms are defined as a bundle of assets organized in a certain structure based on which the company can leverage and develop a set of derivative products. External platforms refer to technologies, products, or services of in an innovative ecosystem working as foundation for external actors to develop complementary technologies, products, or services (Gawer and Cusumano, 2014).

In management research the term platform can be used for either metaphor or construct purposes. Specifically, platform concept can be applied to describe management phenomena at different levels, including single products, product systems, supply chain, industries, markets, and a constellation of markets and industries (Gawer, 2009). However, even there is a growing amount of term adoption, little exploration about the theoretical grounding of platform construct has been conducted, and platform research is scarcely appearing in A-journals of management (Thomas et al., 2014). The lack of coherent theoretical underpinnings (Tranfield, Denyer, & Smart, 2003) limits the potential of platform research for making contribution to management theory and practice. Seeing the need, Thomas et al. (2014) conducted a literature review with 183 papers and found that platform research could be divided into four main streams: product family platform, organizational platform, market intermediary platform, and platform ecosystem, detailed in Table 1.

Table 1. *Overview of platform research streams (Adapted from Thomas et al., 2014).*

	Product family	**Organizational**	**Market intermediary**	**Platform ecosystem**
Alternative terms	Product platform, internal platform, supply chain platform	Platform organization, platform technology, platform investment	Two-sided platform, multisided platform	Technology platform, industry platform
Construct	Product/components	Dynamic capability	Multisided market	Platform ecosystem
Level of analysis	product	organization	industry	Systems/industry
Definition	A common set of products/components acting as basis for derivative products	A set of organizational capabilities enabling superior performance	An intermediary bridging two or more market participants	An architecture or system which supports a bundle of complementary assets
Core discipline	Product development	Corporate strategy	Industrial economic	Technology strategy
Core concepts	Modularity, commonality, architecture	Capabilities and dynamic capabilities,	Multisided market, network externalities	Modularity, standard, innovation, network externalities
Empirical examples	Consumer electronics, machine tools, automotive	Computing, biotechnology, outsourcing, consulting	Telecoms, online advertising, e-commence, online auction	Internet, information technology
Existing literature	Meyer and Lehnerd (1997); Robertson and Ulrich (1998)	Ciborra (1996); Kogut and Kulatilaka (1994)	Armstrong (2006); Caillaud and Jullien (2003);	Bresnahan and Greenstein (1999); Gawer and Cusumano (2002); West (2003)

Among the four streams listed in Table 1, product family stream is the most widely studied area in the platform literature. This is consistent with the former review of Simpson (2004) and the concepts of "supply chain platform" and "internal platform" proposed by Gawer (2009). The core discipline of this stream is related to product innovation (Utterback and O'Neill, 1994), product development (Ulrich and Eppinger, 1994), as well as product modularity (Baldwin and Clark, 2000) and mass customization (Pine and Davis, 1999). Secondly, in organization stream, the term platform is adopted to describe the organizational knowledge (Kogut and Zander, 1992) and dynamic capabilities (Teece et al., 1997). This stream views company itself as a platform that possesses a set of assets and capabilities for adapting to internal and external changes and for addressing emerging opportunities (Eisenhardt and Martin, 2000). For instance, a concept of "platform organization" was adopted by Ciborra (1996) to describe company as a flexible platform to reconfigure its resources and capabilities when facing challenges and opportunities driven by technological shifts.

Next, market intermediary stream is an area growing faster than other three streams (Thomas et al., 2014). The platforms mentioned in this stream act as links or facilitators for connecting two or more parts (markets or producers or users). Due to the two or multisided characteristics of intermediary, a market platform can influence the number of transactions and the volume of sales by either increasing the prices on one side or by charging less on the other side (Rochet and Tirole, 2006). Similarly, Armstrong (2006) viewed market platform as intermediary through which two or more agents could interact. However, unlike the traditional market intermediary which not only facilitates the transaction but also owns the transacted products or services, market platform usually does no take ownership but only acts as facilitator by alleviating bottlenecks between different participants, e.g., buyers and sellers (Hagiu and Yoffie, 2009).

Finally, in platform ecosystem stream, a platform is regarded as a hub or a controlling center of a technology-based business ecosystem (Ceccagnoli et al., 2012; Gawer and Cusumano, 2002). The notion of industry platform proposed by Gawer (2009) is also included in this stream. Theoretically, platform ecosystem literature has been derived from a variety of perspectives, such as competitive strategy (Porter, 1985), value appropriation (Teece, 1986), system competition (Katz and Shapiro, 1994), and network externalities (Katz and Shapiro, 1994). The research of platform ecosystem mainly focuses on the Internet and information technology, or more specifically, the computer industry (Bresnahan and Greenstein, 1999).

Actually, the theoretical underpinning of platform ecosystem literature draws from the product platform stream and market intermediary stream (Thomas et al., 2014). For instance, Meyer and Seliger (1998) predicted the platform ecosystem phenomenon in their product platform research. Economides and katsamakas (2006), and Eisenmann (2008) incorporated discussion of platform ecosystem in their market intermediary platform research. Hence, a platform ecosystem is typically more complex as it combines concepts from two research streams. In this respect, the study of platform ecosystem is not only connected to product modularity, architectural design, interfaces (Baldwin and Clark, 2000), but also to the market facilitation for value exchange (Economides and Katsamakas, 2006). Moreover, the combination of the two streams leads to the provision of a broader business network through incorporation of complementary technologies, products, and services (Hagiu and Yoffie, 2009). As a result, in addition to the underlying logics of product family and market intermediary streams, platform ecosystem stream also incorporates additional constructs to address challenges related dominant design, standards, and offering ownership and control.

Due to the distinct theoretical underpinnings of platform research, the previous discussion has highlighted the differences between the four streams. In reality, however, apart from differences, there are also some commonalities. The most common feature, according to Thomas et al. (2014), is the theoretical logics of leverage and architectural openness. Lev-

erage is a process that generates an output larger than the required input, while architectural openness includes an architecture which is a system of elements and their relationships (Crawley et al., 2004) combined by a notion of visibility in modularity theory (Baldwin and Clark, 2000). Based on the logic of leverage, three types can be identified: production leverage, innovation leverage, and transaction leverage. Based on the configuration of relationships, there are three types of platform architecture: closed or firm-internal, many-to-one, and many-to-many (Thomas et al., 2014).

Production leverage refers to the use and reuse of assets, interfaces, and standards that can be shared to drive economies of scope and scale. Through this sharing logic, manufacturing costs can be reduced with a better product architecture and product development time can be saved (Krishnan and Gupta, 2001). Similarly, innovation leverage is also defined based on the reusing and sharing logic, but unlike production leverage, the goal of innovation leverage is to achieve economies of innovation and to drive complementarity so to accelerate the creation of new products and services (Nambisan and Sawhney, 2011). In contrast, transaction leverage is to drive transaction efficiency and to reduce costs for search and exchange of products and services based on the manipulation of market access and pricing mechanism (Rochet and Tirole, 2006). Generally, those three leverage logics can be observed in platform research. However, depending on the specific stream, the degree of manifestation is different. For instance, product family stream mainly shows the production leverage and innovation leverage; organizational stream demonstrates innovation leverage; market intermediary stream exhibits transaction leverage; platform ecosystem stream, specifically, presents all three leverage logics.

Regarding the features of architecture, all platforms consist a collection of low-variety components surrounded by a number of high-variety components (Baldwin and Woodard, 2009), but the architectural configuration is either closed or open to third-part participants depending on the type of platforms. First, a platform architecture can be closed or firm-internal without involvement of third party when there is constrains on participation in the development, commercialization, and use of platforms (Eisenmann et al., 2009) (mainly for product family and organizational streams). By contrast, a many-to-one architecture shows up when the supply-side of platforms are opened to third-party actors, while a many-to-many architecture appears when both the supply and demand sides are opened to third-party participants. Many-to-many occurs mainly in market intermediary and platform ecosystem streams. Based on the previous discussion, the leverage logic and architectural openness of the four platform literature streams are summarized in Table 2.

Table 2. *Leverage logic and architectural openness of four platform literature streams (author's creation based on the literature review).*

	Product family	**Organizational**	**Market intermediary**	**Platform ecosystem**
Leverage logic				
Production	X			X
Innovation	X	X		X
Transaction			X	X
	Product family	**Organizational**	**Market intermediary**	**Platform ecosystem**
Architectural openness				
Closed	X	X		
Many-to-one	X			
Many-to-many			X	X

As presented in Table 2, depending on how the products and services are developed, commercialized and used, and the restrictions placed on the participation of third-party actors, the leverage logic and architectural openness of different research streams are varying. The only stream that represents a multi-logic leverage is platform ecosystem. It combines production, innovation, and transactional leverage into a many-to-many architecture based on its open system. An open system includes open standards and interfaces that can be used to drive the development of new products and services by involving multiple entities (Chesbrough and Appleyard, 2007), which can be exemplified by open-source projects.

On the other hand, platforms are not static, instead, they are able to evolve over time. According to Gawer (2009), a platform that is initially developed as a closed system could evolve towards greater openness. For example, if a company decides to outsource components that are previously produced internally, an internal platform will first evolve into a supply chain platform, and then further evolve into a platform ecosystem if the supply of the outsourced components change from chains to networks after more horizontal links are formed (Gawer, 2009). Also, platforms can evolve through the change of leverage logic and levels of architectural openness (Thomas et al, 2014). For instance, a platform owner can progressively open a closed platform architecture to a many-to-one or even many-to-many level through a smooth opening of its standards and interfaces. During this process, by bringing more participants into the platform, more sources of innovation will be derived, and the internal platform will evolve from production logic to innovation-oriented logic.

Based on the previous discussion, it is known that the term platform has been used in a large scope in different contexts, and there is not yet a fixed definition to determine what a platform is as it can refer to various entities, such as a product and its family, a supply chain, an organization, a market intermediary, and an industry. For the sake of this thesis, the focus is related to two parts: a digital platform that can be regarded as one type of product family and an ecosystem that is developed around it. In this regard, platforms studied in this thesis is most close to the ones positioned in platform ecosystem stream. Specifically, a platform targeted in this thesis can be defined as a place or a hub where different user groups are connected and interact to co-create value through innovation (Isckia and Lescop, 2015), either it is a physical or virtual location (Evan, 2003).

2.2 Digital Platforms – Types and Characteristics

In the modern economy, with the growth of internet technology and the use of mobile phone and apps, many digital platforms have appeared. According to TNO (2015), a digital platform can be defined as a technological basis for aggregating and delivering digital content/services, while a software platform is defined as an extensible software-based system that offers core functionality and services (Baldwin and Woodard, 2009; Eisenmann et al., 2006). Also, according to Meyer (2000), a digital platform not only offer technical and commercial content and services but also consists of hardware that supports the software services. In this regard, digital platforms contain software platforms and have a larger scope than the latter ones.

The research of digital platforms has been started only in recent years with a focus on mobile networks and software development (e.g. Bush et al., 2010; Wareham et al., 2014). With the advancement in the field of ICT (Information and Communication Technology), enterprises are now leveraging platforms to collaborate and coordinate many business players, including suppliers, complementors, customers, distributors, and even competitors. Players not only have a direct or indirect relationship with the platform owner but interact with each other (Lansit and Levien, 2004). Based on the interaction forms between the different players, Isckia and Lescop (2015) classify digital platforms into four types, listed in Table 3.

Table 3. *Classification of digital platforms based on interaction forms (adapted from Isckia and Lescop, 2015).*

Types	Interaction forms	Players	Examples
Exchange platform	Exchange/transactions	Buyers and sellers	eBay
Content platform	Content (pictures, videos, code, etc.) creation and consumption	Creators and content consumers	Google
Innovation platform	Open innovation	In house teams/external innovators	Orange Partners
Social platform	Socialization	End-users and app/service developers	Facebook

As shown in Table 3, a platform can be a place where players make exchanging activities between at least two players, e.g. between buyers and sellers, or a place where some players create and share content such as pictures, videos, and other content, or a place where various players discuss and interact for open innovations, or a place where social networking activities take place for chatting, sharing between different users. The examples of each platform are given in the table. Even the focus of each platform presented in the table is on one form of interaction, it only represents an ideal situation. In reality, a hybrid platform is often found (Isckia and Lescop, 2015).

In addition to the interaction forms, platforms can also be categorized based on the industries in which they offer services (Tiwana, 2014). For example, in mobile computing industry, there are mainly two platforms, Apple's iOS and Google's Android. In browser space, a range of platforms exist, such as Firefox, Google Chrome, Microsoft IE. In publishing industry, there are Apple iTunes for the publishing of music, Amazon's Kindle for the publishing of e-Books, and other platforms.

More platforms having been emerging in the last few years, and the migration from traditional products and services towards software-based platforms are ongoing in many industries and markets. The transit is driven by a set of forces: packetization of products and services, more need for personalization, increased ubiquity of network connection and software embeddedness in everyday objects, and the integration of routine business activities into software-based tasks (Tiwana, 2014). Those changes can affect how enterprises do business, retain customers, operate, and survive. Since digital platforms have become more influential in every aspect of business world, the focus of this thesis is thus on them. Also, to simplify the discussion, in the following sections when the term "platform" appears, it means by default a digital platform.

Platforms have several unique characteristics, including platform properties and platform dynamics (Tiwana, 2014). Platform properties consist of multisidedness, network effects, and multihoming. Platform dynamics refer to the tipping, lock-in, competitive durability, and envelopment. Figure 1 depicts three platform characteristics: multisidenesss, network effects, and envelopment. Frist of all, Multisidedness is a key characteristic of platform, with each 'side' referring to a distinct group of players/stakeholders that are connected by the platform. For instance, a mobile operation system, such as iOS, can connect consumers or end-users from one side and app developers from the other side. The existence of an iOS platform can facilitate the value creation and transaction of both parties without making efforts to know and make contact with each other.

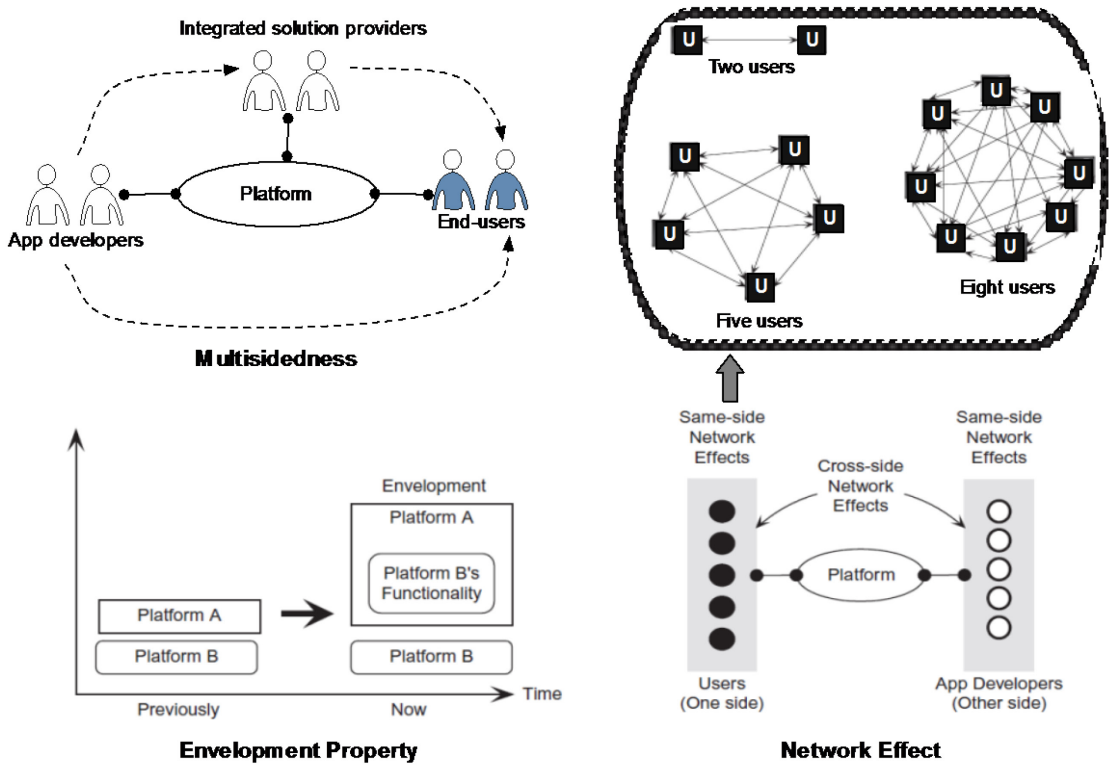

Figure 1. *Typical characteristics of digital platform: Multisideness, network effect, and envelopment (Adapted from Tiwana, 2014).*

The two-sided platform may refer to an app store, an e-commerce site, or a content sharing site. The two-sided platform can create value for participants on one side to easily find users on the other side, or for mediating the interactions between two sides. Theoretically, it is possible for the two sides to find and trade with each other without the existence of platforms, but the cost is much higher and the time is much longer. A platform can thus work as a market place where two or multiple sided groups of people get in touch and interact with one another. In addition to the two groups of players, a third group of players, e.g., integrated solution providers who combine their own capabilities with that of app developers for providing solutions with multiple services, can add one more side to the platform, leading to the formation of a multi-sided platform, as illustrated in Figure 1.

Figure 1 also presents the second key platform characteristics, network effect. Network effects, which are also called network externalities (Saloner and Shepard, 1995), are defined as the degree to which each additional app or user of a platform adds value to the other existing users. The logic is simple here: the addition of each user can increase the number of interaction with another existing user. For instance, social networking platforms, such as Facebook, the value of which would be zero if there were only one user due to the lack of a network, and the addition of second user would add value to the first user, and the addition of third user would add more value to the two exiting users, and so forth. In the end, with the increase of users, the system value grows almost exponentially

rather than linearly, and a network effects are manifested, entering a self-reinforcing cycle.

The case of social network platforms shows the same-side network effect, meaning the value of additional users is combined with the users in similar positions. In another example, if there are more users require a certain type of app, such as a picture treating application, more developers will write new apps for this service. This kind of effect is cross-side network effect (Tiwana, 2014). Moreover, network effects are not always positive; negative effects also exist. For instance, the addition of a user in a wired network can decrease the availability of bandwidth for internet connection.

Multihoming is the third platform property, which refers to the participation of a certain type of users in more than one platform ecosystem (Armstrong, 2006). For example, a consumer can have both an iPhone and a kindle phone which have different operating platforms, or a developer can write apps for iOS, Android, and Windows phones, or a user can register in several social networks, such as Facebook, WhatsApp, Snapshot. The reasons for a multihoming are either for reducing the reliance on a single platform in case of system breakdown, or for lowering the cost when different platforms provide different benefits.

The next characteristic refers to tipping, a dynamic property of platform ecosystem. This property is related to network effects, or more precisely, it is the minimum number of users above which network effects start to present. This tipping point is also called critical mass, which is important for both existing and new platforms. For existing platforms, tipping point needs to be pushed towards to and maintained on the desired trajectory, and for new platforms, it is critical to direct the growth of the right side of users for reaching the point. Distinct strategies are required for a platform before and after it reaches a tipping point.

Lock-in is a second dynamic property of platform. It refers to the platform's strength for retaining the users and avoiding their switch to competing platforms. Lock-in can occur both in enterprise-level platforms and in consumer-level platforms. Lock-in can be realized by coercive or value-driven approaches to make the switch to a competing platform costly or even impossible (e.g. Monteverde and Teece, 1982). A platform owner can set barriers by using proprietary technologies, such as middleware, protocols, adapters, or by defining high migration cost in the contract to prevent the switch of users to rival platforms, leading to a coercive lock-in. Value-driven lock-in is an alternative approach for maintaining users by offering them more valuable products or services at reasonable price.

The third platform dynamic is competitive durability which is viewed as the sustainable usage of a product or service after the initial adoption (Bush et al., 2010). A technology solution, such as an app, may not be used regularly after the initial usage as its functions

may no longer meet the new requirements of users or it can face threats of newly developed apps after some time of usage. To maintain its competitive durability, a platform must become sticky by offering more valuable functionality to the users or by strengthening network effects.

The last dynamic characteristic of platform is its envelopment property, which is depicted in Figure 1 alongside multisideness and network effect. According to Eisenmann et al., (2006), envelopment refers to the swallowing effect when a platform starts to offer the functions of another platform in a neighboring market on top of its own bundle of functionality. As shown in Figure 1, platform A may refer to an Android operating system, and platform B refers to a mp3 reader platform. The addition of music apps in Android system has gradually swallowed the functionality of a mp3 reader. Similarly, the addition of digital photography feature in the smart phones have enveloped the neighboring digital camera industry.

Envelopment is usually possible if the two neighboring platforms have a considerable degree of overlap in their user bases, and the users of the enveloped platform perceive a better value for the functions offered by the enveloping platform (Eisenmann et al., 2011). Based on the types of adjacency, platform envelopment can be either horizontal or vertical or both (Tiwana, 2014). Horizontal envelopment is related to the overlapping of customer bases who use the services offered by platforms functioning in different industries, as described in the case of same users for both the smart phones and digital cameras. Vertical envelopment is related to the services offered at different positions of the value chain of the same industries. For instance, in the photography industry, a photo app might replace the services of a scanner or a copier.

2.3 Platform Ecosystem and Management

In an IT background, a platform usually does not exist alone, but is part of an ecosystem. The multisided property and network effects of platform already demonstrate that more than one group of players are involved in the business. This is aligned with the review of platform ecosystem stream, in which a platform is regarded as a hub or a controlling center of a technology-based business ecosystem (Ceccagnoli et al., 2012). Located at the core position of an ecosystem, the successful launch and maintenance of a platform is in relation to various parts, including not only the direct participants, such as the end-users, app developers, but also those indirectly related actors, e.g., infrastructure provider, regulation agencies. Hence, the management of platform not only refers to the platform itself, but also to the platform ecosystem in which a variety of actors are interconnected with different roles. A typical platform ecosystem is shown in Figure 2.

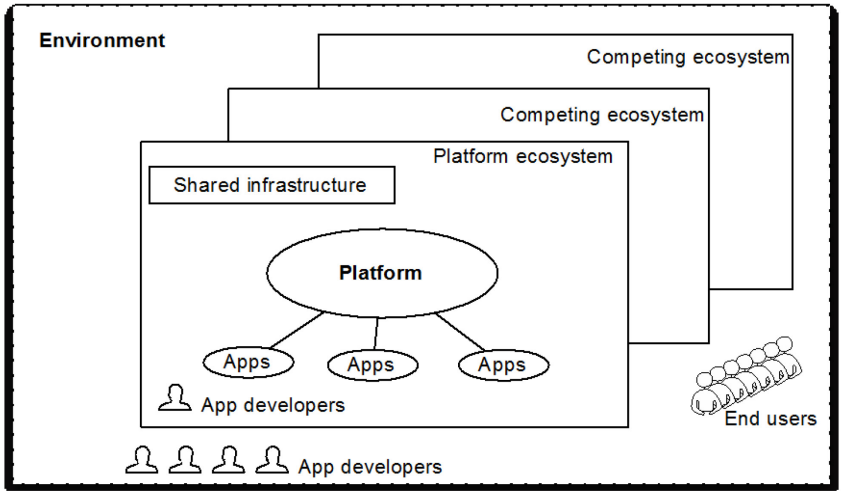

Figure 2. *Platform ecosystem (adapted from Bush et al, 2010).*

The core elements of a platform ecosystem include platform, apps, app developers, end-users, and shared infrastructure. Platform is an extensible software-based system that offers core functionality (Baldwin and Woodard, 2009; Eisenmann et al., 2006). Like the keystone species of a biological ecosystem, platform is the anchoring point of its ecosystems and can improve ecosystem health by facilitating interaction and increasing innovative activities (Isckia and Lescop, 2015). App developers create apps that interoperate with platform. Apps are the software subsystems that are connected to the platform for adding more functions to it. App developers and end-users are respectively those people who create and utilize the services offered by the platform. Shared infrastructure refers to the entities or public structures that are necessary for enabling the functionality of platform, e.g., deployment of broadband network or the 4G network for Internet connection. In addition to the core elements of a platform ecosystem, two other contextual actors, environment that surrounds the ecosystem and rival platform ecosystems, are also important. The definitions of the key elements of a platform ecosystem are summarized in Table 4.

