

Emergence of a Post-App Era – An Exploratory Case Study of the WeChat Mini-Program Ecosystem

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Abstract. Mobile applications (apps) have long fueled the growth of digital business models. However, an increasing reluctance amongst smartphone users to download them has surfaced. For services of infrequent use, it is questionable whether native apps and their respective app stores still offer a suitable development strategy. In China, a novel phenomenon responds to the debate, introducing lightweight micro-apps embedded into the social messaging platform of WeChat. Known as Mini-Programs (MPs), WeChat enables third-party developers to create light apps within its own infrastructure, essentially creating an ecosystem of apps within an app. Supported by an exploratory case study, we shed light on this platform innovation and investigate its implications within the field of mobile platform ecosystems. Our findings implicate that the one-size-fits-all approach of native apps as a general-purpose technology does not meet specific needs of platform users and could be supplemented by innovations such as MPs to fill the gap.

Keywords: Mobile Platform Ecosystems, Platform Innovation, Multi-Sided Platform Ecosystems, WeChat, Mini-Programs

1 Introduction

Today's user expectations towards modern day services reflect a common "there's an app for that" mindset. However, despite the growing size of today's app stores, 65% of American smartphone users download zero apps per month [1]. Not only is it a burden to select from an abundance of fragmented apps, the inevitable process of prior installation poses a great barrier for many mobile users. Having to physically download, install and store an app on one's device significantly decreases user experience, hinders user acquisition and limits the selection of instantly available apps to the few that actually made it past the download barrier. For services used every once in a while, such as food delivery, courier or ride-sharing, high costs of initial adoption typically arise and often even outweigh their perceived value. While such challenges currently reflect the as-is of digital mobile platforms in the West, platform innovations in the East already illustrate a potential future landscape.

15th International Conference on Wirtschaftsinformatik,
March 08-11, 2020, Potsdam, Germany

Specifically in China, to access services regardless of their usage frequency, users can directly launch apps on the spot without the need for prior downloads, sign-ups or inputs of payment details. These apps run as so-called Mini-Programs (MPs), which are lightweight micro-apps hosted on the Chinese messaging platform of WeChat [2]. Since the introduction of WeChat MPs in 2017, many brands and services stopped building native apps, “choosing instead to live entirely in WeChat’s world” [3, p. 59]. For smaller companies and start-ups that cannot afford to develop native apps, this opened up a new possibility to build digital business models. As the direction of both hardware and software technologies is moving towards products that are “micro, light, and small” [2], MPs have extrapolated this trend onto mobile apps.

The rapid adoption of MPs [4] and their transformative impact on the perception of smartphone usage in China is no longer negligible in the research of mobile platform ecosystems. However, outside of China this emerging platform innovation is still underrepresented in public discussions and literature. It conspicuously “stands out as one area where China is really forging ahead into unknown and exciting territory” [5]. Hence, this topic sparks a debate about whether the future will be driven by micro-apps, rather than traditional apps. It fuels speculations, whether this development is leading towards a post-app era, with MPs already racing ahead. These notions are the drivers behind this study’s motivation to explore whether WeChat is on its way to becoming the alternative to traditional app stores in China. We thus pose the research question *what is the impact of WeChat MPs on app developers in China and how are MPs affecting the traditional mobile app environment?*

To answer the research question, we analyze the case of WeChat MPs as an exploratory case study, taking on the perspective of mobile app developers. By conducting 11 qualitative expert interviews, we gather primary data on-site to support the empirical analysis. We discover the distinctive features and value propositions of MPs, including the trade-offs mobile developers face when deciding whether to rely on MPs instead of native apps. By providing insights into a landscape in which a large part of businesses are moving away from native apps, we illustrate that a one-size-fits-all mobile app approach does not suffice for all types of digital businesses and services.

2 Background: WeChat’s Mobile Platform Ecosystem

To understand the emergence of WeChat’s MPs as lightweight micro-apps, we develop a pre-understanding of WeChat as a mobile platform ecosystem and review prior theory concerning limitations currently faced within mobile app development.