Table 4*. Definitions of the key elements of a platform ecosystem (adapted from Tiwana, 2014).*

Element	Definition
Platform ecosystem	The collection of a specific platform and the elements connected to it
Platform	An extensible software-based system that offers core functionality shared by apps that interact with it.
App	Software subsystems that are connected to the platform for adding more functions to it
App developer	People who create apps
End-user	People who use the services of apps
Shared infrastructure	Entities or public structures that are necessary for enabling the functionality of platform

The management of a platform ecosystem depends on two dimensions: platform architecture and governance. Architecture is the conceptual blueprint that describes the components of a complex system or the structure of a technology solution for illustrating what to do and how to interact (van Schewick, 2012). According to Baldwin and Clark (2006), a platform requires an architecture of participation to present and grow its ecosystem. Platform architecture is usually described at a high level to specify the externally visible properties of a system components and their relationships (Sanchez, 1995). From a broad view, there are two extremities for describing platform architectures. One is perfectly modular and the other is perfectly monolithic, and between those two a continuum is formed. Most platform architectures are located somewhere of the continuum. More specifically, a digital platform architecture shows the features of individual apps and their interactions with other apps of the platform (Bush et al., 2010). The degree of platform complexity can influence the technical decision and innovation strategy of the participants.

Platform governance is another critical dimension for platform management and orchestration. If an architecture describes the structural complexity of a platform, a governance describes the behavioral complexity of the platform (Tiwana, 2014). Broadly saying, governance shows who decide what to do in a platform ecosystem. This is essential as it determines whether it is possible to leverage the platform architecture to divide the innovation tasks among participants (Rochet and Tirole, 2003). Also, platform governance refers to the mechanisms with which a platform owner can exert power to influence the app developers and other participants of the platform ecosystem (Schilling, 2005). Overall, platform governance contains three facets: one, the allocation of decision rights between platform owner, app developers, and others; two, the formal and informal control mechanisms that are adopted by the platform owners to influence the participants; three, the structure of pricing model.

Platform architecture and governance are deeply interwoven. They function not only as building blocks for ecosystem management but also for its evolution since they are the foundation for provisioning growth motivation and innovation capability (Tiwana, 2014). The design of platform architecture, platform governance, and the alignment between the two work as levers for the platform owner to orchestrate the platform evolution.

2.4 Evolution of Platform Ecosystem

Similar to its biological analogy, a platform ecosystem needs to be healthy and robust and evolve to adapt to the environmental changes (Moore, 2003). Platform ecosystem is a complex system that is partially designed and partially evolved (de Weck et al., 2011). According to Isckia and Lescop (2015), a platform's evolution depends not only on the keystone organization or the platform owner, but on the capabilities of the ecosystem's members to innovate and deliver continuous, viable and concrete solutions. This is consistent with the statement of Huang et al. (2009): "ecosystems are innovation networks in

which industry leaders coordinate collective efforts of developers and other partners towards shared goals". In this regard, the evolution is the core for the development of the platform ecosystem, and a platform's evolution depends on its ability to innovate.

The innovation process of a platform can be specified with a bathtub model proposed by Tiwana (2014), presented in Figure 3. Based on this model, a platform evolution process can be viewed as inflow and outflow of innovations. Innovation inflows are primarily derived from the contribution of platform owner and app developers, and secondly from other upstream suppliers and end-users, and are even based on ideas copied from competing platforms. Innovation outflows are the concepts and ideas that are leaked out, for instance, those copied by competing platforms. The remaining innovations in the reservoir, which is the result of a difference between inflows and out flows, are the innovation stock which can potentially differentiate the focal platform from the competing ones.

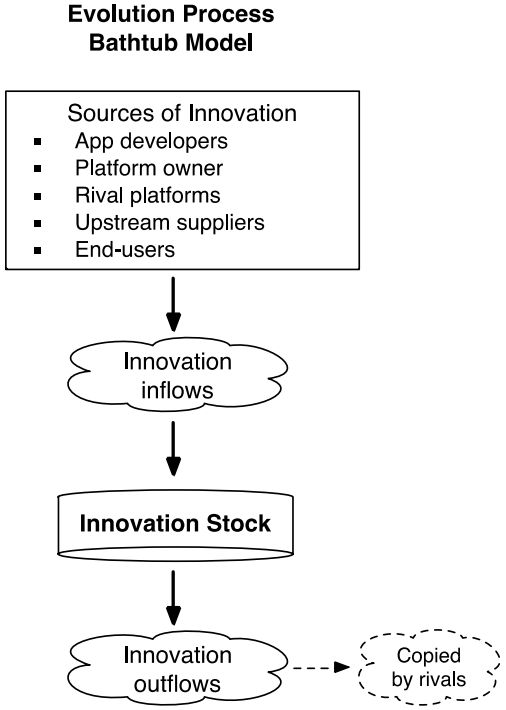

***Figure 3**. Platform evolution process: bathtub model – innovation stocks and flows (adapted from Tiwana, 2014).*

The innovation stock remaining in the tub contains unique features, functions, and services that represent the essence of platform and serve as key sources of competitive advantage, which also determine the long-term development of platform ecosystem. As a result, an increase of innovation stock is the prerequisite for achieving a desired platform evolution. Generally, innovation stock growth can be realized by increasing the inflow and decreasing the outflow, but the reduction of outflow is usually challenging in a rival platform market as competitors can readily replicate many innovations (Tiwana, 2014). Under this condition, the primary focus should be on the increase of inflow. As stated by

Boudreau (2010), the capacity of a platform to create a set of valuable new functions enables it to innovate faster than the speed of replication by competitors.

On the other hand, from the dynamic perspective, according to Bush et al. (2010), the evolution of platform ecosystem depends not only on the coevolution of the options of platform owner endogenous to the ecosystem but also on the environmental change exogenous to the platform ecosystem. Taking into account the impacting effects of environmental factors and the internal influence, the platform owner needs to consider two fits for the evolution of platform ecosystem, namely internal fit and external fit, as presented in Figure 4. Internal fit refers to the alignment between platform architecture and platform governance, which can affect the platform setting in terms of evolutionary dynamics and modules. The two concepts – platform architecture and governance have been introduced in the previous section. Additionally, the interactive relations between the two – platform architecture can reinforce or weaken the influence of platform governance on changing dynamics, and platform governance exert control to ensure the sustainable integrity and innovation (Bush et al., 2010).

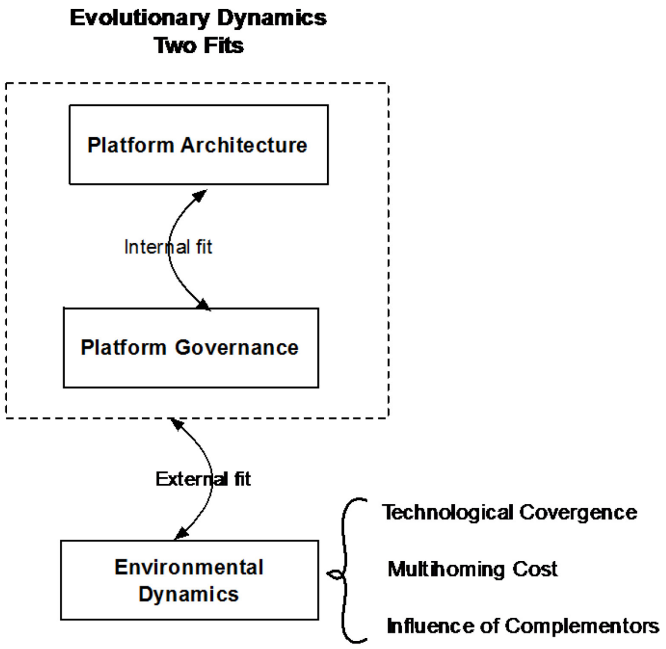

***Figure 4**. Platform evolutionary dynamics: coevolution of platform architecture, governance, and environmental dynamics (adapted from Bush et al., 2010).*

The second fit is the external or environmental fit, meaning the interaction between environmental dynamics and endogenous platform attributes. In the study of Bush et al. (2010), three environmental dynamics are specified: convergence, multihoming costs, and influence of complementors. Convergence refers to the emergence of complementary and substitutive technologies, or the technological changes caused by the integration of data, voice, video, and hardware. This technological convergence can offer chances for the platform to grow in the other business areas dominated by unrelated platforms and allow the unrelated platforms to integrate new functionality into their existing product

bundle (Eisenmann et al., 2006). Next, multihoming cost is seen as the developers' cost associated with their involvement in multiple platforms. Complementors are the providers who offer services directly or indirectly to the platform but who do not belong to the developer community of the focal platform.

Furthermore, platform strategy cannot be ignored as a factor for deciding the innovation of platforms. The importance of platform strategy has been emphasized by several scholars (e.g., see Gawer and Cusumano, 2002; Evans and Schmalensee, 2007; Isckia and Lescop, 2015). According to Isckia and Lescop (2015), the continuous innovation of platforms is closely related to the strategy of the platform owner, and a successfully innovative organization is distinguished by its ability to implement an innovation strategy that dynamically orchestrate the core processes. Through an appropriated strategy, the continuous innovation of a platform is stimulated by the capabilities of the platform owner, who can transform and reconfigure the available resource base into new innovations in a fast-changing environment (Isckia, 2009). In this regard, platform strategy should be added on top of a platform innovation with its influence on platform evolution.

In summary, the evolution of digital platforms can be analysed with two mechanisms. First, from the innovation process perspective, a bathtub model is proposed to illustrate the evolutionary process of platforms (Tiwana, 2014). Second, from the dynamic perspective, the evolution is influenced by both internal fit and external fit between platform architecture, governance, and the environmental dynamics (Bush et al., 2010). In order to have a more comprehensive analysis, the two dimensions can be combined. Moreover, on top of those two mechanisms, platform strategy should be added (Isckia and Lescop, 2015). Based on this view, a new framework canbe created, presented in Figure 5.

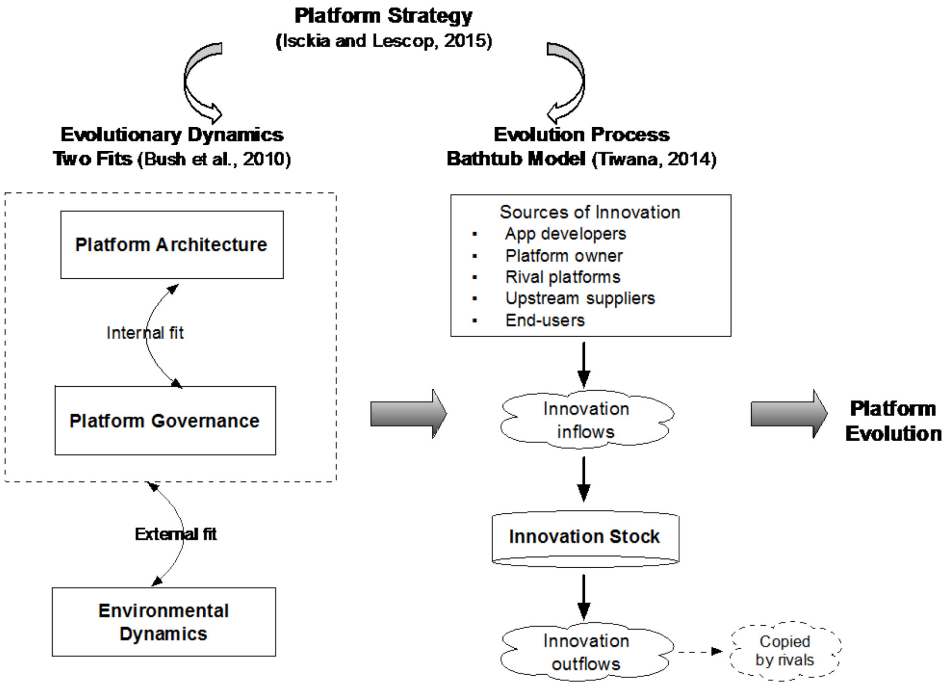

Figure 5. *Evolution of platform and platform ecosystem.*

However, as complete as the new framework might be, there is still one point missing or not sufficiently discussed in the earlier studies - impacts of new technologies in this highly-digitalized world. Even certain environmental factors are mentioned, they are discussed at the most macro level and are quite fragmented. Figure 6 illustrates well this issue by modifying the framework proposed by Bush et al. (2010). To overcome this issue, it is necessary to develop a methodology to systematically analyze the influence of environment on the platform and its evolution.

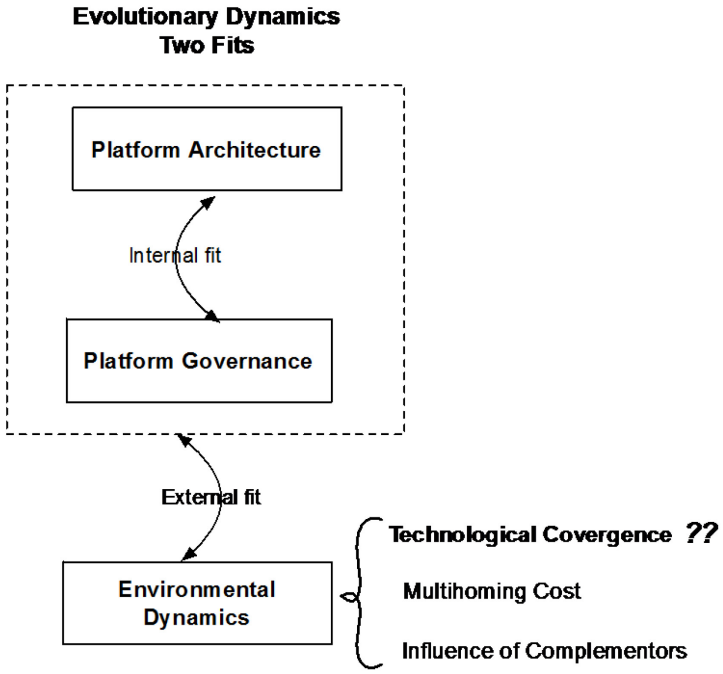

***Figure 6**. Issue of analyzing environmental dynamics for platform evolution (adapted from Bush et al., 2010).*

Why environmental dynamics are critical for platform evolution nowadays? Because in the modern and highly globalized economy, digital environment has a critical impact on the platform evolution and can reshape the metrics set for the evaluation of platform. In this respect, environmental factors, especially the technological changes, are becoming more and more powerful for directing the innovation of various platforms. Furthermore, environment is always full of changes and uncertainties, leading to the difficulties to envision a predictive future in which a platform can be positioned. It is thus necessary to figure out first: what is this new digital world like, and which are the driving forces of the new digital era?

3. SMAC-DRIVEN NEW DIGITAL ERA

3.1 World 2.0 New Digital Era

The current world is undergoing extensive transformations, driven by the technological and business changes due to the influence of new development in telecommunication, the Internet, and mobile technologies. In this context, a "World 2.0" emerged, which is radically different from the old world. A variety of digital tools have been created and have made possible the cooperation and interaction all over the world without concerns of the physical location, either for professionals or for ordinary users. Various digital communities, such as the wikis, blogs, video sharing sites, and social networking sites, have been growing at a significant velocity with the assistance of new internet tools. The transformations have penetrated every aspect of life. For instance, the online courses and online libraries change the means of education; the online shops and payments enable an easy purchase without a physical presence in the stores; the advancement of 3D and virtual reality make possible a world travelling without leaving the home.

Specifically, Karakas (2009) defines World 2.0 as an interactive, highly connected, immersive, digital, virtual online world which has resulted from the changes in technology, communication and business. Following those changes, various digital platforms have been built for a variety of purposes, for example, for people to create and share knowledge (e.g. Wikipedia), to buy and sell merchandise (e.g. Amazon), to have fun and entertain themselves (e.g. Second Life), and to make and share creative videos (e.g. You Tube). Beholding those trends, Karakas (2009) describes the transformation to World 2.0 through five shifts: creativity, connectivity, collaboration, convergence, and community. Figure 7 presents those five shifts and their relations with the building of world 2.0.

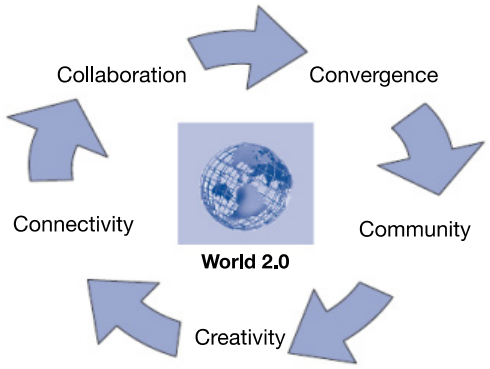

***Figure** 7. Five "C" elements of World 2.0 (Karakas, 2009).*

Creativity and innovations are new ways to deal with businesses. As stated by Pine and Gilmore (1999), work can be regarded as a theatre and every business is a stage, or stated by Jensen (1999), information and knowledge can be shifted by imagination in a dream

society. While aesthetic value or style is transforming culture and business (Postel, 2003), enterprises have been trying to adopt creative mindset for planning and carrying out business tasks to build connections between different people, organizations and industries. Consequently, cross-sector disciplines have been successfully developed. For example, some scholars have tried to incorporate the concepts of art and design into business management study: Merritt and Lavelle (2005) proposed a change of name from business school to design school; Dunne and Martin (2006) stated that design thinking was revolutionizing the study of business administration.

The second shift connectivity is seen as an ability to build connection with the Internet, with which people can get access to a wide range of online information resources by simply clicking on a terminal device. In the last decade, the telecommunication industry has been going through dramatic changes and innovative transformations, which have significantly improved the internet connectivity. Breakthroughs in transmission rate, wireless communication, organic semiconductor, bio-computers have given rise to a diversity of new or even revolutionary products/services that can only been enabled by ubiquitous connectivity. In the meantime, with the innovations related to high-speed wireless access, mobile devices, and apps, added-values based on new services are proposed to consumers (Rao, 2001). Featured by the new digital characteristics, such as the digital literacy, social networking on the net, production and consumption of digital content, and other virtual experiences, the people of World 2.0 generation are referred to as Net-Geners (Prensky, 2001; Twenge, 2007).

Collaboration is the third shift of World 2.0, which can be best described by the theory of Tapscott and Williams (2006), who represent a scene in which billions of connected people collaborate for wealth creation, innovation, and social activities on a virtual global platform enabled by the Internet. Four principles of mass collaboration have been proposed by Tapscott and Williams (2006): openness, peering, sharing, and acting globally. The global collaboration is not just an imagination; millions of people are actually collaborating in different ways on joint projects through Skype communication, Google documents sharing. Those joint projects are making advancement in science, education, culture, arts, and many other fields with innovations coming from open source and crowdsourcing.

The fourth shift refers to the convergence, mainly the convergence of digital technologies and particularly the information and communication technologies. Convergence brings together various medias including radio, TV, video, news, calls, music, to form one global channel. It also makes possible the use of different channels, such as satellite system, cable networks, computer terminals, and mobile devices for people to process all types of information and data. According to Tan and Teo (2002), one implication of such convergence is the trend from e-commerce to m-commerce, driven by the potential of mobile internet. Moreover, the different applications, including e-commerce, tele-education, mobile medical services, and e-reading, are becoming cheap and universally available.

The fifth and the last shift is related to the social media changes and the foundation of virtual social community. The online social community has been used extensively for social activities to communicate, distribute, educate, organize, protest, and democratize information and improve social awareness. As stated by Rheingold (2000), people use online social media to express anger and pleasure, exchange news, engage in intellectual discourse, fall in love, make plan, conduct commerce, show talents, and initiate idle talk.

The five shifts (creativity, connectivity, collaboration, convergence and community) presented above reflect the changes manifested in the World 2.0. Those changes are mainly driven by the ubiquity of internet services and have an influence on the entire business world. New challenges and opportunities are brought out by those shifts, concerning managers and professionals. The new paradigm requires a change of their mindset to fit an environment which is full of complexities, competitions, and uncertainties. How to deal with it? In his study, Karakas (2009) proposes several strategies:

- Expand the innovation ecosystem beyond organizational boundaries to tap into the global brain
- Gather together the best minds from various disciplines and various locations for cross-disciplinary team work and innovation
- Create a positive organizational culture to boost cooperation and creativity
- Provide employees with resources for their innovative projects.

According to Karakas (2009), in a highly-connected world, innovation is difficult to be achieved within the walls of the company but only be viable through external collaboration. Hence, companies need to go outside to obtain innovative capabilities. Also, one alternative to bring outside expertise into the company could be the recruitment of talents from different origins and disciplines. Moreover, in order to create a consistent environment that boosts communication, creativity, and collaboration, and to enable a seamless transformation between external innovation and internal setting, a positive organizational culture needs to be built to provision employees with sufficient resources.

3.2 SMAC Stack – Social, Mobile, Analytics, Cloud

The five ‘C’ shifts discussed previously are driving the world towards a new digital era in which customers, businesses and technological companies are connected at an increasing pace. The convergence of disruptive technologies is breaking down the business boundaries and barriers, leading to the emergence of more agile businesses. Following the trends, technologies and applications have converged to four main areas: social media and networking, mobile/mobility, analytics, and cloud computing, and a new acronym “SMAC” or “SMAC” stake has thus emerged, representing the fifth wave of corporate IT (Frank, 2012). Figure 8 shows the shifts of the five waves along the timeline.

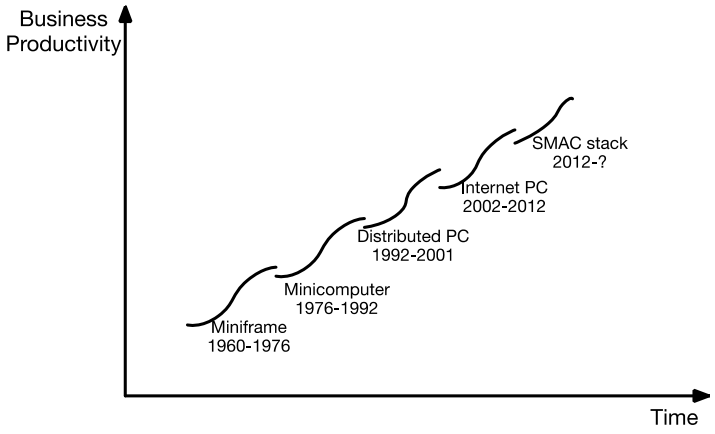

***Figure 8**. Shift of five waves of corporate IT (adapted from Frank, 2012).*

As shown in Figure 8, Before the adoption of SMAC stack, four master corporate IT architectures have played critical roles in the past: mainframe, minicomputer, distributed PC (client/server) and the Internet. Each of the technological shifts has enabled the increase of business productivity and has led the technological and business world for about ten years. Today, the fourth shift is at the late phase and is overlapping with the fifth wave into which many enterprises have already made a jump. The acronym "SMAC" was put into use in 2010 after a continuous growth in technologies and applications related to the four areas – social media and networking, mobile/mobility, analytics and cloud computing (Singh et al., 2016). The year 2012 signals the official beginning of the new wave, which laid the foundations for the development of new business models and consumer experience (Frank, 2012). A short explanation of SMAC terms is given in Table 5.