WeChat was first introduced as a Chinese social messaging app in 2011 by mother company, Tencent. Focusing on its core functionalities as a messenger, WeChat gradually expanded to include hold-to-talk voice messaging, group messaging, photo- and video-sharing [6]. Thus, the initial version of the app was designed as a one-sided platform, on which only one group of users interacted. As pointed out by Staykova and Damsgaard [6], the switch to a multi-sided model occurred in August 2012 with the introduction of public accounts. This feature allowed brands to enter the WeChat environment and interact with customers within the social platform. The transition

continued with the integration of WeChat Wallet in 2014 [7], allowing WeChat to partner up with local city services to provide additional functionalities within the platform. For example, daily tasks such as paying bills, booking cinema tickets, ordering taxis, peer-to-peer transactions, and physical payments were now digitally accomplishable via WeChat. More and more services were transferred into the online space of WeChat, revealing the platform's strength of integrating online and offline (O2O) experiences. With the introduction of MPs in 2017, an ecosystem was created for third-party developers to offer lightweight apps to WeChat's large existing user base [2]. This event marked a new chapter of platform innovation on WeChat, further extending its proposition as an all-in-one-app [7] to a super-app [8].

This came at a time, during which mobile app developers were increasingly facing difficulties to competitively position their apps on the compatible app stores, which were predominantly Apple's App Store and Google's Play Store. A growing body of literature concerning the many challenges of developing and distributing native apps through these dominant app stores arose. Prior studies address the high degree of intraplatform competition [9], low user retention and stickiness rates [10, 11], challenges of multihoming¹ across operating systems [12], limited exposure due to winners-take-all effects [13] and the high costs of revenue-sharing [14]. Consequently, a general consensus that developers are restricted by app stores' efforts to primarily serve their own interests has begun to emerge. Tilson et al. [14] observe the dynamics within mobile platform ecosystems to have a "take it or leave it" [14, p. 5] nature, in which complementors have little bargaining power to voice their concerns. They show that native app stores represent an "obligatory passage point" [14, p. 5] for both the distribution and discovery of mobile apps. As a result, complementors are not able to circumvent their regulations and are legally bound to their agreements. This includes the revenue-sharing scheme, in which app stores typically take 30% of complementors' revenues made through their platform ecosystems [12, 14].

However, in the same paper Tilson et al. [14] entertain the possibility that the control of platform owners may not be as rigid as portrayed. Eaton [15, p. 187] further extends this notion and debates that third-party complementors do indeed have the capability to challenge the control of platform owners by influencing architectural innovation. Developers can increase their bargaining power in regards to app stores and thus affect the approval regulations on platform innovations. Eaton [15] points to the current lack of empirical evidence to support this notion, which we respond to with the empirical analysis of WeChat's platform innovation of MPs.

3 Research Design

This study adopts an exploratory case study approach [16] to investigate the role of MPs within the Chinese mobile ecosystem. We chose a qualitative approach, because first, it is essential to consider the contextual conditions of MPs, which are not only embedded into the super-app of WeChat, but more importantly bound to the unique

¹ Multihoming: Catering to multiple platforms (in this case: mobile operating systems).

environment of China’s internet landscape. Second, the boundaries between the phenomenon under research and its context are blurred [17]. Third, the study does not seek to find a clear, single outcome [16] but rather to provide a holistic view of the phenomenon within its context. Lastly, qualitative approaches are particularly pertinent in the socio-technical sphere, in which technological change is impacting behavior. The introduction of MPs has caused technological change within the Chinese mobile ecosystem, affecting the way people perceive and interact with their mobile devices.

The primary data sources were two sets of, in sum, 11 expert interviews that we conducted in the unique and pre-determined research setting of China. The sampling process led to the identification of two groups of experts: WeChat experts and MP developers. The first group represents individuals, both Chinese and foreigners, with extensive experience in China’s rapidly evolving technology scene, particularly with the WeChat ecosystem. They are reporters, social media marketers and consultants. The second group is formed by software developers, who have in-depth MP development experiences. The selection of the interviewees was facilitated on LinkedIn by searching for profiles associated with “WeChat Mini-Programs” and further through referrals within their expert networks. The interviews were guided by semi-structured interview protocols, recorded and transcribed. After the tenth interview, it became evident that the input had reached a saturation point, such that further data collection beyond this point would not likely provide novel findings [18]. The 11th interview served as confirmation for this assumption.