***Table 5**. SMAC terms (adapted from Singh et al., 2016).*

SMAC Stack	Term	Definition	Applications
S	Social media and social networking, and relevant technologies	The social sites through which people can be connected with other persons for social events and activities	Blogs, e-mail, wikis, and social media/networking applications that enable interpersonal communications
M	Mobile/Mobility and relevant technologies	The mobile devices and mobile applications through which people can be connected anytime and anywhere	Smart phones, tablets, PDAs (Personal Digital Assistants), wearables, and software applications that facilitate ubiquitous connectivity
A	Analytics and relevant technologies	The analysis of data and the application of analysis results	Software for collecting, classifying, processing, determining, and reporting large volume of data
C	Cloud computing and relevant technologies	Places where data is stored and processes are performed	Data storage space, networks, computer processing power, and specialized applications

The first component of SMAC stack "social" represents social media and social networking sites and apps which work as tools for meeting old and new friends, distributing content, building relations, and making advertisement (Dinodia, 2013). It facilitates the human connection by shifting from one-to-many monologue to many-to-many dialogue. The initial development of social networking sites dates back to as early as 1995, and has been through a fast growth in the last decade, during which Twitter, Facebook, and LinkedIn became the representative social networking sites (Singh et al., 2016). The fast growth of social application can be shown by some findings derived from a survey of Sociallystacked.com in 2014 (Singh et al., 2016): 72% of all internet users are active on social medias and networks; 89% of internet users of 18-29 years old are active on social medias; 70% of brands present on Google+; 93% of marketing personal use social medias for business activities. Currently, there are a variety of social networks emerged in the global market. Figure 9 illustrates the leading social networks in the world, ranked by the number of MAU (Monthly Active Users) in millions.

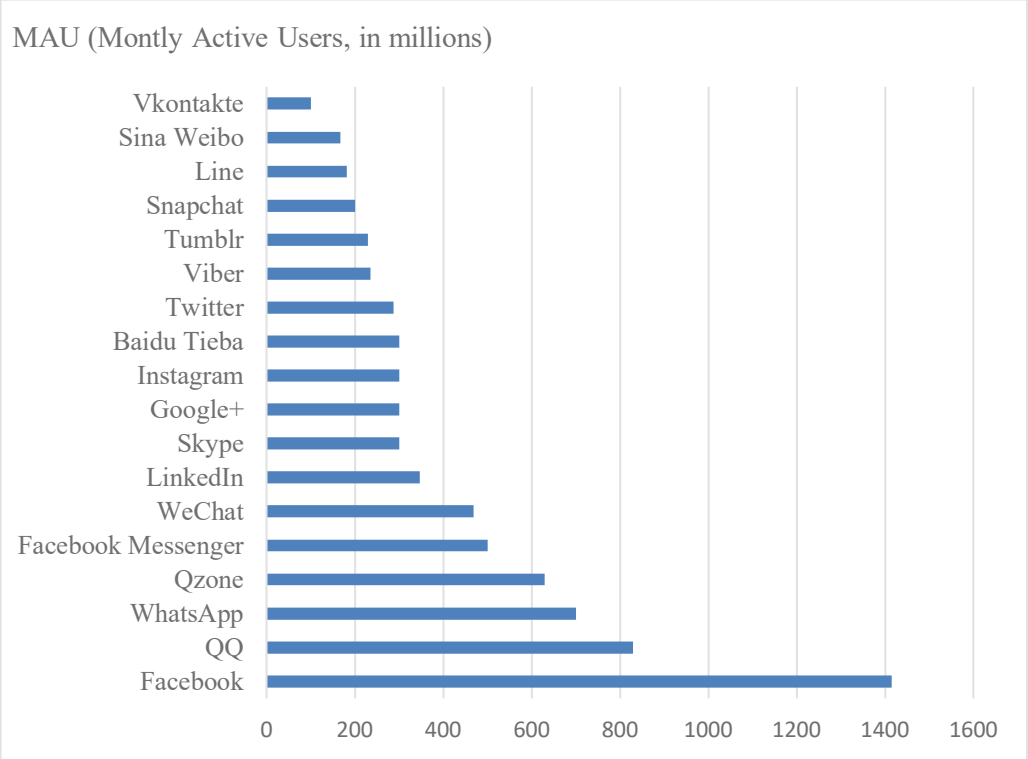

***Figure 9**. Leading social networks in the world ranked by number of MAU as of March 2015 (EY and CIO Klub, 2015, original source: statista.com).*

It is undoubtable that the main functions of social networks are for social activities, but depending on the specific application, they serve for different purposes. Generally, these purposes include emails (Google+), social media (e.g., Facebook, Instagram, Twitter, Sina Weibo, and Qzone.), chat (e.g., Facebook Messenger, QQ, WeChat, LINE, Skype), sharing of digital content (e.g., YouTube), and information search (e.g., LinkedIn). Also, it is not unusual for a social platform to have multiple purposes. For instance, the previously mentioned Sina Weibo can offer both social media and chatting services, and many

chatting tools can be used for social networking and content sharing purposes, or even email service (e.g., QQ).

Social media and networking application is growing rapidly, which has enabled a significant transformation for the global consumers (Niedermeier et al., 2015). On a worldwide scale, according to Statistica (2015), there were 1.49 billion monthly active users on Facebook and more than 302 million monthly active users on Twitter. The adoption of social application as a means to approach consumers has become common around the world (de Vries et al, 2012) For example, as of 2014, 80% of Fortune 500 companies had active Facebook pages and 83% of them had active Twitter accounts (Barnes and Lescault, 2014).

The second constituent of SMAC stack is mobile, which does not merely mean a mobile phone for making calls or sending messages, but represent various mobile devices with which end-users can do almost everything enabled by a computer Singh et al., 2016). In addition, other areas which are in relation to mobile devices, such as the mobile networks, mobiles apps, are also elements of mobile dimension. The portability of mobile devices can remove physical boundaries, making available the sharing of information and knowledge without concerns of the physical locations. According to the estimate of Eng-Tips Forums (2012), nowadays a smartphone possessed by any end-user has more computing power than that owned by NASA when it first sent a man to the moon in 1969. The advancement of mobile computing technologies, e.g., wireless communication, mobile payment, mobile apps, and enterprise mobility, has led to the emergence of varying mobile ecosystems (EY and CIO Klub, 2015).

The development of mobile technology and application can be reflected by the findings of various market research agencies. For instance, Gartner assumed that there were more than 2 billion of smartphones owned by users by 2014. Statista stated that the number of mobile apps in app store had reached almost 2.5 million, and NPD Search (2012) assumed that over 200 billion mobile apps were downloaded in 2015. In terms of mobile data traffic, Research Center assumed it grew 50 times from 2011 to 2016. Furthermore, either the number of mobile app projects or the sales revenue of mobile devices have far more surpassed those of PC (Frank, 2012). In the meantime, the mobile advancement has promoted the successful implementation of mobile applications in enterprises, leading to the development of enterprise mobility, and resulting in a shift of work habits to enable more employees work out of the offices (Whatls, 2017).

The third component of SMAC stack is analytics which has emerged during the transition from traditional product offering to online services. The growth of digital businesses has generated a constantly increasing volume of data. The amount of data is overwhelming: everyday 2.5 billion gigabytes of data is generated; 90% of data available today was created in the last 3 to 4 years; the amount of data managed by enterprises will grow at least

44-fold between 2008 and 2020 (Dinodia, 2013). According to Frank (2012), the explosion of data is driven by two sources. First source is the growth of mobile devices and social networks. The “anytime, anywhere” availability of communication tools connect people with different relationships in their daily lives, either for professional or other purposes. The second source of data, including connected machines and IoT (Internet of Things), is less significant at present in comparison to the first source, but will become much more important in the near future with a predicted outsized growth (Frank, 2012). Analytics is the process of applying visualization techniques to discover hidden patterns and unknown relations for making effective decisions. According to Ding and Marchionini (1997), analytics has three main characteristics: volume, variety and velocity. Volume is the amount of data, variety is the divergent property of data, and velocity is the speed at which data is generated.

Analytics is critical for achieving success in the present digital business world. As viewed by Shirky (2009), the failure in businesses is not due to the overload of information but a lack of advanced analytics. Starting off as a technological trend, analytics has now become an important enabler which has an operational or even strategical position in the organizations for increasing customer base. Information and data analysis can uncover many new opportunities in the business world. Through the analysis of huge volume of structured and unstructured data, opportunities and changes can be identified more easily, forecast can be made more accurately, failure and fraud can be detected much earlier, and productivities and efficiency can be improved within a shorter period.

The last constituent of SMAC stack is cloud computing, an approach to computing infrastructure which connects a large pool of resources shared by numerous users simultaneously (EY and CIO Klub, 2015). The shared resources include data storage space, networks, computer processing power, and specialized applications for both corporate and consumer users (Dinodia, 2013). As a result, individuals and businesses can use hardware and/or software services managed by cloud providers at a remote location over the internet. The talk of cloud computing started in 2007 and became right on top as point of discussion among professionals in 2012 (Singh et al., 2016). Cloud computing-based services are popular as they can enormously decrease the complexity and cost of possessing and operating computers and networks. Users of cloud services do not need to invest in infrastructure for obtaining information technological solutions. The benefits are obvious: quick deployment, customization, low cost, fast return on investment, and flexible utilization. Additionally, cloud services are usually reliable, agile, efficient, and have considerable capacity to scale up the business (Dinodia, 2013). According to NIST (National Institute of Standards and Technology), cloud computing has four deployment modes and three service models, which is the most widely accepted cloud definition in the world (KPMG India, 2011).

The four deployment models are: public cloud, private cloud, community cloud, and hybrid cloud. Public cloud refers to the offering of cloud infrastructure to the general public

or a large industry group. Private cloud refers to the cloud infrastructure that is run solely for an organization. Community cloud is a cloud infrastructure shared by several organizations that support a special community. Finally, hybrid cloud refers to an infrastructure which combines two or more clouds (public, private, community) that remain as unique entities but are bound together by technologies. The four deployment modes, as well as the respective service models are summarized in Table 6. As described in the table, cloud services can be offered through three models: IaaS (Infrastructure as a Service), PaaS (Platform as a Service), and SaaS (Software as a Service).

***Table 6**. Cloud deployment models and service models (adapted from KPMG India, 2011).*

Cloud deployment models	
Public cloud	The offering of cloud infrastructure to the general public or a large industry group
Private cloud	Cloud infrastructure that is run solely for an organization
Community cloud	A cloud infrastructure shared by several organizations that support a special community
Hybrid cloud	An infrastructure which combines two or more clouds (public, private, community) that remain as unique entities but are bound together by technologies
Cloud service models	
IaaS	A collection of fundamental computing resources such as processing time, storage, and networks that can be utilized for deploying and running arbitrary software
PaaS	The capacity of cloud provided to users for developing and hosting applications that can be used for various purposes
SaaS	Software applications that are managed and delivered by service provider over the internet

Firstly, IaaS is the provisioning of fundamental computing resources such as processing time, storage, and networks that can be utilized for deploying and running arbitrary software, e.g., operating systems and applications. The underlying cloud infrastructure is normally managed by the service providers. Typical examples of IaaS include Zenith's Proud and Amazon's EC2. Secondly, PaaS is the capacity of cloud provided to users for developing and hosting applications that can be used for various purposes. Since PaaS is built on the servers or networks of IaaS, the management of PaaS is also under the control of service provider. Typical examples of PaaS include Windows Azure and SalesForce's Force.com. Finally, the SaaS is the software applications are managed and delivered by service provider over the internet. The applications are made available through web browsers and accessed from different user devices. As the underlying computing infrastructure used for hosting the applications is managed by the service provider, users of SaaS are not concerned with the upgrade and maintenance of the systems. Typical examples of SaaS include SalesForce, Facebook, and Gmail (KPMG India, 2011).

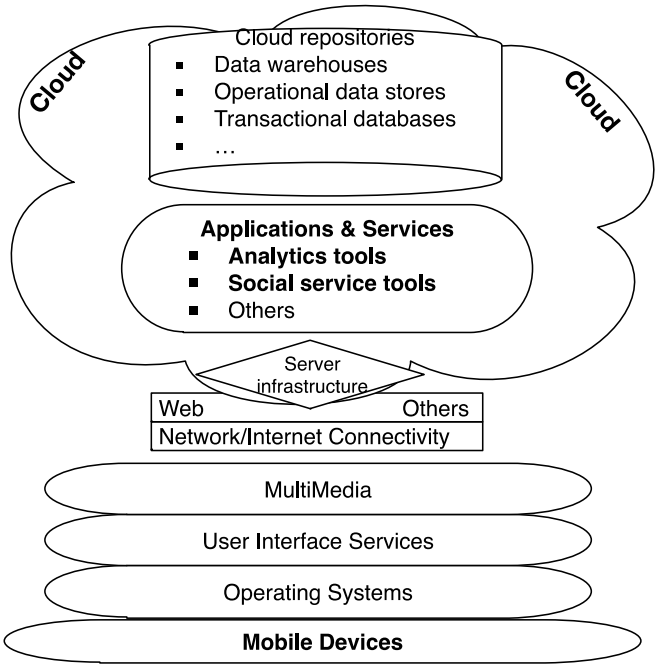

Figure 10. *Notional model for technologies and applications in the SMAC-based marketplace (adapted from Bonometti, 2012).*

Even the four components of SMAC stack have been discussed separately, they usually do not exist alone but interact closely with each other. These interactions can be explained by a notional model proposed by Bonometti (2012) in Figure 10. The top layer of the model depicts a diverse set of data repositories which are stored in a cloud-based environment. In the next layer down the stack lay the range of applications and services including various business intelligence tools and social networking tools. The layer one level below contains a simplified collection of technologies and systems for enabling either wireless or broadband connectivity, and fundamental server infrastructure such as web servers. The lowest layer represents a collection of devices, operating systems, user interface services, and technologies for enabling multimedia presentation.

3.3 Evolution of SMAC Stack

Emerged as disruptive technologies, SMAC stack is dynamic and is evolving all the time. Based on a survey result conducted with 267 CIOs (Chief Information Officers) by EY and CIO Klub (2015), CIOs are now embracing new frontiers, moving from SMAC 1.0 to SMAC 2.0. There is a shift from individual technologies to integrated solutions, resulting in the delivery of new digital experiences. The four technological trends, including social, mobile, analytics and cloud, are converged to deliver integrated solutions to empower the business. The integrated solutions can offer a consistent user experience that cross different digital channels, e.g., websites, social sites, mobile apps. Those solutions can better meet the requirement of customers and make them feel personally relevant and deliver within the due time. By doing this, the digital experience of customers can become

more context-aware and more personalized. Based on the research of EY and CIO Klub (2015), the journey from SMAC 1.0, to SMAC 2.0, and finally to SMAC 3.0 is summarized in Table 7.

Table 7. *Evolution of SMAC: from SMAC 1.0 to SMAC 3.0 (adapted from EY and CIO Klub, 2015).*

	Social media	**Mobility**	**Analytics**	**Cloud**
SMAC 1.0	Original concept for connecting real-world friends	Introduction of the idea of using individual mobile devices to manage work, initiation of BYOD (Bring Your Own Devices) concept.	Statistic tool	Initial testing and delivery of a major application from the cloud
SMAC 2.0	Emergence of various sophisticated platforms, connecting both friends and strangers and offering new marketing channels for audience communication	Access anywhere outside the workplace with mobile devices, aiming to create a unified enterprise platform	Predictive tool	Some amount of information served from the cloud for most companies
SMAC 3.0	Advancement of mobile CRM (Customer Relationship Management) tools which do trend analysis via advanced algorithm for offering personalized ads and increasing ads coverage	Application of cloud technologies for the creation of unified platform	Prescriptive tool	Most of information or even all services operated on cloud for most companies

In addition to the new digital experience described in Table 7, the evolution of SMAC stack can also improve customer engagement by offering them with multiple channels of contact and communication. Moreover, once the capabilities for enabling a better digital experience can be configured and shared between varying parties, work efficiencies can be dramatically increased. All in all, according to the research of EY and CIO Klub (2015), the current stage of the SMAC journey is at SMAC 2.0, and is moving gradually towards SMAC 3.0.

4. SMAC AS A TOOL TO ANALYZE PLATFORM EVOLUTION

4.1 Impact of SMAC on Business World

SMAC stack, as a new IT architecture, is transforming the business world and corporation in a significant manner. From sales to customer service to the development of new products, hyper-intelligent software platforms have been created and have penetrated in various business areas. SMAC stack is not merely a bundle of technologies that are incorporated into the existing business model but are transforming the current business models or are even creating completely new business models (Frank, 2012).

Under the influence of SMAC, the business is transitioning from widget to digit and is shifting a massive value in many industries. This transition can be demonstrated by several examples, represented in Table 8. In details, Kodak went bankrupt and was replaced by picture galleries such as Flickr and Shutterfly when there were more than 10 times photos taken than those in 1992. New York Times got into a junk state because of its competition against media apps when more news was generated on a daily basis. Borders lost its fight for book retailing services to digital reading tools when sales of book has actually increased. The examples mentioned in Table 8 only show a small portion of the changes as transformation is happening in every corner of the business world, in which many traditional "widget winners" are being replaced by "digital winners".

Table 8. *The transition from "widget winners" to "digit winners" (adapted from Frank, 2012).*

Business field	Widget winners	Digit winners
Photograph	Kodak	Flickr, Shutterfly
Book retailing	Borders	Amazon
Online communication	AOL	Facebook
Map	Rand McNally	TomTom, Google
Movie rental	Blockbuster	Netflix

The reason for this kind of digital transformation is clear: the impact of SMAC stack. Actually, in comparison to the traditional winners of each industry, the digital players have less advantage for their weakness in terms of R&D capabilities, distribution channels, brand awareness, customer relationships, and financial status since they have only emerged recently and generally possess less resources. However, they still win the games because their value chains are aligned with the needs of present information-based market and because they have taken advantages of SMAC stack.

The digital transformation driven by SMAC in business world has three key features: decoupling, dematerialization, and knowledge-based process (Frank, 2012). Decoupling refers to the transition of tightly-coupled value chains into loosely-coupled value webs. Dematerialization means the transition of value chain from material-based to virtual. Knowledge-based process is necessary because the transition cannot be uniform across the enterprise but can only occur process by process, and the priority setting for deciding which process to start with is based on the knowledge and digital inputs and outputs of the processes. As decoupling and dematerialization features are more relevant for the discussion, more details will be given next.

First, the decoupling feature can be explained by the change of value chain from industrial age to SMAC driven digital era. In industrial business management, there is a well-known value chain model developed by Porter (1985). This model breaks down the key activities of a company into two groups: primary and support activities. Primary activities include inbound logistics, operations, outbound logistics, marketing & sales, and service offerings based on the flow of value. Support activities include procurement, technology development, human resource management, and company infrastructure based on the functions of employees. The proposal of this model is based on the assumptions of industry age, when communication costs were expensive, information was finite and propriety, and information and humans had to be co-located (Frank, 2016). For those reasons, the constituents of the traditional value chain must be co-located or tightly coupled. However, with the emergence of SMAC stack, the old assumptions are being threatened and their sticky positions are being shaken around. In a hyper digitalized business world, contrary to the assumptions of industrial dominating era, the communication costs have fallen to almost zero, information becomes nearly infinite and universal, and information and people are currently rarely co-located. Consequently, the application of SMAC helps enterprise to unbundle or decouple the traditional tightly-coupled value chain, and to create a loose, boundaryless business model.

Another key feature of SMAC-driven business transition is dematerialization, which can be explained by some typical examples to show how SMAC has successfully virtualized products and services which are used to be material-based (Frank, 2012). For instance, SMAC has virtualized the human relationship assisted by some social networking tools, such as Facebook and Skype. Those tools help to maintain and enhance personal and working relationships based on mutual trust and capabilities even in the absence of physical presence. In another case, SMAC allows the virtualization of customer experience. The new CRM (Customer Relationship Management) tools, such as the social CRM, have been made available in many enterprises, and professionals can use them to increase customer intimacy without a face-to-face meeting with the customers. The following example represents the separation of information and humans, which can be best described with the Google effect. With the help of Google search, physical location and information have been fully dematerialized and virtualized, information does not need any longer to

be stored somewhere in the book or in the local computer, but can be put in database located anywhere in the world.

One particular impact of SMAC stack, especially from the dematerialization perspective, is the emergence of numerous platforms. As discussed previously, the virtualization of human relationships has driven the development of Facebook and Skype, the separation of human and information has given rise to Google, the virtualization of customer experience has led to the development of Amazon. Apart from them, many other digital platforms, such as LinkedIn, Chrome, iOS operating system, App Store, iTunes, have emerged and developed under the influence of SMAC stack. As there is currently not a systematic tool to analyse the impacts of environment, particularly from the technological perspective, it is hence reasonable to think: if SMAC has helped to drive the development of platforms, why cannot it be used purposefully for the study of platforms?

4.2 SMAC as a Tool to Analyze Platform Evolution

As introduced in Chapter 2, the evolution of digital platforms can be analysed by two mechanisms. First, from the innovation process perspective, a bathtub model has been proposed to illustrate the evolutionary process of platforms (Tiwana, 2014). Second, from the dynamic perspective, the evolution is influenced by both internal fit and external fit between platform architecture, governance, and the environmental dynamics (Bush et al., 2010). To enable a more comprehensive analysis, a new framework has been built that combines the two mechanisms and the platform strategy. However, as complete as the new framework might be, there is still one point missing or not sufficiently discussed in the earlier studies - impacts of new technologies in this highly-digitalized world. Even certain environmental factors are mentioned, they are discussed at the most macro level and are quite fragmented.

The a highly-globalized business world, digital environment can have an essential impact on the platform evolution and can reshape the metrics defined for the evaluation of platform. In this context, environmental dynamics, particularly the technological convergence, is becoming more and more powerful for directing the evolution of various platforms. Furthermore, one typical characteristics of the digitalized World 2.0 is its high velocity at which new technologies and digital solutions are coming out (Karakas, 2009), driving the formation of an environment which is always full of changes and uncertainties, and leading to the difficulties to envision a predictive picture in which a platform can be positioned. To overcome this issue, it is thus interesting to develop a methodology to systematically analyze the influence of environment on the platform and its evolution. However, based on a literature study, until now there is not yet an effective tool to analyze how technologies are shaping the platforms. It is thus interesting to develop a methodology to conduct a systematical analysis.

Meanwhile, the discussion in the previous chapters demonstrates how SMAC stack has helped drive the foundation of new digital era and how it has impacted the whole business by reshaping the enterprises. The difficulty to transform the existing value chain and to create new business models has led to the failures of many traditional widget winners who have been replaced by new digital winners (Frank, 2012). Even many new digital players have less resources and less known reputation in the market, they still win the competition because of a harmony with the realities of the digital world. Moreover, the virtualization and dematerialization feature of SMAC effect has driven or at least helped drive the emergence and development of many digital platforms. To conclude, SMAC contains all critical technological trends for shaping the new digital era, and it works as a useful tool for describing the digital transformations in new business world. Therefore, it should also be an effective tool to analyze the platforms and their evolution, especially from environmental perspective. Based on the previous discussion, a conceptual framework is configured in Figure 11.

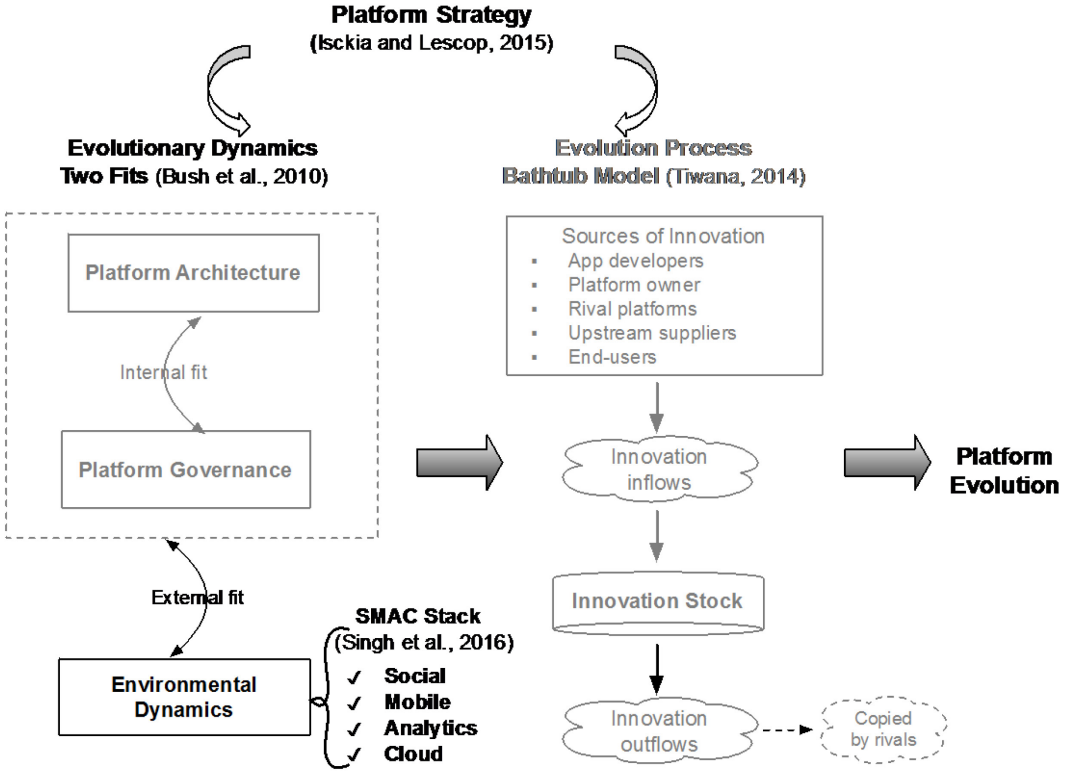

***Figure 11**. SMAC stack as a tool for analyzing platform evolution.*

Framework in Figure 11 contains three core elements: platform strategy, evolutionary dynamics which include internal fit within a platform and external fit driven by the impacts of SMAC stack, and platform evolution process explained by the bathtub model. Among those elements, platform strategy can be found from the company's vision or road map description, and is important to guide the evolution of platforms from company's internal perspective. As for the evolutionary dynamics, internal fit between platform ar-

chitecture and governance is often related to the platform owner's capabilities, the building of which needs time and resources (Eisenhardt and Martin, 2000). As the study of capabilities cannot be made within a short term and is not so relevant for a SMAC-based research, it is thus out of the scope of this thesis. Regarding the bathtub model (Tiwana, 2014), it mainly refers to the sources of innovations, and the process of innovation based on a differentiating strategy. This subject will be discussed in this thesis but is not a focus. Finally, given the importance of technological trends in highly-digitalized era and the lack of methodology for analyzing platform in this context, the SMAC stack and its impacts on platform evolution are the core of this thesis.

5. RESEARCH METHODOLOGY

5.1 Research Strategy

There are several approaches to conducting social science research, including surveys, experiments, histories, the analysis of archival information, and case study. Depending on the type of research questions, the control of the researcher over the behavioral events, and the focus on either historical or contemporary phenomena, each approach has its advantages and disadvantages. Generally, if there are "how" or "why" questions being asked, and the researcher has little control over the studied event, and the focus is on a contemporary phenomenon happening under a real-life condition, case study is often the preferred research strategy (Yin, 1994). According to this description, this thesis obviously meets the two criteria of case study approach: first, the topic studies why SMAC stack can be adopted for analyzing platform evolution and how to use it; second, the focus is on the recent and current evolution of platform in the real world. As for the degree of investigator's control over the event, since the investigator has mainly observed and tested the functionality of the targeted platform, and has conducted interviews to verify the effectiveness of proposed solution, she has little influence on the platform itself and the organizations who owns the platform. Hence, case study is the main strategy adopted for the empirical study.

Moreover, in order to achieve the goal of case study, two conventional methods can be used: quantitative and qualitative approaches. Quantitative methods are developed from natural science and are mainly employed to deal with numeric information, relating to quantifications and measurements. On the other hand, qualitative methods, based on social science, are mostly used in the domains of psychology, sociology, education and anthropology. As business management is one field of sociology, qualitative methods are the main research methods (Gummesson, 1993).

According to Patton (1990), qualitative research typically focuses on relatively small number of samples, including single cases, which are purposely selected for an in depth analysis. Purposeful sampling concentrates on information-rich cases from which one can evaluate the study purpose and results with a set of carefully selected samples, representing the needs and interests of the entire research program. Number and size of cases depend on research purpose. Patton (1990) proposes 16 sampling strategies for purposefully selecting information-rich cases. Table 9 summarizes the evaluation purposes of those strategies.

***Table 9**. Purposeful sampling strategies and their evaluation purposes (adapted from Patton, 1990).*

Type of Strategy	Evaluation Purpose
1. Extreme or deviant case sampling	Learning from the unexpected outcomes and unusual phenomenon, such as unexpected success/failure, unusual crises/events
2. Intensity sampling	Similar logic to extreme samples, but the cases, such as above/below average, reflect intense examples of interests instead of an extreme demonstration
3. Maximum variation sampling- a wide range of variation on dimensions of interest	Study on variations in adaption to different conditions and on finding common patterns
4. Homogeneous sampling	Focused subgroup sampling for variation reduction, to simply analysis and facilitate group interview
5. Typical case sampling	Emphasis on typical and average phenomenon
6. Stratified purposeful sampling	Highlight the features of subgroups, focusing on differences and comparison
7. **Critical case sampling**	Experience learned from some cases can be applied on others
8. Snowball or chain sampling	Starting with "who should I talk to?", key phenomenon found by a chain of people or diverged sources of information
9. Criterion sampling	Samples selected with preset criteria, typical in quality assurance.
10. **Theory-based or operational construct sampling**	Formal version of criterion sampling; samples collected to examine and judge the predefined theoretical construct, such as a psychological interaction
11. **Confirming and disconfirming cases**	Testing ideas; confirming the fitness of patterns; finding variation and seeking exceptions based on initial analysis;
12. Opportunistic sampling	New samples that takes advantage of unforeseen opportunities after fieldwork begins
13. Random purposeful sampling (still small sample size)	Radom selected cases for qualitative study, cases selected within a larger size but not for statistical generalizations or representativeness
14. Sampling politically important cases	Cases selected for political evaluation, such as politically sensitive sites or units.
15. Convenience sampling	Cases with easy access and inexpensiveness are selected for saving time and efforts
16. Combination or mixed purposeful sampling	Flexible selection of cases with multiple angle analysis, study to satisfy multiple interest

One single case was selected in this thesis with a deep analysis. Depending on the evaluation conditions and purposes, the sampling method used in this thesis is a combination of purposeful strategies, including critical case sampling, theory-based sampling, and confirming cases. The applied sampling strategies are highlighted in bold.

Firstly, with theory-based sampling strategy, the researcher selects samples based on the representation or manifestation of theoretical proposals, and the samples can represent the phenomenon of interest. This definition is aligned with the research objective of this

thesis: the interaction between SMAC stack and platform evolution to assess how SMAC has affected and will affect the development of platform ecosystem. To prove the effectiveness of the theory, WeChat platform was selected as a representative sample. Secondly, critical cases are those which can make an essential point, and their existence can be stated as: what happen here can also happen anywhere else, or what does not happen here will not happen anywhere else. Under such condition, the study of WeChat is typical given its fast evolution and leading position in various industries. Despite mainly operating in China, the success experience of WeChat, its intention for global growth, and its horizontal expansion in various verticals have inspired many other national or international platform owners. In this respect, the case of WeChat is critical for its "role model" status. Thirdly, confirmatory cases are usually employed for testing ideas, confirming the meaning and effectiveness of possible patterns and checking out the importance of emergent findings with new cases and additional data. In this thesis, the case of WeChat will be first studied and discussed in the interview, and then later case company's own platform will be mentioned to confirm the effectiveness of proposal.

5.2 Data Collection

According to Gummesson (1993), five methods can be used to generate qualitative data in case study research on management subjects: existing material, questionnaire surveys, qualitative interviews, observation, and action science. The five research methods are explained in details in Table 10.

Table 10. *Qualitative methods and their characteristics for data gathering (adapted from Gummesson, 1993).*

Methods	Characteristics
Existing Material	Books, research reports, computer databases, internal memos, articles, recordings, etc. – everything that is carried by other medias except human beings, which is often referred as secondary data.
Questionnaire Surveys	Questionnaires and surveys used to formalize and standardize interviews, aiming at quantifications.
Qualitative Interviews	More informal, similar to a conversation but in a systematic manner.
Observation	Data generated by observing the subject of study, categorized into direct observation and participant observation.
Action Science	Researchers become active participants and change agents in the case, meaning total involvement of the researcher.

Following the order ranked in the table, closer to the action science, deeper are the researchers involved in the case study, and usually more time they consume and more reliable data they obtain. However, it does not mean action science is the best method, because there is no rule defining which approach is the best to choose from, and the option depends on the real situation. In many cases, a combination is required. For this thesis, existing data, qualitative interviews and discussions, observation, and action science are employed as the main data collection methods, Table 11 summarizes the sources of data collection for the thesis.

Table 11. *Data gathering methods and data collection for the thesis.*

<table>
<tr><th>Methods</th><th>Sources of data collected for this thesis</th></tr>
<tr><td>Existing Material</td><td>Websites of case companies, relevant research reports obtained on the internet, online news and articles</td></tr>
<tr><td>Qualitative Interviews and discussions</td><td>Six interviews with managers of the case company. Each interview was recorded and lasted for an average of 1 hour.
<table>
<tr><td>Interviewee 1</td><td>63 min</td></tr>
<tr><td>Interviewee 2</td><td>58 min</td></tr>
<tr><td>Interviewee 3</td><td>67 mins</td></tr>
<tr><td>Interviewee 4</td><td>56 mins</td></tr>
<tr><td>Interviewee 5</td><td>59 mins</td></tr>
<tr><td>Interviewee 6</td><td>61 mins</td></tr>
</table>
Additionally, regular meetings with the author’s supervisor (senior positioning service manager) in case company for discussing relevant topics, each meeting lasts for one hour between August and May.</td></tr>
<tr><td>Observation</td><td>Direct observation of the functionality of the focal platform</td></tr>
<tr><td>Action Science</td><td>Field study in China to test functionality of the services provided by the WeChat platform; findings were reported to the case company</td></tr>
</table>

Managers to interview include: one manager in Finland: a senior service manager; three managers in Germany: a senior strategy manager, a senior business planning manager, and a senior product manager; two managers in China: a senior consumer solution manager and a senior account executive. One interview was conducted face-to-face, and the five others were made through online calls. All the interviews were recorded, the time used for each interview is detailed in Table 11.

5.3 Research Process

The internship was initiated in August of 2016 when the author started conducting a research on Chinese indoor positioning market. For the first few months, the tasks were not

focusing on the thesis, but on the general understanding of the market, the available indoor positioning solutions in different verticals, and the key players active in relevant areas. Also, even the focus of the internship is on indoor positioning, the author's tasks are not limited to them. In some cases, outdoor market is also involved, such as the solutions related to the GNSS (Global Navigation Satellite Systems) applied in some key verticals. Additionally, the author has some other tasks related to the Chinese market, such as in-depth analysis of individual companies, and the study of relevant regulations. Eventually, the thesis about WeChat was started in late November of 2016. Therefore, the whole research process was not proceeded in a consistent but an intermittent manner, as illustrated in Figure 12.

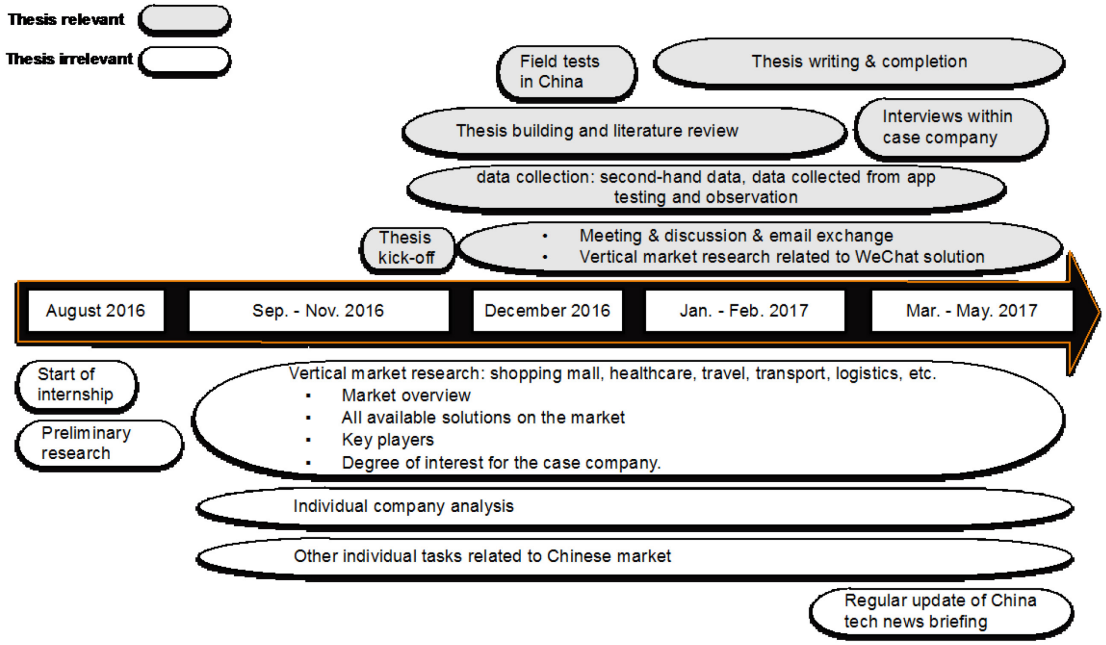

Figure 12. *Research process.*

Figure 12 contains two parts: thesis relevant and irrelevant tasks. Since WeChat-based study is one part of the overall research, the overlap of tasks between the two parts are unavoidable. For example, meetings were set between the author and the managers of case company with various responsibilities for training and discussion to understand the indoor positioning technology, purposes of application, and concerns of market expansion in case company. Also, vertical market research that include both WeChat-based solutions and WeChat irrelevant solutions was carried out to understand each vertical in terms of market overview, typical solutions existing on the market, and key companies that provide those solutions.

The thesis was officially kicked off in November of 2016 after WeChat was identified as a critical platform which was relevant for many targeted verticals. Afterwards the author began a research focusing on WeChat to see how it has evolved and would evolve in the future, so to better understand its connection with the Chinese indoor positioning market and judge if it could be used as a medium for the market expansion of case company. To

achieve the objective, a set of new data was gathered from various sources, including the existing materials and the observation of service functionalities offered in WeChat. Moreover, a field test was made in a shopping mall in China to actually see how the indoor positioning services worked through WeChat. Finally, based on the findings, interviews were conducted with the senior managers of case company to evaluate the effectiveness of the proposal on WeChat platform with a mention of other platforms, e.g., the open location platform of case company.

6. CASE COMPANY AND WECHAT PLATFORM

6.1 Case Company and Problem Identification

Case company is a cloud-computing based technological firm which operates at a global scale for providing mapping data, technologies and services to varying sectors: automotive, enterprises and consumers. The company transforms data and information from various sources, such as vehicles, fixed and mobile devices, and infrastructure into real-time location-based services. The company uses location as a tool to create innovative solutions that improve mobility and enable interactions between people, enterprises, and cities, in order to create a safer and more efficient driving experience and life.

The company is currently building an OLP (Open Location Platform) for creating a place where the location-based context of people, places and things can be understood easily and efficiently. This is a multi-sided platform designed to collect, process and analyze location data and is agnostic to varying sources and types of data. An open location platform offers a safer and better tool for developers to leverage the greater power of location for providing solutions and services in different markets: manufacturing, transportation and logistics, infrastructure construction, bank and financial sectors. To enable a multi-sided adoption, the platform is open to third-party developers of various industries. In this regard, the platform owner can provide a one-stop-shop experience for all developers to either leverage data and services provided by other platform users or create data and services within the platform that can be used by other platform users. Also, with a multi-sided participation, both producers and consumers of data and services, can connect to each other and interact between organizations, industries, and across borders.

Location-based services are essential elements of the open location platform. Case company has twenty-year experience in location-based technologies and services, ranging from satellite-based to cellular network-based product offering. Indoor positioning is the newest addition to its technology portfolio. The main positioning technologies adopted by case company are based on WiFi and/or Bluetooth. Case company offers IPS (Indoor Positioning System) tools to developers for building location-aware web solutions and mobile apps.

Beholding the high potential of Chinese market, the case company wants to launch its new IPS solutions there. However, the problem is that the company does not know well about the market although the company has set a sales office in China for many years. There are two reasons for the difficulty to launch new businesses there. First, the IPS is a new business field either in global and in Chinese market. There are a great number of risks and uncertainties in terms of technologies and business models. As the technologies are meant to offer solutions in various industries under the condition that there are not yet

clear business models for monetizing the applications, great opportunities and risks exist simultaneously. Despite the risks, the high potential has attracted a good variety of companies operating in different industries. Hence, unlike the traditional industry, IPS market is loose and somewhat chaotic. Meanwhile, from the end-user perspective, except certain early adopters, the majority of end-users have no clear ideas about the benefits of IPS. Demonstration and education are often required for them, but this is not an easy task due to the time and efforts that are required. Second, China, as the second largest economy in the world, is still an emerging market, featured by its unique characteristics related to culture, policy and regulations. Those characteristics set high entry barriers for foreign companies. More importantly, the newness of IPS market also means that the relevant regulatory setting is immature, which load more burdens on the companies who want to expand into Chinese market. Under this circumstance, the case company needs first to have a comprehensive understanding of the overall IPS market and then to design appropriate expansion strategies.

6.2 Indoor Positioning Technologies and Applications

Positioning or location based services are not unfamiliar for most people. GPS (Global Positioning System) based applications have entered modern society and have changed various aspects of modern life. Historically, GPS services were originally designed for intelligence and military applications during the Cold War of 1960s, and were released for civilian applications in the 1980s (MIO, 2017). Today, relying on satellite navigation, GPS is applied across a wide range of economy, including construction, farming, mining, manufacturing, transportation and logistics with one or multiple services in relation to location, mapping, navigation, timing and tracking (NMT, 2017).

However, GPS does not work well in indoor environment. In certain situations, sensitive GPS chips may sometimes help determine the location inside a building with signals from enough satellites, but the determination is usually not accurate enough to be applicable. Blocked and scattered by walls, roofs and other objects, satellite signals are weakened and the resulting location range is often larger than the building itself (Schutzberg, 2013). As a consequence, GPS is not quite useful in indoor positioning space, and new technologies and applications are therefore required, leading to the development of IPS (Indoor Positioning System).

IPS can be defined as a system that is deployed to locate people or objects inside a venue/building by analyzing data collected from a variety of sources, such as radio signals, acoustic signals, magnetic fields, and other sensory information (Curran et al., 2011). The idea of locating people and objects indoors goes back to 1990s with the launch of RTLS (Real Time Locating Systems), which allowed hospitals to track equipment and warehouse to track merchandise (Sinopoli, 2013). The initially used technologies are RFID (Radio Frequency Identification) tags. Later, Wi-Fi based systems, Bluetooth beacon-based systems, and other positioning systems were developed for people and item

tracking. An overview of technologies used for indoor positioning services is presented in Table 12.

Table 12. *Overview of indoor positioning technologies (Adapted from Mautz, 2012).*

Technology	Typical accuracy	Typical coverage (m)	Typical measuring principle	Typical application
Infrared	cm-m	1-5	Thermal image, active beacons	People finding, tracking
WLAN/Wi-Fi	m	20-50	Fingerprinting	Pedestrian navigation,
Bluetooth	m	2-15	Proximity detection, fingerprinting	People tracking
RFID	dm-m	1-50	Proximity detection, fingerprinting	Pedestrian navigation
UWB (ultra wide band)	cm-m	1-50	Body reflection, time of arrival	Robotic, automation
Magnetic systems	mm-cm	1-20	Fingerprinting and ranging	Hospitals, mines
Camera	0.1mm-dm	1-10	Angle measurement from image	Metrology, robot navigation
Sound	cm	2-10	Distance from time of arrival	Hospital, tracking
Tactile & polar system	um-mm	3-2000	Mechanical, interferometry	Automotive, metrology

Tens of technologies listed in Table 12 can be used for indoor positioning purposes. However, as different technology covers different size of areas and has different accuracy in terms of positioning, the utilization of each technology is thus varying. From the consumers' perspective, considering their requirement of accuracy (within 10 meters) and coverage (room level) for indoor positioning services, the most commonly used and commercialized technologies in the market are: Wi-Fi, Bluetooth, motion sensors, and magnetic fields.

First, Wi-Fi access points and Bluetooth beacons both send out radio signals that can be received and measured by certain devices, such as a mobile phone or a server, which can calculate later the location with the help of a predefined algorithm. Radio signals sent by Wi-Fi access points and Bluetooth beacons are also referred as 'signals of opportunity' for they are usually available in most buildings and thus no extra infrastructure is needed (Grizzly Analytics, 2016). Second, indoor positioning can be realized with the help of multiple sensors that are built directly in devices, e.g. a mobile phone (Tian et al., 2015). This type of positioning is called motion sensing, or inertial navigation (Xiao et al., 2011), or dead reckoning (Tian et al., 2014). For example, the lateral motion can be measured by the change of readings from an accelerometer, and the vertical movement can be conducted by a gyroscope, a magnetometer and a barometer. The third technology is related to positioning with the use of magnetic field measurement (Kasmi et al., 2015). This class

of positioning is realized with the help of one special type of sensor – magnetometer that is built in the devices. Since magnetic fields at different places within a venue have different measurements, similar to the difference of radio signals, the variations can be used to calculate and determine the location of an object (De Angelis et al., 2015).

Even IPS could be traced back to 1990s, its commercialization for civilian and business utilization has only started recently. Several elements are required for launching IPS services on the market: the development of indoor positioning technologies, the deployment of necessary infrastructure, the wide adoption of smart devices used as application medium, and the maturing of business models for monetization. All those elements have started to boom only in the last few years. Moreover, end-users always need time and experience to understand the value of new services.

The application of IPS, which can be used interchangeably with the term indoor LBS (Location-Based Service), is currently flourishing. As an estimation, people live 80-90% of their lives indoors (Sinopoli, 2013), where indoor positioning services can offer various values. For example, public services, such as those provided by shopping malls, hospitals, schools, would be enabled by IPS for locating people and products, finding ways and objects, and navigating. On the other hand, industries, such as manufacturing, logistics, tourism, can use IPS for management of human resources, products, inventory, and autoguide. Further, people can use IPS for private applications, such as household lighting controlling and emergency and security monitoring. Overall, the application of IPS serve for varying purposes. According to Mautz (2012), the purposes of applications can be identified based on the users' requirement for positioning accuracy and coverage range, demonstrated in Figure 13.

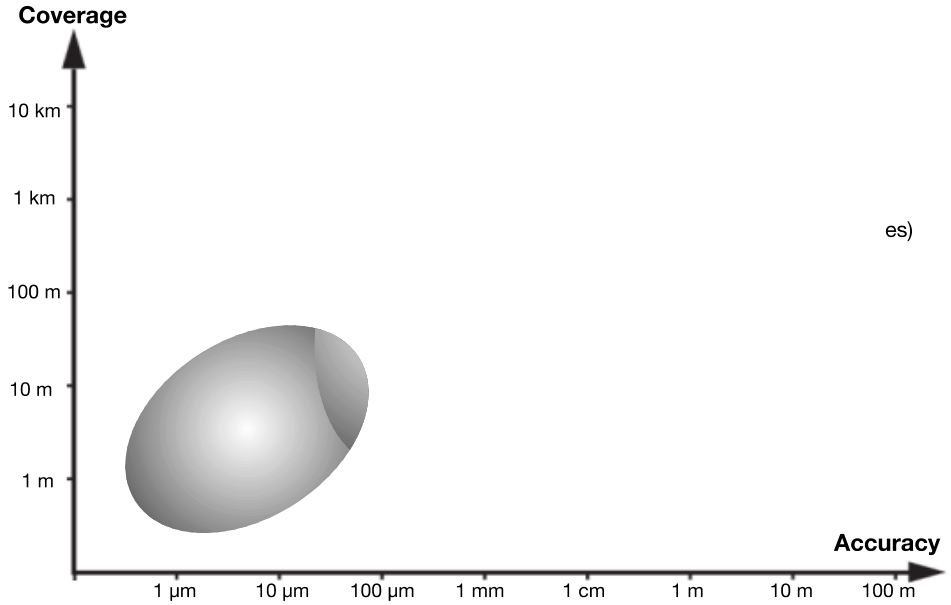

Figure 13. *User requirements in terms of positioning accuracy and coverage (Adapted from Mautz, 2012).*

The users' requirements for positioning accuracy and coverage range is consistent with the parameters offered by different positioning technologies. In this regard, when a particular purpose is required, e.g. a precise positioning for machine industry use, technologies that can provide accuracy to centimeter level, such as ultrawide band, infrared, cameras, can be applied. Also, as illustrated in Figure 13, application of IPS can be roughly divided into two groups: mass market utilizations and other utilizations. Mass market application for indoor positioning services, according to Mautz (2012), requires the use of standard devices (e.g., mobile phones, tablets, wearables) without the addition of extra physical components. On the other hand, for the application in non-mass markets, such as the underground construction, manufacturing robotics, and ambient assistant living, physical modifications are often required. For facilitating the discussion of this thesis, mass-market application will be the focused area, and applications examples will be given in next section.