For coding and analysis of the gathered data we followed an inductive approach relying on procedures from grounded theory methodology [19] with the aim to provide rich descriptions of a new phenomenon [19, 20]. First, open coding was used to examine the data line-by-line. In this step, 273 codes emerged from the 11 expert interviews. These were associated with 736 quotations. Second, axial coding was performed to consider the similarities between the many different codes. As a result, 25 subcategories had been detected and labeled, which condense and categorize related open codes to a more manageable amount of codes. These subcategories were then grouped to form 9 categories. An exemplary excerpt of the coding structure is portrayed in Table 1².

Table 1. Illustration of the Coding Structure

<i>Open-coded quotations</i>	<i>Subcategories</i>	<i>Categories</i>
<i>“I personally think that, [...] most apps can be replaced by MPs¹. I think that maybe for bigger, heavier apps - you can break it down into several MPs that serve different purposes.² But honestly, people have become so used to using MPs these days³ that I think a lot of times they would rather just use the MP instead of having to download the app^{1,4}.”</i>	1) Disruptive impact 2) WeChat strategy 3) Significance of MPs 4) Bridging gap between user and services	<ul style="list-style-type: none"> ▪ Impact on native apps ▪ China business strategy ▪ Mass adoption ▪ USPs of MPs

² The full coding scheme is available from the authors.

4 Results and Interpretation

In this section, we first describe the emergence of WeChat MPs to frame the context, in which the following narrative is set. Then, we highlight the trade-offs developers face when choosing to implement MPs.

4.1 Emergence of WeChat Mini-Programs

Since its introduction in 2011, WeChat has constantly undergone platform innovations and pursued a feature bundling platform expansion strategy [6], creating a dynamic multi-sided platform ecosystem. The recent introduction of MPs in 2017 further extended the concept of an all-in-one app [7], allowing third-party developers to create apps that reside within WeChat's ecosystem. The idea of an MP is rather simple: An MP is a lightweight sub-application within the ecosystem of the social messaging app WeChat; essentially making it an app within another app [21]. Characterized by its maximum size of 10 MB, an MP is small enough to directly run on WeChat's interface. MPs do not require prior download nor installation, making them instantly available on any smartphone that has WeChat installed. To date, MPs have achieved high rates of adoption with over 230 million daily active users (DAU) and an MP count exceeding 2.3 million in the ecosystem [22]. Due to the app-like experience and the diverse implementation possibilities, MPs have been adopted across 200 industry segments and are continuously growing [22].

MPs have already managed to establish themselves as an integral role in people's everyday lives. They have become such a wide-spread phenomenon that, from a user's perspective, MPs have become the norm for getting things done. If given the choice between a native app and an MP with identical capabilities to obtain a certain service, people will in most cases turn towards the MP. One interviewee revealed: *"This idea of not having these app on your phone is incredibly powerful."* (I11, MP Developer).

Apart from changing people's interaction with mobile services, MPs have also begun to change people's perception and expectations of mobile app usage overall. One interview partner shared: *"They change the way both companies and people perceive using applications in general. Because now, when I think about needing to send a package from one place to another, I do not think about downloading a native app. I go into WeChat and I search for MPs that do that [...]."* (I9, MP Developer).

MPs have five unique selling points (USPs), which make them particularly attractive for smartphone users. First, they circumvent the need for prior download and thus bridge the gap created by the download-barrier, particularly for apps of infrequent usage. Second, they serve as simple utilitarian tools addressing one specific problem, which increases their usability in terms of efficiency and effectiveness. Third, they seamlessly integrate O2O experiences, which has opened up novel possibilities for companies to interact with their customers. Facilitated by Quick Response (QR) codes, an MP can be accessed from any physical location, allowing brands to send their customers from an offline environment straight into an integrated O2O experience. Fourth, MPs enable fluid social shareability as brands leverage WeChat's strong social features and benefit from high social traffic and the power of word-of-mouth. Fifth,

MPs significantly increase convenience overall through their increased ease of access, simplicity of usage, the seamless user experiences within WeChat and the instant availability granting users the flexibility to launch them at any given time.