Finally, regarding the market size and growth of indoor positioning business, at the global level, the market of indoor positioning and navigation is estimated to grow from $448.56 million in 2013 to $2.60 billion in 2018, representing a CAGR (Compound Annual Growth Rate) of 42.1% over the years (Reuters, 2016). The demand of indoor LBS (Location-Based Services) in the marketplace is substantial in a variety of sectors and verticals. Indoor location and positioning is assumed to be the Next Big Thing (Don Dodge, 2013).

6.3 Chinese Indoor Positioning Market and WeChat Platform

In China, the indoor positioning business emerged a little bit later than the developed market as the prerequisites such as the technology, the mobile phones, and the infrastructure for enabling IPS services boomed later, and few people or companies back then had clear idea to monetize the application. However, even not specifically focusing on the IPS in the early stage, China is sensitive to the users' need for LBS (Location-Based Services), which include both indoor and outdoor positioning services. The launch of Beidou satellite system (Xinhua, 2012) and the initiation of Xihe national projects intended for the improvement of LBS (China GNSS White Paper, 2016) indicate the ambition of Chinese government for the location services.

IPS has started to grow in China since 2014, represented by the moves of three Chinese internet giants: Alibaba, Tencent and Baidu. Alibaba first acquired a well-known Chinese map company, AutoNavi for boosting its internet mapping tools, based on which to promote the indoor positioning services. At a later phase, Baidu invested $10 million in a Finnish indoor positioning startup IndoorAtlas (Shu, 2014), and Tencent completed a strategic investment in Sensewhere (Wauters, 2015), a Scottish indoor positioning company. In the meantime, between 2014 and 2015, some IPS applications emerged and were

integrated into certain mobile applications, such as the apps for offline shopping. Following the trend, business model of IPS solution became clearer, and much more companies entered the field, including a large number of startups, leading to a rapid growth of IPS business in China.

Generally, the indoor positioning services are offered in the form of mobile apps, thus the apps having the potential to integrate those services were seen as a core part of the research. Moreover, during the research, one mobile app – WeChat, which was initially launched as an instant messenger but has now become an all-in-one platform, drew the interest of the case company. With a deeper study, it is found that many IPS services have been incorporated into WeChat and offered to the users. In the meantime, to create those services, a variety of developers, startups, and even large enterprises, have been involved into WeChat platform ecosystem. After a series of observation and testing within a period of several months, many IPS cases are identified in WeChat.

Typically, indoor maps, positioning, routing, and navigations are the services mostly required by users when IPS is enabled. However, before the realization of those services, users have already gained benefits through WeChat for indoor location-based services. For instance, "Shake" feature, a popular functionality of WeChat, has been used by various parts to engage numerous users for linking the physical world to the online ones and augment it (Cheng and Budiu, 2016). The shake gesture can be interpreted by WeChat based on the context of interaction: the timing or the location. Figure 14 illustrates some examples of the user engagement through shake gesture of WeChat.

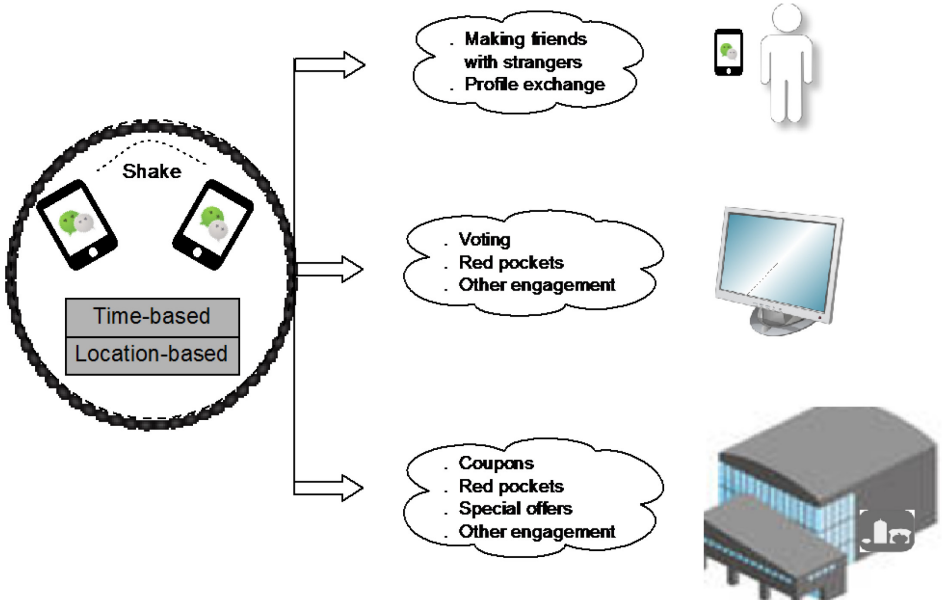

Figure 14. *examples of user engagement through shake gesture of WeChat (author's creation based on observation and Cheng and Budiu, 2016).*

As depicted in Figure 14, “Shake” function in WeChat works when users are actually shaking their phones. Through the shake gesture they can interact with the service providers in different manners for obtaining various benefits. When the interaction is based on the indoor location of the users, IPS is required as the users can only be engaged via pre-installed devices nearby, e.g., Bluetooth beacons. The popularity of WeChat “Shake” functionality demonstrates a viable model for the monetization of location-based services and is thus one important reason why IPS application is growing fast in the last few years, especially in the area of O2O (Online to Offline). However, WeChat “shake” function is mainly used for marketing purposes that can be achieved on a basis of time or location but not for offering a full chain of indoor positioning services. In an individual venue, such as a shopping mall or a hospital, IPS can offer more functions than those enabled by “shake” gesture.

As an open platform, WeChat connects users and various service providers in two ways: third-party services embedded in WeChat “Wallet” function and official accounts developed by different companies from a variety of industries and verticals. As for indoor positioning services, they are normally offered in the second form – official accounts. To create those accounts, companies or even individual developers can use the tools provisioned on WeChat open platforms. Depending on the utilization purposes, developers can choose different development toolset. Moreover, since developers can combine those tools with their own technologies and infrastructure, the final services offered to the end-users could be different even they are developed by companies operating in the same vertical. Generally, the basic indoor services include indoor venue maps, routing, positioning, and navigation intended for way-finding or tracking of people and assets. In specific cases, improved IPS services include 3D AR (Augmented Reality) view of the venue, in-account “shake” feature which is similar to WeChat’s own “Shake” function, and location-based voice control. Figure 15 is an illustration of the overview of IPS service launched in WeChat with an involvement of multiple verticals.

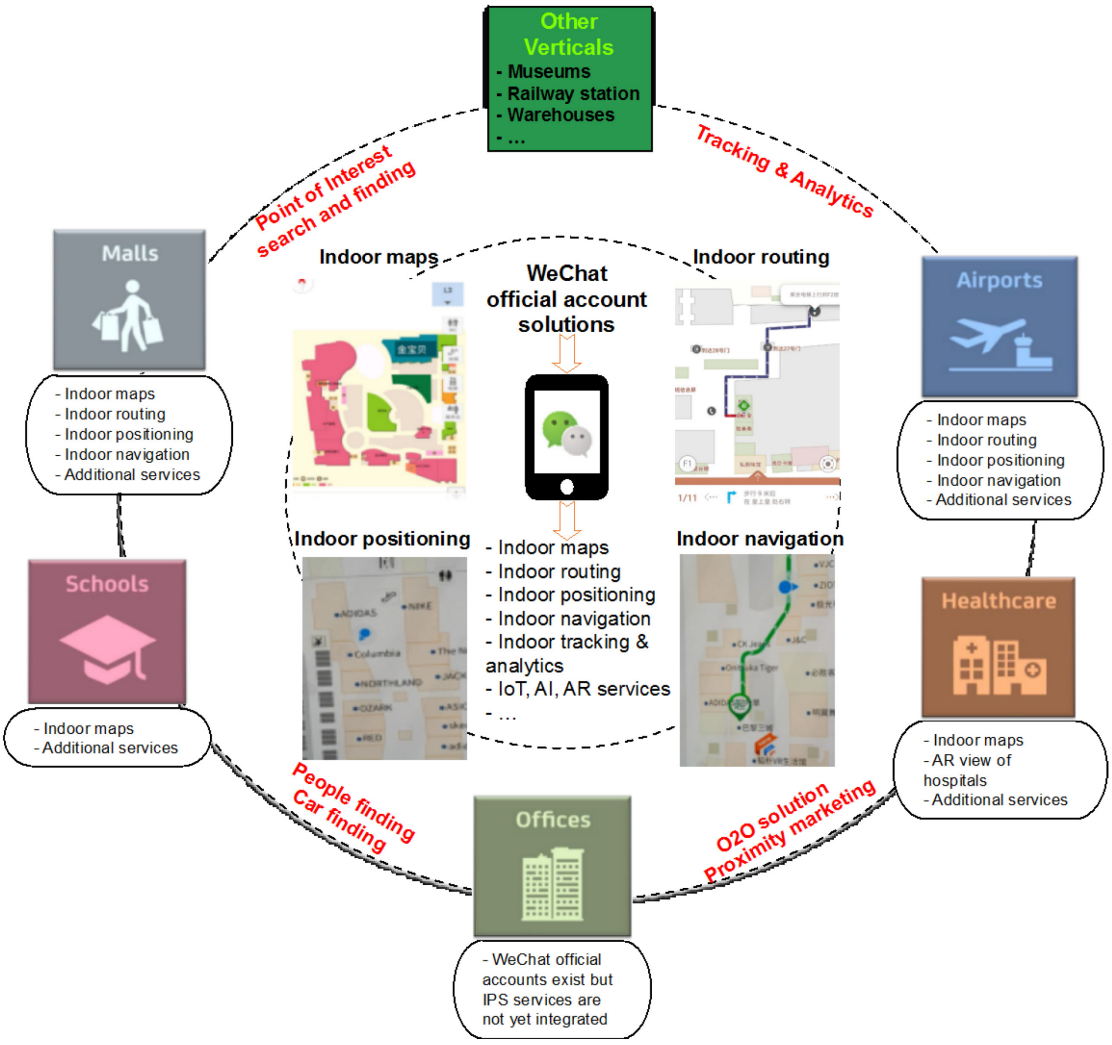

Figure 15. *Overview of IPS application in WeChat (author's creation based on observation and test).*

Examples given in the table only show a part of the overall IPS services provided in WeChat, but they do demonstrate how WeChat is promoting the development of indoor positioning technologies and solutions. One fact is clear: IPS services are emerging in WeChat platform, and many IPS relevant companies, a good portion of which might be the potential customers or partners of case company, are engaged with this platform. However, the current engagement is still fragmented and IPS services offered by WeChat are still scattered. Also, without evidence it is difficult to say WeChat platform is to evolve positively and to involve more IPS players as the development of WeChat is decided by a set of factors. In order to know what might happen to WeChat in the future, it is necessary to understand first what has happened and is happening to this platform with the help of some tools.

6.4 WeChat Platform Evolution

WeChat was first launched on the Chinses market in 2011 as an instant messenger, but has now become an all-in-one platform with services across different verticals. It belongs to the company Tencent Inc., which was founded in 1998 and is the China's largest internet service provider. Since its foundation, the company has been growing at a very fast pace. In 2004 it went public on the main board of the Hongkong Stock Exchange. Tencent has two types of key platforms: social networking platforms and several individual platforms for online entertainment, media and mobile utilities. WeChat, as well as QQ, are Tencent's two social networking platforms and its star products.

Before the introduction of WeChat, QQ was Tencent's key product, which can be seen as the foundation for Tencent to obtain and maintain its leading position in social networking market. QQ, similar to WeChat, was launched as an instant messenger but running first on PC and later web and mobile versions were made available. QQ's history can be traced back to 1999. After years' development, its main functionality has stayed the same and been expanded significantly. Similar to other social networking tools, the main function of QQ is for services such as text and message, voice and video chat, and file sharing and transforming. On top of those services, QQ's Qzone network offers online games, online music, microblogging, and shopping services. Based on the statistics of Tencent, the monthly active users of QQ for PC and Mobile QQ are 877 million and 647 million respectively as of September 2016 (Tencent.com, 2017).

Unlike QQ, WeChat was initially developed as a mobile-only messaging app (Millward, 2016), representing a breakthrough in Tencent's change from PC-based social networking and online gaming to mobile era (Millward, 2016). Facing the threats of two companies Gexin Hudong and Xiaomi, who have launched the first two instant messenger services in China at the end of 2010, Tencent's mobile QQ app was losing its market share. In response, WeChat project was kicked off as an interest program led by a R&D center outside the headquarters. In January of 2011, the first WeChat app was launched for running on different mobile systems: iOS, Android, and Symbian. Since its initial release, the number of WeChat's monthly active users has been growing very quickly. Figure 16 illustrates the user growth between 2013 and 2016.

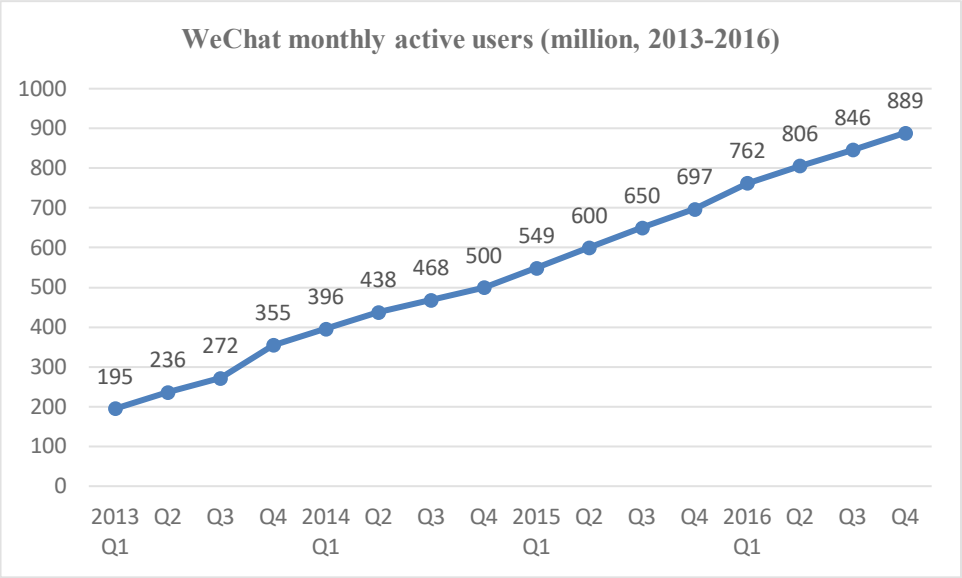

Figure 16. *Growth of WeChat MAUs (monthly active users) between 2013 and 2016 (adapted from Statista, 2017).*

After several years' development, WeChat has now become an all-in-one platform which offers services to an array of verticals and industries. Not only social networking technologies, but new technologies, such as IoT (Internet of Things), AI (Artificial Intelligence), AR (Augmented Reality), and VR (Virtual Reality) have started to play roles for the development of high-end services. Moreover, as the functionality of WeChat increases, this platform has started to show its envelopment property on both vertical and horizontal sides to involve more members from the same value chain and to get more players from different industries.

Currently, three types of services are provided in WeChat. The first type is related to WeChat's instant messenger services, including text and audio messaging, voice and video call, post on moment updates, gaming, and mobile payment ("Wallet"). Those services have been developed and launched by Tencent itself. The second type contains the services offered by the third-party companies. WeChat has built strategic partnership with many companies that operate in various verticals, such as e-commerce, utilities payment, taxi-hailing, tickets buying, and hospitality. Unlike the services offered by the third type introduce later, the second group of services are directly embedded into WeChat, and end-users can use them without the "search" and "follow" steps required for the third group of services. This group of services are jointly developed and launched by Tencent and its collaborators. Next, the third type of services are offered by numerous "official accounts" developed by enterprises and individuals who use the developing tools offered by Tencent. Those services reach almost all aspects of consumers' lives, including services related to entertainment, healthcare, travelling, and education. Additionally, one specific kind of official accounts – enterprise accounts provide services for professionals, to help them deal with daily work tasks, such as the office documentation, materials sharing, and secured professional chatting. Through WeChat, all those services can be provisioned by

a single platform. The basic information of WeChat and the varying services offered by the platform is summarized in Table 13.

***Table 13**. WeChat overview.*

Terms	Description
Owned by	Tencent
Launched in	Jan. 2011
Available languages	English, Russian, Indonesian, Spanish, Portuguese, Thai, Vietnamese, Chinese, etc.
Monthly Active Users	889 million as of December 2016
Operation mode	From an instant messenger to an all-in-one platform
Main functions	- WeChat's own services: text and audio messaging, voice and video call, post on moment updates (similar to Facebook status with no word limit), mobile payment, gaming, etc. - Embedded third party services: taxi hailing, mobile shopping, ticketing and ordering, public transport services, etc. - Numerous services provided by corporate's "official accounts" in WeChat, providing similar solutions to those of native apps, e.g., office Word and Excel, e-health services, e-library, online banking.
Posting rate	Daily for many people
Western counterparts	Combination of WhatsApp, Facebook, Instagram, Twitter, and even LinkedIn to some extent

Since its first introduction on the market, the functionality of WeChat has been improved through a series of innovations. According to Luo et al. (2015), WeChat evolution has been realized on a basis of micro-innovating process, during which repetitive integration and iteration for new and small functions were made to overtake comparable products. Through this process, a seemingly incidental vertical app has been transformed into a platform with multiple functions that disrupt apps and platforms across industries. Two key points are emphasized for the micro-innovation of WeChat: the first is the observation of the real-time demand of users, and the second is a continuous but fast process of trial and error with new functions.

Luo et al. (2015) have divided the WeChat past evolution process into seven stages: start-up stage, catch-up stage, complete catch-up stage, stage of internationalization, stage of platform-based innovation, stage of cross-industry extension, and latest stage of foundation of mobile business empire. At each stage, new functions were added into WeChat based on micro-innovations, the sources of which include Tencent's own product QQ, the inspiration of products offered by the competitors which are either domestic or international firms, and incorporation of new technologies and services utilized in other industries. Those innovative sources for the development of WeChat can be regarded as the innovation inflows of WeChat platform, which meet perfectly the description of Tiwana's (2014) bathtub theory. Based on this theory, the services launched by Tencent but copied

by the competitors can be considered as the innovation outflows. Figure 17 explains the evolution process of WeChat platform explained by the bathtub theory.

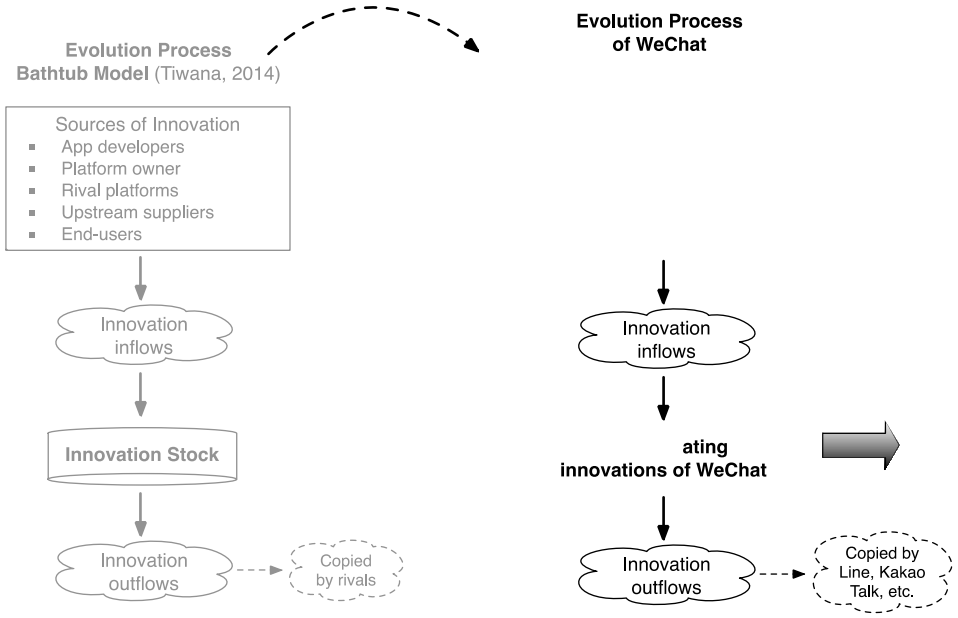

***Figure 17**. Application of bathtub theory (Tiwana, 2014) on WeChat evolution process (modified from Luo et al., 2015).*

More specifically, perceived from the functionality perspective, the journey of WeChat can be expressed in a chronicle manner showing the addition of new functions along the time, as described in Table 14. Since its launch in 2011, the functionality of WeChat has been evolving from a simple instant messenger to be a social communication-based all-in-one platform.

***Table 14**. Chronicle of WeChat evolution (functionality perspective, modified from Millward, 2016).*

Time	Addition of new features
Jan. 2011	WeChat was launched as a messaging app with basic functionality: Text messaging, voice clips, photo sending. The new app was called Weixin in Chinese, no English name existed yet.
Aug. 2011	Video clips sending and nearby users finding functions were added. There was a slow shift from 2G to 3G, hence compress videos became cheaper to send out
Jul. 2012	Voice and video calls were added. WeChat webpage edition was released
Jul. - Aug. 2012	Popularity of QR codes and the opening up of WeChat attracted a lot of brands to create official accounts in WeChat
Aug. 2012	WeChat platform were further opened to individual and organizational developers
Sep. 2012	User accounts syncs with Facebook and Twitter: users outside China could log into WeChat with their Facebook and Twitter accounts when Facebook and Twitter were blocked in China
Aug. 2013	Gaming and WeChat "Wallet" were added
Jan. 2014	Taxi-hailing service was added: Tencent partnered with Didi Dacche for allowing users to call a taxi and make payment within WeChat Pay
Mar. 2014	Mobile shopping function was added. Tencent invested in JD (second biggest online retailer after Alibaba) and embedded JD's service into WeChat. Through this move mobile e-commerce service was added to WeChat
May 2014	WeChat stores acted in the form of official accounts
Jun. 2014	Money transfer was enabled to friends through WeChat's Wallet, when SMS was nearly dead at that time
Jan. 2015	Addition of ads in the Moment feeds: allow people to like and make comments on the ads. Big brands were involved first, e.g. BMW and Coca-Cola
Jan. 2017	Official launch of cloud-based WeChat "Mini Programs"

Among the events listed in Table 14, several of them need to be emphasized. First, the opening up of WeChat and the initial dissemination of official accounts in 2012 represent the beginning of WeChat's horizontal expansion in different industries. Second, the launch of WeChat "Wallet" services in 2013 indicates the start of service integration across multiple verticals that require mobile payment. It also signals a huge potential for mobile commerce based services and creates a prerequisite for the establishment of strategic partnership with other well-known e-commerce companies, such as JD.com. Third, ads were displayed in WeChat "moment" feeds in 2015 for the first time, showing the company's intention to seriously earn advertising profits from its huge consumer base. Lastly, the most recent launch of "Mini Programs", which are more native app-like applications, indicates the emergence of a new and possible disruptive change to the app market.

7. USE SMAC TO ANALYZE WECHAT EVOLUTION

7.1 SMAC Stack Evolution in China

Being one of the world's leading economy entities, China has great market potential. Meanwhile, as an emerging economy, Chinese market is also very diverse, complex and highly dynamic. As pointed out by Back et al. (2014), emerging economies such as China are characterized by their immature capital market, poor legal framework for property right protection, lack of necessary resources for innovation, and weak pools of vertical intermediaries. Consequently, business development in China is usually multidimensional, non-linear and even discontinuous in some cases (Hendrichs, 2015). Driven by globalization and digitalization, the market is known for its fast-changing conditions and continuous evolving consumer behavior, posing challenges for many traditional companies that have difficulty to secure new opportunities due to their narrowly focused core competencies and insufficient capabilities (Hendrichs, 2015). Moreover, besides the typical features of an emerging market, cultural factors play important roles for doing business in China, one of which is related to Guanxi – a complicated cultural relationship construct which represents the exchange of favors for trust building and personal network connection (Niedermeier et al., 2015).

The concept of Guanxi is regarded as a special relationship between individuals (Guo and Miller, 2010), which can be presented as a connection or exchange of resources and processes among family members, friends, and business contacts (Fan, 2002). Fan (2002) describes Guanxi with several types of favor exchange, including exchange of information, advice, gifts, service, and job offering. The creation of Guanxi is not a simple process but requires a great amount of time, energy, and money. For this reason Guanxi is viewed as a limited resource and people cannot build a Guanxi with anyone they want. In a SMAC-driven digital era, Guanxi can be more easily created and developed with the help of new methods, for instance, the utilization of social media and networking tools.

Social

Social media and networking represents a significant transforming technology for the global consumers. On a worldwide scale, according to Statistica (2015), there were 1.49 billion monthly active users on Facebook and more than 302 million monthly active users on Twitter in 2015. The high number of active users of social tools is one of the main reasons for their adoption as a common means to approach consumers around the world (de Vries et al., 2012). For example, as of 2014, 80% of Fortune 500 companies had active Facebook pages and 83% of them had active Twitter accounts (Barnes and Lescault,

2014). In China, the popularity of social tools has been enabled by the ubiquitous penetration of internet connection since the Internet was first introduced into the country in 1994 (Ye et al., 2017). There were only 1 million internet users in 1997, but this number increased exponentially to 11 million in 2005 and to 668 million in 2015 (CNNIC – China Internet Network Information Center,1998, 2008, 2015). As of June 2015, the number of mobile internet users was 594 million and almost 89% of Chinese netizens had a mobile device. The high ownership of mobile device further promotes the penetration of social media and networking applications. Overall, regarding the development of social technologies and applications, three phases can be identified (Ye et al., 2017).

Phase One is before 2005 when BBS (Bulletin Board System) was used as the main form of social media. There were two types of BBS sites: one are major portal sites such as 163.com, Sohu.com and Sina.com, another are specialized sites such as Qiangguoluntan, Maopu and Tianya. Almost all of those sites are still functional today and are still popular in China. Phase Two is between 2006 and 2008 when an array of social media and networking sites appeared through which users could interact with friends and post photos and comments. Two of such sites were widely used among the Chinese netizens at that time. The first is Renren.com, which is a Chinese version of Facebook, and the second is Tencent's QQ, an instant chatting software. Phase Three began after the year of 2009, since then a variety of social applications have been launched on the market driven by the fast penetration of internet and mobile internet services. Among those popular apps, two of them have emerged and become leading players, one is Weibo – a Chinese version of Twitter - launched in 2009, and another is Tencent's Weixin (WeChat in English) which became available on the market in 2011. Since its release, WeChat has attracted a good number of users on leveraging the user base of Tencent QQ and become the most popular social networking tool, followed by QQ and Weibo (CNNIC, 2014). According to the statistics of Kantar (2015), approximately 89% of Chinese Netizens use WeChat, 61% use QQ and 44% use Weibo.

Social media and networking has dramatically changed people's lives for both daily activities and professional tasks. First, people can use social tools for communicating with family members and friends through activities of chatting, monitoring friends' status and sharing their own status and uploading pictures. They can also use social tools for entertainment services such as watching video, listening to music, and online shopping. Different social applications can offer different services. For example, the use of Weibo and other microblogging sites are mainly for obtaining news and checking status of the people users are interested, e.g. the celebrities, whereas WeChat is mainly used among friends who want to chat with people they know and exchange personal information. Nevertheless, the convergence of technological trends has led to the development of common functionalities among different social apps. For example, in addition to the functions described above, Weibo can also be used for chatting services, and both Weibo and WeChat have

similar features like “Wallet”, content sharing, and health data tracking. Also, people can use both of them for obtaining news distributed by integrated public accounts.

On the other hand, the utilization of social applications has become common for business purposes because social tools have high potential to influence sales at every phase of selling process (Rapp and Panagopoulos, 2012). According to Andzulis et al. (2012), social tools can affect the sales from six facets: understand the customer, approach them, identify their needs, make presentation, close the deal, and follow-up. The communication functionality of social tools is emphasized during the entire process, for which specific tactics can be proposed. For instance, Andzulis et al. (2012) mention the use of Facebook promotions as referrals and Twitter for discussion of conference results and innovation. In China, given the fact that Chinese netizens spend almost 40 percent of their online time on social media and networking, it shows great opportunities for businesses to approach the Chinese consumers (mich et al, 2012). Currently, the largest social sites/applications include WeChat, QQ, Weibo, and Renren.

As a matter of fact, Chinese sales force adopt social media technologies more quickly than their US counterparts. Accroding to OgilvyOne Global Survey (2010), 38% of Chinese respondents used blogs to promote their sales in contrast to merely 3% of US respondents. Moreover, as the importance of Guanxi for business development has been emphasized in the Chinese background, the social media, which is an effective tool for relationship building and maintaining, plays critical role in marketing and sales in China. Based on the research results of Niedermeier et al. (2015) who have conducted in-depth interviews with three sales managers and 42 sales representatives in China, it is concluded that social media is an extremely important tool for sales process, especially for the building of Guanxi which is an essential success factor for doing business in China. During the interview, the use of WeChat was highlighted by all the managers. According to them, WeChat is the most popular social media and networking tool used by all the sales staff because it “mixes business with personal relationships, like a lubricant in the business process” (Niedermeier et al., 2015).

Additionally, another influential factor censorship, which has different impacts on different social platforms, needs to be mentioned. For instance, one reason for WeChat’s popularity is the Chinese government’s tighter censorship on Sina Weibo since 2010 (Council Information Office, 2010, cited in Tu, 2016) when a strengthened control on internet services was initiated. A further control was carried out in the summer of 2013, when a large-scale crack down on opinion leaders was implemented on Weibo (“From Weibo to WeChat,” 2014). Later a tougher policy was released again on Weibo, and people became less and less interested in Weibo and turned to WeChat which is more private and secure. Actually, WeChat is not immune from the censorship, but it can be avoided or at least decreased to a more acceptable level through some technological means. In details, 1.5% of WeChat official accounts’ posts were censored by the state (Tu, 2016), whereas the censorship of Weibo posts is 16.25% (Bamman et al., 2012).

Furthermore, the sharing of content between different social tools is becoming common. For instance, the content (e.g. videos and music) offered by some social media apps, can be directly shared on other bigger social platforms, e.g., Sina Weibo and WeChat. After years' development, those social apps, especially the bigger ones, have added more and more functional features, and some of them are services that originally belong to other industries. It is now becoming common that social platforms start to expand vertically and/or horizontally into other areas due to the platform' envelopment characteristics. This phenomenon can be better described with examples of Sina Weibo and WeChat.

In Sina Weibo, a new service feature - live video was added in May 2016 and within only two months 10 million live videos were broadcast on the platform. This Weibo Live feature is being used by various brands, media outlets, and individuals such as stars and celebrities for business and advertising purposes. In another example, IoT-based services have started to emerge in WeChat. For example, an US IoT software enterprise called Ayla Networks has developed an official account in WeChat which can realize a manual and voice control of the energy systems (light and temperature) in an office. This example perfectly shows how new technological trends, such as IoT, can be applied in WeChat. The launch of those new services is beneficial for both WeChat (or Tencent more precisely) and the companies providing the new technologies and applications. On the one hand, WeChat can consistently offer new services to maintain the old users and to attract new users. On the other hand, new technological firms, such as those IoT enterprises can in turn utilize WeChat toolset for developing their solutions more easily and simultaneously promoting their IoT products/services through WeChat at a lower cost but to a large customer base.

Meanwhile, not only social platforms have started to offer services in other industries, but some platforms operating in other industries, such as Taobao (e-commerce platform) and Alipay (online payment platform), have added social functions into their service portfolio. For instance, Taobao (web and mobile app) has for a long time added chatting services for facilitating communication between online shop owners and consumers. Similarly, Alipay provides chatting and messaging services through which people can communicate with friends and the contacts of public accounts.

To conclude, the main social apps/sites, their current status, and the political and cultural factors that influence their development in China are summarized in Table 15. In addition to those factors, one technological force – advancement of mobile devices and mobility works as a basis for social media evolution, the details of which will be given in next section.

***Table 15**. Overview of social media and networking market in China and top four Chinese social apps and sites (source: author's creation based previous discussion).*

Social platform	MAU (m, 2015)	Main functions	Overview
WeChat	600-700	Social networking between friends	- User experience affected by censorship of Chinese government - High utilization rate in China (e.g. 89% of netizens used WeChat in 2015), as of Sep. 2016, the MAU of WeChat were 846 million. - Chinese netizen spend 40% of online time on social media - Facilitate Guanxi building in China for business purposes, WeChat in particular - Six facets to affect sales: understand the customer, approach them, identify their needs, make presentation, close the deal, and follow-up - Content sharing between different social media app - Addition of social functions in non-social media platforms - Service developed based on new technological trends (IoT, AR) are emerging on the big platforms
QQ	800-900	Social networking between friends, gaming	
Weibo	200-300	Microblogging, social media	
Renren	200-300	SNS (social networking services) sites	

Mobile

As of February 2016, approximately 1.28 billion mobile phone subscriptions have been recorded in China (Statista, 2016). The fast growth of ownership and the development of various applications have enriched the mobile ecosystem and enabled the emergence of mobile commerce and improvement of enterprise mobility. However, impacted by the locale context, the Chinese mobile market has some special characteristics in comparison to western markets, particularly US market. According to the research results of Neogames Finland (2016), Chinese market has the following distinct features:

- Android OS (Operating System) dominates the market as the number one platform. The statistics of Kantar Worldpanel (2016) shows that the sales market share of Android phones in 2016 was between 73.9% to 85.9%.
- The preference of payment patterns and systems is different in China. Chinese people use fragmented methods for making payment, such as online-billing, SMS payment and mobile wallet.
- Android application stores are also fragmented. Android app market is led by tens of app stores, in contrast to 1-2 leading Android app stores in the western market.
- Due to the tight policy on censorship and regulatory protection, a local partner is often necessary for a western company.
- Some western social media platforms, Twitter, Youtube, and Facebook are blocked in China, and local social media applications such as WeChat, QQ, and Weibo are dominating the local market.

Despite of those distinctive features which make the entry and expansion of western enterprises in Chinese market a tough task, they are still attracted by the huge market potential and promising business opportunities, and intend to expand into Chinese market if possible. The high potential of Chinese mobile market can be demonstrated from two building blocks: mobile devices and apps (app stores included). Also, when mobile devices and apps are particularly used for business purposes, one application area, enterprise

mobility must be mentioned. Furthermore, for enabling mobile phone utilization, one condition is a must – deployment of mobile network infrastructure. Hence, the development of mobile ecosystem can be discussed from four dimensions: mobile network, mobile devices, mobile apps, and enterprise mobility.

First of all, to promote the development of mobile market, the advancement of mobile broadband network is a critical prerequisite, and Chinese companies are doing well by their efforts on 4G and 5G network development. In China, 4G networks have started playing a major role by contributing more than 50% of total mobile internet connection, and it is expected that 4G traffic will take more than 90% of total traffic by 2019 (Zhang and Wang, 2015). Besides, China is also acting actively for the international standardization work of 4G. Among all the patents delivered for 4G network, almost a quarter of them are for Chinese companies, leading to their increased influence on the evolution of global communication. In terms of 5G networks, some large Chinese networking and telecommunication companies have initiated their 5G steps ahead of many western companies. For instance, Huawei has completed 5G concept prototype design and prototype verification which meet well the requirement of IoT implementation and larger broadband businesses. Meanwhile, ZTE has come up with its pre-5G base station which has a much higher capacity that is 4 to 6 times as much as the capacity of 4G base station, and the company is ready to put its findings into commercial utilization (Zhang and Wang, 2015). Furthermore, not only enterprise, but Chinese government is actively involved in the formulation of 5G standards. As early as 2013, China has built a special group for speeding up its 5G research and issued a white paper depicting 5G definition, requirement, and expectation at the turn of 2014 (Yang et al., 2015).

Second, in terms of mobile devices, according to the research of Newzoo-App store (2017), more than 900 million smartphones and tablets are used monthly in China, representing 30.2% of the global market. Also, the Chinese app revenue in 2016 is $11.9 billion, overtaking the US market ($9.4 billion in 2016) as the biggest market and accounting for more than a quarter of world revenue. As of December 2016, 28.8% of mobile devices were running on iOS, and Apple is still the biggest tech brand measured in terms of the monthly active used devices and revenues. However, even the Android device brands are fragmented, they together account for 71.2% percent of total monthly active devices. Table 16 presents the top mobile brands by monthly active devices in December of 2016 (Newzoo-Mobile, 2017)

Table 16. *Top 10 mobile brands by monthly active devices (December 2016, Newzoo-Mobile, 2017).*

Rank	Device Brand	Share of monthly active devices
1	APPLE	28.76%
2	HUAWEI	14.46%
3	XIAOMI	11.55%
4	OPPO	10.90%
5	VIVO	9.20%
6	SAMSUNG	8.04%
7	MEIZU	3.34%
8	COOLPAD	2.20%
9	LETV	2.06%
10	GIONEE	1.84%

Third, as discussed previously, unlike the western market, the app store market in China is fragmented. Technode (2015) estimates there are more than 200 app stores in China, and they are developed by companies with different sizes and scales. Giant Internet companies, such as BAT (Baidu, Alibaba and Tencent), telecommunication operators like China Telecom, and smart phone developers and vendors such as Huawei and Xiaomi are all active players in the market. The top five Android app stores are listed in Table 17.

Table 17. *Top 5 Android app stores in China by coverage across all android phones & tablets (December 2016, Newzoo-App store, 2017).*

Rank	APP store	Coverage
1	MYAPP (TENCENT)	24.42%
2	360 MOBILE ASSISTANT	16.11%
3	BAIDU MOBILE ASSISTANT	15.24%
4	XIAOMI APP STORE	14.05%
5	HUAWEI	11.09%

Finally, the advancement of mobile devices in China has also promoted the successful implementation of enterprise mobility technologies. Enterprise mobility is defined as a trend for a shift of work habits, when more employees work out of the offices to perform business tasks on leveraging cloud services and mobile devices (Whatls, 2017). Chinese companies put enterprise mobility at a high strategic level. According to a study conducted by Accenture (2014, cited in Enterprise Innovation Editors, 2014), Chinese businesses regard mobility as a more important strategic area in comparison to other markets, and two thirds of business executives state good progress in meeting the key mobility priorities, compared to 44% at global level. Also, 59% of Chinese executives believe the mobility is in the top two priorities for the following year, and 87% believe in the top five. Besides mobility, social, cloud, connected things, and analytics are also listed in the top five priorities for 79% of respondents, in comparison to 67% at global level. Based

on the conclusion of Accenture, China was significantly ahead of the other markets regarding digital priorities, and the country is more likely to create a formal mobility strategy in most of the Chinese companies (Enterprise Innovation Editors, 2014).

Early in 2014, more than 90% of Chinese firms have executed their mobility strategies or have started to configure the mobility plans (Chang, 2014). The primarily focused industries were finance, government, and retail. The reasons for the intention or actual implementation of enterprise mobility were mainly for the satisfaction of business requirements and the improvement of operational and working efficiency (Chang, 2014). For instance, to meet the financial customers' requirements for accessing financial services at anytime and anywhere, all Chinese major banks offer mobile banking solutions. By doing this, bank employees can increase their work efficiency and more convenient services can be provided to customers.

Particularly, mobile CRM and mobile ERP (Enterprise Resource Planning) systems had a strong market need in 2015. Compared to the previous year, the need of mobile CRM has increase from 61.5% to 69.4% and the need of mobile ERP has grown even faster, from 30% to 63.6% (MIRC – Mobile Informatization Research Center, 2016). The respective market needs of those mobile enterprise applications in 2015 are illustrated in Figure 18.

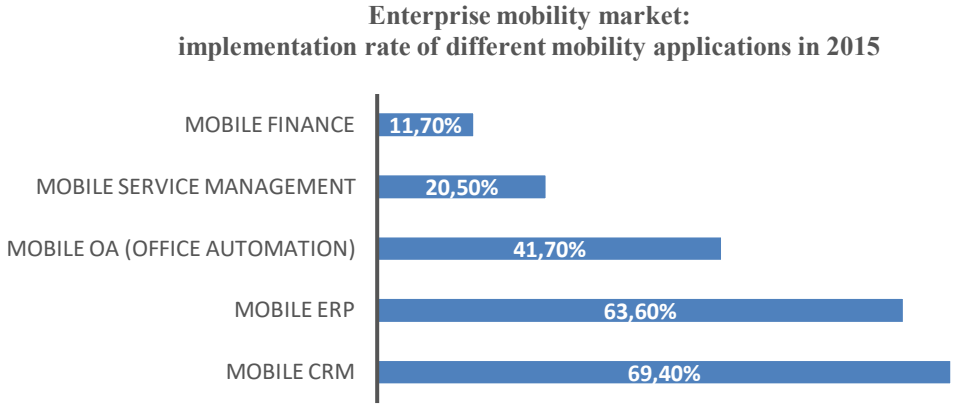

***Figure 18**. Implementation rate of enterprise mobility solutions by application areas in 2015 (adapted from MIRC, 2016).*

In the meantime, to create the enterprise mobile applications, developers can choose from a range of modes, based on which enterprise mobility services can be offered in different forms. A mix of modes is often common in some cases. For example, services for mobile CRM and mobile OA can be offered on WeChat or WeChat alike platforms, or on web, or offered in the form of a native app, or as a mix of previously mentioned applications. Depending on the need and preference of enterprises, different modes will be created and used differently. To assess the difference, Chinese MIRC conducted a survey including 1150 participants in 2015. Figure 19 is the survey result of one application area, the mobile CRM.

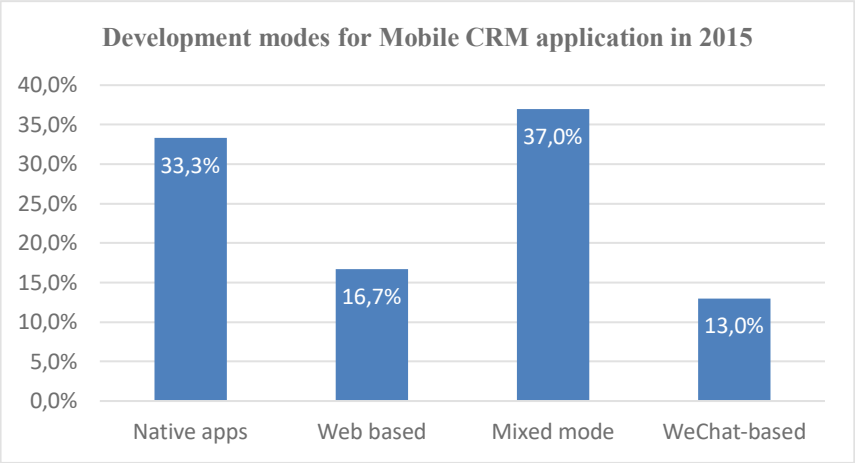

Figure 19. *Developing modes for mobile CRM by percentage in 2015 (adapted from MIRC, 2016).*

As illustrated in the figure, WeChat-based developing mode represents a noticeable fraction of the overall modes, demonstrating a good penetration of WeChat in enterprise mobility space. Also, the survey result shows that enterprises have become more interested in developing application based existing platforms, e.g., WeChat or WeChat like platforms, for their popularity among employees and ease-to-use property (MIRC, 2016). Lastly, the characteristics of Chinese mobile market are summarized in Table 18, represented by four dimensions: mobile network, mobile device, mobile apps, and enterprise mobility.

Table 18*. Overview of Chinese mobile market development – Four dimensions (source: author's own creation based on previous discussion).*

Dimensions	Characteristics
Mobile networks	- 90% of 4G network coverage by 2019 - Proactive involvement in the 5G network development and standardization (Huawei, ZTE, government)
Mobile devices	- Market share: Android vs iOS: 70%-80% vs 20%-30% - 1.29 billion mobile phone registration, and more than 900 million actively used mobile devices
Mobile apps	- China is the biggest market in the world in terms of app revenue - Fragmented market: more than 200 Android app stores, led by ten brands; Tencent's app store was #1 as of Dec. 2016
Enterprise mobility	- Chinese enterprises see enterprise mobility at a higher strategic position than the global average level - Rapid growth of mobile CRM and mobile ERP, implementation rate more than 60% in 2015. - WeChat-based enterprise mobility apps account for a noticeable part of overall modes (e.g. for mobile CRM apps, 13% are based on WeChat and 37% based on mix mode.
Overall, China is advancing in 5G network building. It is a market with high potential with its #1 position in terms of mobile device users and app revenue, but the app market is very fragmented. Enterprise mobility is developing very fast, and WeChat plays a noticeable role in this area.	

Analytics

Since 2011, the big data market in China has been growing at a rate faster than the averaged global level (Liu et al., 2014). Ranked the first in the world in terms of the number of internet and mobile phone users, China has been accumulating an enormous amount of data created by a great number of internet industries and various information systems (Guo, 2014). The development and rapid growth of smart cities and IoT have added even more data to the current storage level. In a new digital era, the utilization of this huge amount of data can create great business opportunities. The development of data technology not only reduces the cost for data storage, data mining and data-based applications, but also increases productivity and provides more opportunities for innovations.

In a World 2.0 background, users no longer passively consume data, but actively generate a variety of data at a high velocity with good accuracy (Lai and Turban, 2008). With the fast growth of mobile internet, people have now moved to the mobile platforms so to be connected anytime and anywhere, leading to a higher volume of data generated by consumers than by enterprises (To and Lai, 2015). For example, China Unicom, one of the three biggest mobile operators in China, recorded a total volume of 525 Tbytes of data per month generated by its 250 million mobile users (Huang et al., 2014). According to an internal statistic, 1.4 million records were written per second, and the retrieval time for trillion of data is less than 100 millisecond (Huang et al., 2014). Figure 20 presents the volume of transaction created online within one minute in China, demonstrating the potential to generate a huge amount of data at a high velocity.