Despite the mass adoption of MPs across industries, a lot of limitations are still encountered. *“They don’t cover the full spectrum, they’re simply too limiting”* (17, WeChat Expert). Throughout the course of MPs’ evolution, WeChat has addressed many of their limitations with both efforts to improve the ease of development and to enhance the user experience. A notable update came with the version 7.0.3 in January 2019, which incorporated a new feature resembling a home-screen (Figure 1). There is now a space within WeChat, where users can “pin” and store the MPs that they frequently use. By pulling down the chat screen, users can access all their pinned MPs. This update quickly attracted the attention that WeChat increasingly resembles an operating system, fueling speculations about the implications for native app stores.

The evolution of the MP ecosystem is characterized by WeChat’s progressive changes, presenting opportunities for new use cases to constantly emerge across industries. This makes WeChat MPs a particularly relevant case, demonstrating where mobile platform ecosystems could be headed and challenging the debate of future mobile app usage with a perspective beyond the predominant Western approaches.

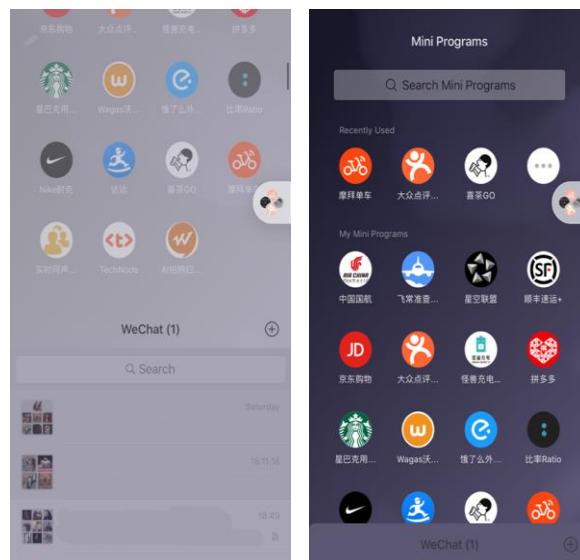


Figure 1. Screenshots of the Mini-Program “Home Screen” with Update 7.0.3

4.2 Mini-Programs’ Trade-Offs for Developers

This section summarizes the findings regarding the advantages and limitations of MPs as four trade-offs that developers face. These findings are based on insights from the interviews, which have been clustered as part of the coding process. Although both aspects had initially been analyzed separately, it has been found that most of them merge to form trade-offs.

Table 2. Perceived Trade-Offs of Mini-Programs

<i>Advantages</i>		<i>Limitations</i>
Lightweight and Low Cost	vs.	Limited Functionalities
Integration into WeChat's infrastructure	vs.	Tencent's Rules and Restrictions
Multiple Entry Points	vs.	Limited Discoverability
Trend and New Opportunities	vs.	Immature Technology

Lightweight and Low Cost vs. Limited Functionalities: To begin with, MPs are lightweight and thus very fast. Restricted to a size of maximum 10 MB, MPs load very fast and are cached on the smartphone [23, p. 16]. Because they load directly from Tencent's servers, MPs automatically run their latest versions. The second advantage in this trade-off concerns the low costs associated with the development. This lowers the entry barriers for developers significantly. Though Tencent provides a proprietary framework, WeChat's programming languages are very similar to universal ones such as HTML, CSS or JavaScript. This remarkably lowers the initial learning costs for developers. Additionally, MPs do not require distinctive versions to cater different operating systems, which further minimizes costs notably. Because less recourses are required, the development process is very fast, enabling developers to release their products very quickly. It is estimated that the associated costs reflect 20-50% of the cost for native app development [23, p. 16].

Opposing these advantages, MPs are limited in their functionality, size and storage space. More complex functions cannot be done within the MP framework, which may appear limiting to certain developers.

Integration into WeChat's Infrastructure vs. Tencent's Rules and Restrictions: Being embedded into WeChat's infrastructure is a big advantage for developers. First, WeChat's app programming interfaces (APIs) and its JavaScript Standard Development Kit allows developers to integrate WeChat's functionalities with their MPs. These include, WeChat's QR Code scanner, WeChat Pay, WeChat Login, geo-location, accelerometer, template messages and more. Second, Tencent manages configuration considerations as explained by one MP Developer: "[...] *different phones have different screen sizes. When it comes to Android phones, they might even have completely different functionalities. [...] [Tencent] take[s] care of a lot of these configuration problems for you. That's a huge benefit.*" (19, MP Developer).