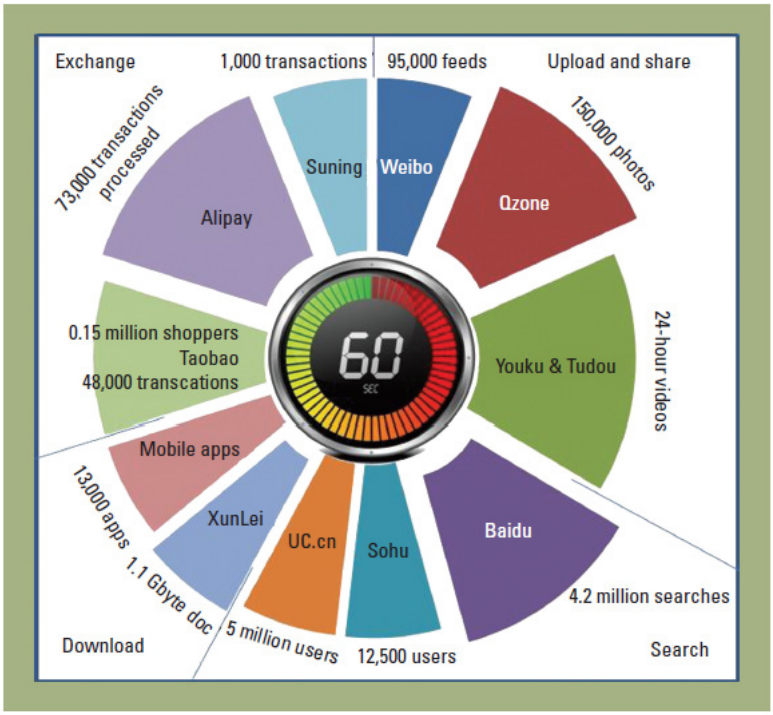

***Figure 20**. Transactions in one Internet minute in China (To and Lai, 2015).*

In China, there are mainly two sources for the generation of data: online business and social sites. Online business platforms include B2B (business-to-business), B2C (business-to-consumer), and C2C (consumer-to-consumer), led by Alibaba.com, Tmall.com, Taobao.com, and JD.com. China's online retailing platforms created a total transaction value of $248 billion (To and Lai, 2015). On 11 November 2016 the Chinese Single Day, the total sales value of Alibaba was $17.8 billion, compared to $14.3 billion in 2015 (Cheang, 2016). Taking advantage of this vast volume of transaction data and analytics, companies can gain good insights on how to improve the development of e-commerce and mobile commerce.

The second major source of data is social media and networking. As discussed previously, the use of social apps has become a common phenomenon in China, leading to the enormous amount of data generation when people share their opinions and files, chat, and exchange information through various communication and media platforms, such as Weibo, QQ, WeChat, and various news and video platforms. Data collected from social sites can be monitored, analyzed, and visualized for both political and business purposes (To and Lai, 2015). First, in political arena, government policies can be easily spread through social media and political discussion can be encouraged. Second, in business context, data analytics helps to measure brand images, understand customer behavior, determine enterprise reputation, and facilitate decision making. Moreover, emergent trends and threats in the market can be more easily identified by gaining meaningful insights from data analysis.

Seeing the significant opportunities represented in data, many companies have prioritized analytics capability as one of their key strategical dimensions. A survey conducted by KPMS shows that 48% of Chinese consumer firms highlighted the strategic position of data analytics and arranged it into their current agenda (KMPG, 2014). Besides, in the big data space – a key component of data market, analytics is viewed as a critical element. For instance, First Mark Capital released a version 3.0 of the world's big data industry ecosystem in 2014, in which big data market is divided into six blocks: infrastructure, data source, open source, analysis, cross platform infrastructure, and data-based applications (Turck, 2014). Among those elements, data analysis and applications account for a larger part in terms of the number of companies. For instance, in the research of Liu et al. (2014), out of 126 Chinese big data enterprises, more than 60 percent of them focus on analytics and data applications, compared to 50 percent at global level, demonstrating the strong ambitions of those enterprises to walk towards a future based on a prospect of analytics.

However, as a high potential market, China was lagging behind the western market in terms of data quality and outcomes of analytics solutions. According to a survey conducted by CDAC (China Data Analysis Committee) in 2013 with 300 organizations, even organizations were aware of the importance of data analytics and were actively searching for relevant training and consulting services, many of them were still focusing on low-

end solutions, such as the profiling the product offering and users, and analyzing basic financial and strategic information. Moreover, there are three drawbacks that substantially influence the advancement of analytics in China – the lack of competent people, the vast volume and high variety of data (The Economist, 2010), and the security and privacy issues that concern enterprises and consumers (To and Lai, 2015). Despite of those challenges, the outlook of analytics is still bright in China, and Chinese government is strongly supportive for its development. In the Chinese 12th five-year plan, IT is seen as a key strategic industry and national infrastructure is to be constructed specifically for data (big data in particular) analytics (To and Lai, 2015). Finally, to conclude, the current state, drawbacks, outlook of analytics market is summarized in Table 19.

Table 19. *Overview of Chinese analytics market development (source: author's creation based on previous discussion).*

Major sources of data	Characteristics of data	Drawbacks
Two major sources: - Online retailing: e-commerce and mobile commerce (Alibaba.com, Tmail.com, Taobao.com, JD.com, etc.) - Social media and networking (Weibo, QQ, WeChat, various news and video platforms	- Enormous volume generated from online shopping and social media platforms - Data generated in various forms (structured and unstructured) - Data generated at an astonishing velocity	- Lack of competent people in local market - Security and privacy issues
Overall, full of potential, but its current development is lagging behind the western market and is catching up at a high pace.		

Cloud

Cloud computing has emerged as an important ICT force that revolutionizes the way computing resources are offered and consumed (Yu et al., 2016). In an emerging economy like China, cloud computing promotes the creation and deployment of information infrastructure which can be leveraged for more economic updating. Cloud computing also works as a basis for technological development of an array of industries. Through this new ICT tool, domestic information can be more easily connected with the rest of the world. According to Bain & Company, China's cloud computing market is expected to be $20 billion by 2020 with a CAGR (Compound Annual Growth Rate) of around 40% (Meehan et al, 2015).

Cloud computing has represented a fundamental shift in the way IT services are innovated, deployed, maintained, updated, and scaled. Since its advent and dissemination in 2007, cloud computing has been changing the traditional ICT landscape in China (Yu et al., 2016). Driven by the convergence of two major trends in information technology - IT efficiency and business agility (Marston et al., 2011), cloud computing has been evolving rapidly. In the Chinese context, the development of cloud computing has gone through several phases, during which various actors, including government, foreign and domestic enterprise, institutions, have played different but critical roles. After the examination of key milestones, Yu et al. (2016) have divided the evolution process of cloud computing

in China into three phases: initiation from the concept (2008-2010), building of cloud infrastructure (2010-2012), and development of cloud ecosystem (2012-present). The phases of evolution, key actors, and their main activities during the evolutionary process are described in Table 20.

Table 20. *Evolution of Chinese cloud computing market from 2008 to present (adapted from Yu et al., 2016).*

Phases	Activities of main actors
Initiation from concept (2008-2010)	- Central government: policy setting and strategic development of emerging industry - Large foreign companies: exploring the Chinese emerging cloud market and exploiting the potential for expansion, and working as educator for local companies to learn the concept and applications. - Domestic IT vendors: trying to seize the first mover advantage in the emerging business field
Building of infrastructure (2010-2012)	- Central government: collaborating with national telecommunication operators and business players, 3CPP was established as a collaboration bridge. - Local government: seeking support from central government for local cloud business development - Telecommunication operators: expanding the existing networks and obtaining the first-mover advantages
Development of cloud ecosystem (2012-present)	- Central government: setting policies for information security, devising regulations and standards with enterprises, stimulating and supporting domestic players - Large foreign companies: further expansion in Chinese cloud market - Domestic IT vendors: development of viable business models and monetization of cloud business - Cloud service users: using higher quality cloud-based IT services

During the evolution process, actors from different parties play different and interactive roles. First of all, Chinese government plays an essential role for infrastructure deployment and policy setting. The implementation of ICT strategies in China is carried out in a top-down manner by which central government provide goals and guidelines and local government of different levels define local plans and deploy required infrastructures (Zhu, 2006). Among the government institutions, two of them play critical roles for launching major programs and building national systems in cloud computing industry. They are MIIT (Ministry of Information and Industry Technology) and NDRC (National Development and Reform Commission) who are the major actors for policy making and strategy planning for the promotion of cloud computing in China (Zhu, 2006). In terms of the policies, cloud computing was viewed as a strategic priority and written into the nation's twelfth five-year plan and this strategy is most likely to be reaffirmed in the thirteenth five-year plan between 2016 and 2020 (ITA Cloud, 2016). In its pilot cloud schemes, NDRC has prioritized five Chinese cities: Beijing, Shanghai, Hangzhou, Wuxi, and Shenzhen.

Moreover, to create a communication channel between the government and business actors, a government-business partnership is necessary for facilitating innovation and sustainable development. In this respect, an association named 3CPP (China Cloud Computing Promotion and Policy Forum) was established in 2011 to help the building of cooperation relationships between solution developers and service providers, or between service providers and end-users. Since the foundation of 3CPP, both state-owned organizations and private companies have been actively participating in the development of relevant businesses. For instance, an investment of $180 billion between 2015 to 2017 was planned by the state-owned telecom operators for wired and wireless connectivity. Meanwhile, two Chinese giant internet companies – Tencent and Alibaba, announced respectively an investment of $1.57 billion in 2015 over the next five years for its cloud computing business (Osawa, 2015) and an investment of $1 billion into its cloud computing unit – Aliyun (Shu, 2015).

Additionally, many foreign big names are also active in the Chinese cloud market. However, restricted by the local telecommunication regulations, foreign companies that intend to run a cloud computing business in China may not have the capabilities for a sole operation, and some sorts of strategic partnership are necessitated with the local companies (Yu et al., 2016). Despite of this restrict, foreign companies are still interested in the China market and want to grow their businesses there. For example, Microsoft has cooperated with 21Vianet – a local data service firm for offering public cloud services (Business Cloud News, 2015). IBM is working with 21 Vianet too for rolling out its hybrid cloud platforms. Amazon is teaming with China Net Center for cloud computing services (China Net Center, 2014). Oracle has announced an increase of Chinese employees, and has most recently partnered with Tencent for providing more cloud-based services on leveraging WeChat platform (Foley, 2016).

To conclude, even having a relatively late emergence, Chinese cloud market is advancing at a high speed under the influence of a multi-faceted support of government, big efforts of domestic companies, and positive roles played by foreign companies. Therefore, even there is indeed a development gap between the Chinese cloud market and the most advanced market, the gap is currently narrowing down very quickly. Table 21 is a summary describing the cloud computing market in China.

Table 21. *Overview of Chinese cloud market (author's creation based on the previous discussion).*

Historical development	Current state
Three phases: - Initiation from concept: 2008-2010 - Building of cloud infrastructure: 2010-2012 - Development of cloud ecosystem: 2012-present	- Market value $20 billion by 2020 according to Bain & Company - Driven by convergence of two trends – IT efficiency and business agility - Three parts actively involved in the current development: - Government: The implementation of ICT strategies in China is a carried out in a top-down manner; MITT and NDRC are two central parties for policy setting; 3GPP is a new association bridging communication between government, enterprises, and consumers. - Domestic companies: huge investment of big companies, including telecom operators (China Telecom, China Mobile, and China Unicom), Tencent, Alibaba, etc. - Foreign companies continuously partner with local firms for local growth (IBM-21Vianet, Microsoft-21Vianet, Amazon-China Net Center, Oracle-Tencent)
Overall, the market emerged late but evolved very fast. The current development may be slightly later than the western market but is catching up very quickly.	

The previous section has discussed SMAC stack in the Chinese context, showing in details the evolution process and the current scenario of each market driven by the four constituents: social, mobile, analytics, and cloud. To simplify the following discussion, Table 22 is a summary to present the strength of and opportunities, as well as the weakness and threats demonstrated in each market based on the previous discussion. The companies that want to launch relevant products/services in China can get some insights from it.

Table 22. *Strengths/Opportunities, and Weakness/Threats of Chinese market under the implication of SMAC stack (summary based on previous discussion).*

SMAC	Strengths/Opportunities	Weakness/Threats
S	- High number of social media users: approximately 89% of Chinese Netizens use WeChat, 61% use QQ, and 44% use Weibo. As of Sep. 2016, the MAU of WeChat were 846 million. - Chinese netizen spend 40% of online time on social media - Use of social media becomes common for business purposes, especially for Guanxi relationship building, WeChat is particularly useful. - Integration of new features such as live video in Weibo and applications of new technologies such as IoT and AR in WeChat - Content sharing between different social media apps - Addition of social functions in non-social platforms (e.g., Alipay)	- Censorship of sensitive news by government - Distinct user behaviors and app interfaces between Chinese and western social apps - Difficult to build Guanxi out of personal network through social platforms
M	- More than 900 million smartphones and tablets are used monthly (2016), representing 30.2% of the global market. - The biggest app market in the world with a revenue of $11.9 billion in 2016 - 90% of 4G network coverage by 2019 and a proactive involvement for 5G network development and standardization (Huawei, ZTE, government) - Increased use of mobile ERP and mobile CRM for enterprise mobility, implementation rate more than 60% in 2015 - WeChat-based enterprise mobility apps account for a noticeable part of overall developing modes	- Android devices dominate the market with a share of between 73.9% to 85.9% for mobile phone sales in 2016. - Fragmented Android app market, more than 200 app stores led by tens of them - Chinese people are used to fragmented payment methods: cards, online-billing, SMS payment and mobile wallet.
A	- Two major sources for data generation: online retailing (e-commerce and mobile commerce) and social media & networking. - Additional sources: smart cities, IoT apps, cloud-based platforms - Numerous opportunities for pattern analysis, trends identification, efficiency and productivity improvement, as well as applications for political reasons. - Big data market is estimated to be growing at 100% and in 2016 the value is supposed to be RMB9.39 billion.	- a huge amount of data is growing at an astonishing velocity and in a variety of forms - Lack of competent people in local market - Security and privacy issues
C	- Market value $20 billion by 2020 according to Bain & Company - Three parties are actively involved in the space: government (MITT, NDRC, 3CGG), domestic companies and foreign firms - Five cities - Beijing, Shanghai, Hangzhou, Wuxi, and Shenzhen were emphasized in the pilot cloud scheme of China's 12th five-year plan - Foreign companies continuously partner with local companies for local growth (IBM-21Vianet, Microsoft-21Vianet, Amazon-China Net Center, Oracle-Tencent)	- A local partnership is needed for foreign companies - Government plays an important role - Competition from international and local companies

Apart from SMAC stack, the empirical case shows that there are other technological trends emerging to load weight on the business world, and some of them have started to play bigger roles, one of which is IoT. As in China, the country has started its IoT sensing network research since 1999 and has positioned IoT as one of the strategic fields that were written into the government work report. Since then the IoT researches, applications, pilot projects have been vastly promoted. In 2014 at least 9 billion devices were interconnected in China, and the number was expected to reach 24 billion by 2020 (Chen et al., 2014). Huge amount of revenue is expected from varying industries, such as automotive,

healthcare, consumer electronics, entertainment, and transportation. Similar to the cloud computing industry, even IoT has merely emerged several years ago, a lot of efforts have been made from both the government and business entities. From the government side, special funds have been set for research schemes and demonstration projects. 22 national IoT application projects have been supported by Chinese government since 2011 and more national IoT pilot projects were announced in 2013 by NDRC to be carried out in special regions between 2014 and 2016 (Chen et al., 2014).

There is not only advancement in the infrastructure setting and national IoT research projects, but also the increase of commercially available IoT applications appeared in different industries. In China, many IoT companies provide RFID (Radio Frequency Identification) solutions for applications in manufacturing, warehousing, and hospital verticals. Besides, smart city, smart office, and smart home are some new verticals where IoT can be adopted to meet people's daily needs, e.g., the requirements for energy saving, light and temperature controlling, real-time public information checking, tracking and monitoring of assets and people (Industry Focus, 2014).

VR (Virtual Reality) and AR (Augmented Reality) are technologies that may not as significant as IoT at present, but they are becoming one of the core areas of many high-tech companies. Early adopters of those technologies have started to generate an increasing amount of VR and AR content through devices and apps. According to a study of Newzoo-App store (2017), at the end of 2016 AR apps had a user base of more than 5 million, whereas VR apps have been installed in more than 15 million mobile devices in China.

7.2 SMAC as a Tool to Analyze WeChat Evolution

In their study, Luo et al. (2015) have attributed the success of WeChat to three factors: capture of strategic opportunities during TP (technological paradigm) shift; effective knowledge management and organizational learning; and the integration of powerful virtual competences across sectors, firms and regions. The interactive effects of those factors have led to iterative innovation of WeChat. Luo et al. (2015) mainly studied the development of WeChat from the company's perspective, showing how Tencent has successfully orchestrated the platform innovation after reconfiguring its capabilities for adapting to new changes. Nevertheless, in a new digital era, technological shifts have greater power to influence the development of platforms like WeChat, which can either drive it to success or failure, hence it is interesting to know how the technological changes affect the platforms from the environmental perspective. For this thesis objective, it means the implications of SMAC stack on WeChat.

In the last section, strengths/opportunities and weaknesses/threats that face companies which want to expand in Chinese market have been discussed from SMAC perspective.

Based on this discussion, combined with the introduction to WeChat, it is possible to make an evaluation about the effects of SMAC stack on WeChat evolution. Table 23 is a summary of those effects.

Table 23. *Summary of SMAC stack impacts on WeChat evolution in China.*

SMAC Stack	Impacts on WeChat
S	- Since WeChat itself is a social networking platform, there is an interactive reaction between general social applications and WeChat: on one hand, social needs accelerate the development of WeChat; on the other hand, WeChat enhances the overall development and increase the coverage of social media from friend circle to public sphere - Launched as an instant messenger, the primary purpose of WeChat is for social communication and networking between friend, family members, and strangers in certain cases. - To facilitate communication between enterprise and consumers, third-party services and official accounts are developed and WeChat "Wallet" service is offered - The increased social needs such as the sending red envelop further drives the evolution of WeChat payment services - Government's tight censorship on other platforms drove users to WeChat - The use of social media in professional life and the necessity to build Guanxi for business purposes accelerates the use of WeChat for business relationship building and maintenance. - To facilitate the utilization of different social media apps, accounted can be synced between WeChat and other platforms, and content can be shared between them, e.g., the content of a live video app can be watched on WeChat by one click. - Seeing the dramatic social impact of WeChat, other giants, such as Alibaba also launched its social networking app – Ding Talk for enterprise internal use.
M	- The increased ownership of smart devices helps to grow the use of WeChat (944 million active mobile device users in December of 2016 according to Newszoo) - Increased use of 4G network and proactive roles of Chinese government and enterprises for 5G network enable a faster speed of connection and information exchange with reduced cost, accelerating the use of mobile phone and mobile social networking platform like WeChat - The difference of mobile OS has no effect on WeChat as it has different versions which offer almost the same services. - The inconvenience of downloading and installing multiple native apps drive users to follow the official accounts in WeChat which can provide similar services to the native apps, leading to development of more official accounts and the latest introduction of cloud-based Mini Programs which has the potential to significantly affect the whole app market. - The increased need for enterprise mobility drives the development of WeChat-based enterprise services such as mobile CRM (e.g. 13% out of all mobile CRM), mobile ERM, and one type of WeChat official account – Enterprise Account used for the internal communication and documents sharing at high security level.
A	- Analytics provides benefits for both Tencent and the actors involved in WeChat given the ever-growing enormous amount of data generated. - Specifically, with the further provision of WeChat-based ads, analytics becomes more important for measuring ads effects, analyzing effects, and making appropriate decisions. - The increased hiring of analytics experts by Tencent also demonstrates the company's growing interests in this area - Challenged by the security and privacy issues, WeChat may need special approach to dealing with them.
C	- WeChat open platform was built on Tencent's own cloud system, which has been evolving greatly in those years with a latest investment of $1.5 billion on cloud computing. - More collaborations between WeChat's platform and other cloud-based platform (e.g. an agreement was signed in November of 2016 with Cisco) - WeChat newly launched feature – Mini Programs are cloud-based, so they do not occupy a physical storage location on user's device. This is a big advantage in comparison to native apps.

To make the analysis simpler and clearer, the effects of each component of SMAC stack on WeChat have been discussed separately. In reality, however, the SMAC components often work as a converged force to drive the evolution of WeChat. It is known that WeChat was first released as a mobile app, so the initial success of WeChat could not have been achieved without the widespread of mobile devices. Next, the increased use of mobile devices and WeChat generate more data, leading to the growing need of analytics. Further, the huge amount of data requires a large storage capacity and computing capabilities for data analysis. A cloud-based solution is thus put into function. Lastly, the implementation of cloud computing in WeChat will further promote its evolution. In this regard, WeChat could not have become an all-in-one platform without the interactive effects of the four SMAC components. Furthermore, even all four components of SMAC stack have impacted the evolution of WeChat to a certain degree, two of them – analytics and cloud have recently started to exhibit more power on WeChat development, and are possibly to become more influential for its future evolution.

Additionally, during the research, it was found that apart from SMAC stack, new technologies, such as IoT, AR and VR, have also started to impact the evolution of WeChat as their applications are emerging in various verticals. However, unlike the SMAC components which have comprehensive and systematic effects on WeChat, the impacts of those new technologies are fragmented. For example, it was mentioned that among almost 900 million of actively used mobile devices in China, there were only 15+ million of them installed with VR apps and 5+ million with AR apps, and most of those apps are preferred by younger users, e.g., 75% of AR app audience and 65% of VR app audience are under 36 (Newzoo-App store, 2017).

For the evolution, especially the future development of WeChat, the SMAC stack mainly works as the external push. To enable a positive development of platform, a company's platform strategy and its dynamic capabilities are also vital (Luo et al., 2015). However, as the study of capabilities are too complicated to be conducted within a short period and the focus of this thesis is on the external influence, they will not be discussed in this empirical case. On the other hand, the platform strategy for continuous innovations (Isckia and Lescop, 2015) is much easier to be obtained and will thus be viewed as a focal factor that impacts WeChat evolution from company's internal perspective. Strategy directs where a company allocates its resources and how to conduct continuous improvement. The activities conducted under the guidance of strategy enable a company to create and sustain competitive advantages in a complex and dynamic context (Jiao et al., 2013). Therefore, in addition to SMAC stack, Tencent's strategy is also definitive for the evolution of WeChat. According to Tencent's "2016 Internet Entrepreneurship and Innovation White Paper", the strategy devised by Tencent for WeChat include (Tencent Innovation White Paper, 2016):

- Open platform strategy: further open WeChat, bringing more developers on the platform, and having more cross-industrial and cross-platform collaborations.

- Mobile payment strategy: invest more to support WeChat payment service providers, and increase the cross-border payment (at present WeChat Wallet service can be used in 10 currencies of 20 countries).
- WeChat IoT strategy: intend to connect three types of hardware devices to WeChat platform: personal devices (smart phones, wearables...), household electronics, and public facilities (e.g. those on parking lots)

Guided by Tencent's strategy for WeChat, shaped by the impacts of SMAC stack from the environmental perspective, and influenced by the new technological drivers, the evolution of WeChat, including its possible outlook, can be estimated. The entire analysis process is illustrated in Figure 21.

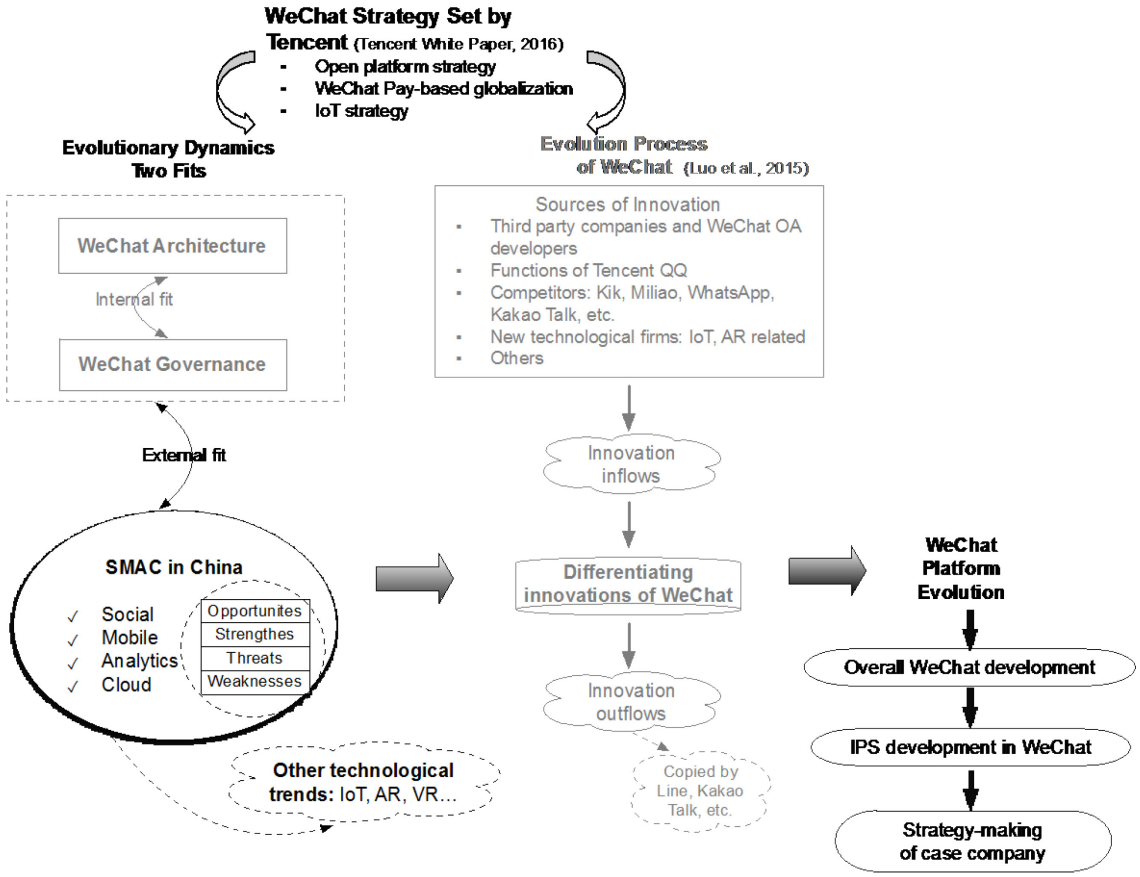

***Figure 21**. Use SMAC stack, combined with WeChat strategy, to analyze WeChat evolution.*

As demonstrated in Figure 21, once the evolution of WeChat platform is known, the application of indoor positioning in WeChat can also be assessed, which could be leveraged for the strategy-making of case company. Additionally, there are two greyed parts in the figure, the internal fit between WeChat architecture and WeChat governance, and WeChat innovation based on the bathtub model (Tiwana, 2014). The former part is out of the scope of this thesis. The latter part was mentioned in the study of Luo et al.

(2015), which could help the understanding of WeChat for its micro-innovation based evolution, but it is not closely related to the topic of this thesis.

7.3 Interviews and Lesson Learned

In the preparation for the interview, derived from the previous analysis, a picture was first drawn depicting the possible outlook of WeChat. Details of the outlook can be found in Appendix A. Afterwards, based on all the findings, a list of questions was configured and discussed during the 6 interviews with the senior managers of case company. The answers to the questions can demonstrate how the managers evaluate the analysis results, how they assess the relationships between WeChat evolution and IPS market development in China, and how they judge the potential of SMAC as a tool to analyze other platforms. Depending on the availability of managers, the six interviews were completed in April and May. All the interview questions are listed in the table of Appendix B. A summary of the interview results is presented in Table 24.

Table 24. Summary of interview results.

Interviewees	**1**	**2**	**3**	**4**	**5**	**6**
Q	SMAC helps understand better WeChat and its evolution (Y-Yes, N-No)?					
	Y	Y	Not sure	Y	Y	Y
Q	Agree with the analysis of SMAC's impacts on WeChat (current and future)?					
	Y	Y	Y	Y	Depends	Y
Q	Rank the four components (S, M, A, C) of SMAC for WeChat outlook					
	S, others	S&A, others	S, others	A, S, others	S, others	S, others
Q	Alignment between WeChat strategy and SMAC effects on WeChat?					
	Y	Y	Y	Y	Y	Y
Q	Other technological trends more critical than SMAC for WeChat's future evolution?					
	N	N	N	N	N	N
Q	Connection between WeChat and IPS development in China, and influence on case company's IPS strategy making? (S=Strong, M=Mediocre, N=None, D=Depends)?					
	D	M/D	M	S/M	M/D	M/D
Q	Feasible to use SMAC to analyze other digital platforms?					
	Y	Y	Y/ Depends	Y	Y/ Depends	Y/ Depends

As summarized in Table 24, almost all the managers reached an agreement that SMAC stack is a good and effective tool for the analysis of WeChat. One manager commented:

> "*They are interesting dimensions to use for looking at WeChat, it is a helpful way of structuring and evaluating WeChat, so (the answer is) yes*".

Similarly, another manager replied:

> "*I think it's quite powerful so you can see how these four elements actually are mapped into WeChat and about the easy-to-understand*".

In summary, through SMAC, the evolution of WeChat can be studied and understood more easily and comprehensively. The analysis with four components of SMAC cover both the width and depth of the research.

Additionally, one manager was not sure about the effects, according to him:

> *"The answer is not really, at least for my perspective. It (SMAC stack) covers different observations and degrees, but it does not explain what is the secret source that helps WeChat to succeed in the market"*.

He made a very good point from a particular perspective, analyzing the reasons for explaining why WeChat has succeeded. In this thesis, nevertheless, the focus is on the tools for analyzing evolution, which is intended for a neutral evaluation of the development process. The results may be judged as success, failure, or something including neither of them, depending on how people view the analysis outcomes.

As for the SMAC's impacts on WeChat in both current and future scenario, nearly all the managers agreed with the analysis results. For example, one manager said:

> "*It's a fair assessment, naturally the WeChat due to its nature has an influence by all the effects because the company has all the facets, the assessment of this influence is pretty fair*."

Besides, one manager has a slightly different opinion. He confirmed SMAC is a good tool to analyze WeChat, but mainly for the services related to consumer market. When enterprise market is concerned, and the data security is placed at a high priority level, he assumed SMAC might not be enough. Here is his comment:

> "*The data security is always a concern. When the trade secret or other confidential information is involved, for example, some companies prohibit the use of WeChat for discussing work-related topics, and web version WeChat is not allowed to be installed. From this (enterprise) perspective, SMAC may not be enough for analyzing WeChat*".

Actually, his opinions are in good consistence with the emphasis of analytics dimension, in which data security and privacy is a significant concern.

Regarding the ranks of the four SMAC components, managers have slightly different opinions, but majority of them agreed that social part would be the most critical driver

not only for the past and current, but also for the future evolution of WeChat. One manager explained:

> "*WeChat is a social program, the strategy is probably a good way of looking at it, probably the social part could be the core because I feel that WeChat has the best assets and has the individual accounts with the users that can crack into different components which have an identity thing which is the best of their offer. Social part is for sure WeChat's specialty and probably has the biggest influence on the future of WeChat. It's where they come from, it's where they are based up*".

Similarly, another manager said:

> *"My view is that the success of WeChat is in its social part, there might be changes in the future in terms of social, for example, the application of AI, but I believe the social is a necessity for humans, so it will continue to develop for the future*."

In addition to social part, analytics, as described by two managers, could be as important as the social part or even more critical than it. One managers assumed analytics would be equally important as the social part. He explained:

> "*As for the analytics, the customers want to see the value of their services, so the more accurate the analysis you can provide, the more sophisticated, the better would it be for the service providers*".

Another manager assumed Analytics would play greater role in the future:

> "*I believe analytics, especially big data analysis will be the most critical part for the future development of WeChat. All the other three dimensions, social, mobile, and cloud are used to converge into a productivity capacity, cumulated by data. WeChat has a good data base and user loyalty, and can generate a great amount of data and becomes a gold mine. Through data mining and analysis, new patterns can emerge, and in turn guide the social and other activities more effectively, and improve efficiency*."

Regarding other two dimensions, managers either think the mobile part is not a specialty of WeChat or believe mobile is already there and no dramatic breakthrough is expected from it or assume mobile would be presented in various forms other than phones. Moreover, most managers view cloud dimension as a foundation or infrastructure for the development of WeChat but not as a core part which can direct its evolution. One manager stated:

> "*Cloud can just provide very elementary and very basic level of services, (which) is totally different from providing like WeChat where you have wallet and everything so the added-value is huge, but for the cloud, it's very low value and the competition is high*".

In terms of the alignment between WeChat strategy and the external impacts of SMAC stack, all managers confirmed a good match between the two elements. They believe the alignment is achieved because Tencent makes its strategy based on the needs of customers which are shaped by the environment and Tencent always takes into account the power of market demand and dynamics. In certain cases, as stated by one manager, the company is too carefully listening to the market need to become somehow conservative in launching new features,

Comparing the SMAC stack with other new technologies, such as IoT, AI, AR & VR, an uniformity is again reached among all the managers, who believe that SMAC is an effective tool for analyzing WeChat, for both its past evolution and future development. For example, one manager argued:

> "*I think one would think this SMAC is quite close to our current reality, and when you think about how to develop things in the next few years, this SMAC thing covers pretty well. The other trends, for sure they will somehow influence what WeChat is doing but I'm not so sure how much there would be*".

Generally, managers believe those new technologies are less powerful than SMAC, especially from analysis perspective. Some managers consider IoT and AI as the sources for generating data to serve social and other purposes, and some think AR and VR are mainly used for entertainment or games or other engagement but not for services that can be perceived indispensable. The comment of one manager may summarize well the point:

> "*in the end, it's not a matter of technology but a matter of what service you can provide which would entertain or answer people's need. SMAC for me is an analysis tool, AR and VR can only add the interactivity of WeChat but they would not change the nature of SMAC concept. AR and VR based chat and calls are very possible in the future but SMAC will remain in the place, so those new technological trends will not take the place of SMAC*".

As for the connection between the development of Chinese indoor positioning market and the evolution of WeChat, most managers think there is no strong connection between the two, especially on the WeChat side. From WeChat perspective, its success is not dependent on indoor positioning services but has been achieved before the indoor positioning services emerged. However, from the IPS perspective, they agree WeChat is an important platform where indoor positioning services are emerging more, and companies better consider it as a critical channel for launching indoor location services in China. According to

the managers' common comments, the reason for this consideration is somehow straightforward: companies can access a large number of consumers with reduced cost and better effects within a shorter term, on leveraging the ever-growing user base, the loyalty of users, and the widely involvement of companies and developers from various verticals. Hence, WeChat cannot be ignored when setting expansion strategy in Chinese market, especially for the services launched for consumers. Below is a snapshot of different managers' opinions:

> "*WeChat works quite well without that components (IPS), it has many in the basket and IPS is probably not the most important one for them*".

> "*I don't think there is a very strong connection between WeChat and IPS because WeChat doesn't need IPS to succeed. I mean, it will be successful even without IPS… (As for the strategy), obviously WeChat is such a huge platform so you can reach hundreds of millions of people, tens of thousands of venues, so definitely it is an opportunity, but we have to really understand now how we use, or what is the opportunity for us to use it. But anyway it is clear that WeChat is very powerful and even though the connection is not so strong, there is a connection, and then the size of WeChat is making even the weak connection very valuable, so it definitely rules out any standardized application, so if you invest in application, it has to be part of WeChat. The trend will not change because the volume is so huge*".

> *"If anyone considers launching indoor positioning or indoor services in China, they should right away consider WeChat as one of the platforms, for example when you extend your coverage in shopping malls or similar places, especially when it comes to public venues".*

> *"It is difficult to predict how the relevant strategies would be like, but if I were the strategy maker, WeChat would actually impact my marketing strategy in China, as the speed of expansion can be significantly increased through WeChat*".

On the other hand, as explained by certain managers, even the relevance is certain, the actual strategy making is complex as the process involves a range of factors. First, WeChat is more consumer-oriented, and indoor positioning can be applied in areas beyond consumer market, such as the robots used for industrial automation. Second, even in consumer market, the launch of indoor positioning services is not only related to software development, but the deployment of hardware is often required. In this regard, even WeChat provides common tools for solution development and works as a common place to enable an easier access to partners and users, the solutions still need to be implemented individually for different cases. Because of this, additional factors must be considered for the strategy making. Third, the strategy-making is a company-specific process, a series of procedures and people are involved, hence it is hard for one person to state what kind of strategies are to be made, even at the high level.

Finally, regarding whether SMAC can be applied to analyze other digital platforms, most managers confirmed this feasibility and agreed SMAC could be a good tool for analyzing many different platforms. One manager confirmed as:

> *"The width and depth of analysis with SMAC are good enough, and the hot topics related to the existing technologies are all included in this SMAC. You can use it to analyze not only WeChat, but, say, other internet companies, or service products"*

Despite of the confirmation for the feasibility, it is reasonable to imagine that SMAC is not an omnipotent tool that can be used in all cases. For instance, there is already a disparity regarding the use the SMAC for analyzing the OLP (open location platform) of case company. In the discussion, one manager was hesitant to use SMAC for analyzing this platform. He emphasized that the location platform is designed for developers not for consumers; thus, the lack of social feature makes the adoption of SMAC stack inappropriate. He stated:

> "*The use of SMAC may not be suitable here because this OLP works as an integrator to enable other consumer-faced services, and the social services offered are not visible to the consumers".*

Interestingly, another manager agreed that the case company's platform is indeed targeted at developers, but he also mentioned the indirect relevance of social factor via the developers who work with the platform or via SDKs (software development kits):

> "*I think the OLP story is still at the moment aimed towards the developers, through the developers we can access the consumers…We should have something (of OLP) by the end of this year, but it's been missing this social so it would be kind of nice to see… There is none (social) for our OLP, but you analyze our SDK, then that would be different story, not so much about analytics, but more about maybe social part, because you can then build apps."*

Based on his comment, the missing of social feature in OLP is certain, but it is still interesting to map the platform with the addition of social elements due to the indirect connection.

Moreover, not directly mentioning the target segment of the OLP or the social relevance of this platform, a manager was more interested in the definition of social dimension and application of social context. According to him, locations, especially people's locations, are usually a building block of social context. He said:

> "*It's again a question of what you consider a social, right? I think it's not going to be a communication protocol where we want to focus on, but it's something like, if you, for example, know where a person is, or going to be, or was, or whatever, can derive a lot of social context along this. I think that is basically what a social*

component is. It (people's location) is helping create a social context, which is quite important".

To supplement, one could argue that the application of SMAC is not only limited to social-related platforms, mainly for two reasons. First, even SMAC contains four components, it does not mean that all four dimensions should be present. In the evaluation, some factors might have more weight than the others, or totally replace others. Second, in some cases, as commented by some managers in the interview, a platform might only work as an enabler or an integrator and the social part is not directly demonstrated in the current offerings, but the final products are generally aimed at consumers. When consumers are involved, social feature is often unavoidable. Under this condition, the social part determines the feature of final product offerings, which will in turn determines the features of the upstream or midstream products. As a result, social part can indirectly guide the development of non-social platforms. Therefore, for the non-social platforms, SMAC might still be useful as an analysis tool. However, in order to prove the applicability, more research is required.

As a conclusion, based on the interview results, several insights can be gained regarding the real adoption of the SMAC stack for analyzing digital platforms. One, for the future development, in the case of WeChat, as agreed by most managers, social dimension would continue to play a leading role. As for the other non-social platforms, social feature may not be ignored because almost all final offerings of platforms are targeted at consumers and social factor can either directly or indirectly guide platform's future evolution. As for the other dimensions, analytics may gain more weight, mobile might be transformed into other forms, while cloud is mainly viewed as a critical pillar for infrastructure deployment. Two, the emergence of new technologies, including IoT, AI, AR and VR, would not affect the use of SMAC, as they are seen either as a subset of analytics that can generate and consume data, or as an integrator for improving social and mobile services. Three, strategy-making is a complex process involving a lot of procedures and functions. If a new strategy to be set is in relation to a platform, for example, a strategy for new product development that takes advantage of the platform SDKs, or a strategy for launching a marketing campaign that leverages the platform user base, a cross-functional study is often required before any decision is made.

8. CONCLUSION AND DISCUSSION

In this highly-digitalized, fast-paced and customer-driven economy, driven by the advancement of different technologies, a variety of new industries and business fields have emerged. To obtain a first-mover advantage, companies operating in the new businesses often choose to act as early as possible. However, due to the unclear feature of the new technology and the uncertainty of emerging business area, it is not easy to find an appropriate expansion strategy. Meanwhile, the convergence of various technologies has been focusing on four dimensions: social media and networking, mobile and mobility, analytics, and cloud, leading to the creation of a new term - SMAC. In this context, a new digital era starts to reshape the whole business world, and some digital platforms become powerful not only to win their own industry but also to start offering services in other industries, including sometimes the emerging areas. In this regard, platforms seem to be useful for companies to expand in relevant fields. However, as the digital environment is highly dynamic and the platforms are always evolving, an effective tool is needed to evaluate to which degree those platforms could be useful.

The objective of the thesis was to see if SMAC could be used as a tool to evaluate platform and its evolution. For this purpose, literature study and empirical research were conducted. Platform approach was reviewed first to introduce the four research streams, followed by the discussion of platform classification, characteristics, and evolution, as well as the presentation of SMAC in terms of its origin, development, and impacts on the business world. Based on the literature review, a theoretical framework was built containing elements related to platform evolution. Afterwards, guided by this framework, case of WeChat was studied in the Chinese context with a focus on indoor positioning. To have a broad and deep evaluation of WeChat, the influences of SMAC stack on overall Chinese market and on WeChat platform were analyzed in combination with the introduction of indoor positioning technologies and applications. Finally, to prove the effectiveness of proposal, six interviews were conducted with the managers of the case company.

After the research, all the research questions mentioned in the Chapter 1 have been answered. First of all, platforms and platform evolution have been clearly explained by a broad literature review, including the explanation of various concepts and theories. In addition, the impacts of disruptive technologies related to SMAC dimensions have been discussed not only at the general level but also in the Chinese market context, demonstrating how SMAC has driven the transition of business world. In order to evaluate the relationship between platforms and SMAC, WeChat was analyzed as a specific case. Moreover, the influence of technologies other than SMAC, such as IoT, AR, and VR, have been discussed and compared with SMAC in both market research and interviews.

Furthermore, to prove the effectiveness of the proposal, relevant questions were asked during the interviews with the managers, who either strengthen the existing findings or add more insights from different perspectives.

The outcome of the thesis proved the effectiveness of the proposed solution from two aspects. On the one hand, WeChat was studied with the help of SMAC stack to show how it has evolved and has become an all-in-one platform. Also, taking into consideration of the additional elements, such as the platform strategy and new technological trends, it is possible to estimate the future evolution of WeChat. On the other hand, based on the results of interviews with the managers of case company, the connection between WeChat evolution and new market strategy is confirmed, and the use of SMAC stack is indeed helpful for a better understanding of the platform and its evolution. Also, managers agreed SMAC could be a useful tool for the analysis of other platforms, even there might be special cases that require particular attention. Therefore, the outcome of this thesis not only proves the effectiveness of proposals for the case company, but also confirms the usefulness of SMAC stack as a tool to analyze varying platforms, and shed light on the expansion strategy adopted by technological companies that want to provide services in relevant fields.

Based on the outcome, several insights have been gained for the adoption of the SMAC stack as a tool to analyze digital platforms. First, SMAC is indeed an effective tool for analyzing various platforms, but more study is required for non-social platforms. Second, for social-based platform, such as WeChat, social part continues to play main role in the future, while for non-social platforms, social features might indirectly impact the platform evolution. Third, mobile may be presented by more and different forms in the future, analytics will grow its weight, and cloud tend to be a critical infrastructure pillar. Forth, new technological trends are less important than SMAC from a systematic analysis perspective. Finally, strategy-making is a complex process that involves a variety of procedures, functions, and people, and a number of prerequisites must be met before a solution is put into place. Consequently, an expansion strategy cannot be easily made even the platform has a considerably positive relevance in the business.

The findings of this thesis can make contribution to managerial discipline from two dimensions. First refers to the management theory. It is known that the respective studies of platform and SMAC stack have been started very recently, and few people have purposefully discussed the connections between those two concepts, or at least not in a systematic manner; therefore, the findings of this new research can add good points to the theoretical study. Meanwhile, in this new digital area when all organizations are going through a digital transformation and when the convergence of technological shifts is becoming common, enterprises, CIOs (Chief Information Officers), and other involved players must be aware of the changes and make appropriate decisions in the near future. Hence, this topic is also interesting in a sense that practical advices can be proposed to people who are hesitant in a context that is full of new technologies and applications.

Apart from the managerial contribution, the thesis has its limitations. First the study was conducted only for one platform. Even questions were asked in the interviews about other digital platforms, it is still too limited to conclude that SMAC tool could be used for all types of platforms. Just as one manager mentioned in the interview, it is doubtful to apply the SMAC for non-social platforms; thus, more study is required to prove a broader adoption of SMAC stack. Second, the literature of SMAC is scarce. Even the term has been adopted by some scholars, IT professionals, and consulting companies, a systematic and comprehensive study on SMAC is still missing. Researches on one element of SMAC, e.g., the mobile operating systems, or the social media policies, are available in the literature but they are scattered. In this context, two streams of study can be conducted in the future. On the one hand, in order to understand more about SMAC, a standardization of the terminology is needed and a wider application of SMAC is necessary. On the other hand, it would be valuable to apply SMAC for analyzing different platforms functioning in different industries, especially the platforms not directly featuring social elements.

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APPENDIX A: WECHAT OUTLOOK

SMAC Stack	WeChat Outlook
S	- More developers from varying industries will be involved for the creation of official accounts and Mini Programs - WeChat "Wallet" services will be used as a main driver for its globalization process - Continuous and increasing use for Guanxi building for business purposes - More cross-industry and cross-platform collaboration for either adding social features in other platforms (e.g. case company's own platform) and bringing non-social services in WeChat platform - Application of new technologies (IoT, AR, and VR) for social use - For IPS Chinese market, WeChat will definitely play a core role
M	- The increased ownership of smartphones and the increase of speed for mobile data transfer will continuously drive the use of WeChat in China - Chinese mobile app market will be affected if the launch of Mini Programs becomes a success (tend to be a long-term effect) - Increased development and implementation of WeChat solutions for enterprise mobility - Positive for using WeChat as a basis for IPS market development in China
A	- Analytics will play main role in the future for both WeChat and its collaborators - Issues such as the lack of analytics professionals and the concerns of security & privacy must be solved ASAP, which is negative for launching more IPS services in WeChat (e.g. lack of experts to analyze the effects of ads launched on a IPS basis)
C	- More investment on Cloud and more collaboration with other cloud service provides represent a strong support for WeChat future development (e.g. storage, mini programs, analytics) - As a main cloud service provider for other Chinese companies who want to go global, Tencent's cloud strategy might also help to promote WeChat globalization since the services of those companies are sometimes related to WeChat. - This is also positive for IPS applications in WeChat

APPENDIX B: INTERVIEW QUESTIONS

Interview Questions
1. Do you think the analysis with SMAC helps you to understand WeChat and its evolution?
2. Do you agree or disagree with the influence of SMAC on WeChat?
3. If disagree, what is your opinions on the effects?
4. Either agree or disagree, please rank the four components of SMAC stack based on their weight to the future evolution of WeChat and give your reasons.
5. How do you think the impact of Tencent strategy on WeChat? Is the strategy aligned with the effects of SMAC or not? If not, please give your reasons.
6. In addition to SMAC, what's your opinions of other technological trends, such as IoT, AR, and VR? Do you think those trends are more important than SMAC, and which one in your opinion would be more critical for WeChat future evolution?
7. Based on the previous discussion, do you think the evolution of WeChat has a strong connection with the development of Chinese IPS market? If yes, how does this affect the company's strategy for market development (strongly, mediocrely, or not at all)?
8. Finally, do you think SMAC is a good tool for analyzing platform evolution, and can be used for analyzing other platforms, e.g. case company's own platform? If not, what is missing there?