On the contrary, an MP is restricted to the ecosystem of WeChat, which restricts developers to the Chinese market. While Tencent is constantly making changes and defining new rules, MP developers have to abide by them. Additionally, prior to the official launch and every new update, approval by Tencent is required.

Limited Discoverability vs. Multiple Entry Points: The limited discoverability has been a disadvantage since the beginning of MPs. The increase of possible entry points arose out of this limitation. The opportunities for MPs to gain exposure was very limiting at first. For a user, it is difficult to find an MP organically, because as one interview expert states "*There is no real app store.*" (19, MP Developer). They are hidden within the WeChat ecosystem, and therefore do not drive a lot of traffic. Unless

they are shared by friends or discovered offline through QR Codes, uncovering new MPs without prior brand awareness is restricted.

Though discovery is still a concern, Tencent has addressed it by opening up many novel entry points for accessibility. According to the report by 31Ten [23, p. 16], there are over 60 entry points to date. Out of these, social sharing is the most common method of entry, attributing to 34.6%. This is followed by quick entry accounting to 25.9%. The latter was enabled by WeChat's update, introducing the new home screen-resembling space (Figure 1). Other methods include access through Official Accounts, offline QR codes, direct search etc.

Trend and New Opportunities vs. Immature Technology: MP developers that have started when they were first introduced have experienced the difficulties of poor documentation and constant changes. The development process itself is not complicated. Understanding the documentation and Tencent's rules were the primary challenges at first. Especially for foreign developers who cannot read Chinese, this was not an easy process. As a result, it involved a lot of trial-and-error, learning-by-doing and asking for help within developers' communities. Because MPs are still relatively new, many additional rules are constantly added and changes happen quickly. MP developers need to react and adapt to them very fast. This is a trade-off to the opportunity of engaging with new innovations and developing trendy products. MPs open up novel possibilities that developers can incorporate into businesses. Moreover, regarding developers' personal interest, it is a domain that they can currently only explore in China. Above-quoted developer adds: *"You know it's exciting, it's new. And nobody really knows where it's going to go from here. There's a lot of hope. It has a lot of potential."* (I3, MP Developer).

5 Discussion

This chapter discusses the characteristics regarding MP development derived from the empirical analysis. By comparing the features of MPs with those of native mobile apps, the study investigates if, and in which cases an MP is a viable substitute to a native app. Based on this discussion, implications for the future role of native apps are presented. Finally, in light of the evaluation, speculations regarding how platform owners may address alternatives to native apps in the future are touched upon.

5.1 Value Proposition of Mini-Programs vs. Native Apps

To provide a comparative overview between MPs and native apps, certain attributes have been selected to illustrate their respective characteristics (Table 3). The aim is to portray the key features identified in the results section and illustrate the areas in which either MPs or native apps surpass one another. In addition, the selection was further reinforced by frameworks proposed in papers that have compared native apps to other types of mobile apps [24, 25].

Table 3. Comparison between Native Apps and Mini-Programs

<i>Attribute</i>	<i>Native Apps</i>	<i>Mini-Programs</i>
<i>Access to Customers</i>	Users of smartphones with compatible operating system	WeChat’s user base
<i>Discoverability</i>	Listing in app stores, ratings and review	Limited to O2O and shareability
<i>Distribution Constraint</i>	Limited to respective app stores, its rules and revenue sharing	WeChat’s rules and restrictions
<i>Portability</i>	Restricted	Unrestricted
<i>Development Costs</i>	High	Low
<i>Development Support</i>	Advanced development tools	Improved development tools
<i>Trialability</i>	Low	High

Access to Customers: Native app owners have access to users of the respective app stores through which they distribute their products. Google Play has a user base of over 1 billion MAU [26], while Apple’s iPhone install base accounts to 900 million [27]. Simultaneously, WeChat surpassed the 1 billion MAU mark in 2018 [28]. It is noticeable that the size of the user bases across the three ecosystems is similar³. However, while the access to customers is fragmented across the different app stores for native apps, MPs retain access to anyone who has WeChat installed, regardless of the smartphone’s underlying operating system and version.

Discoverability: For both native apps and MPs, discoverability is highly limited. Native app stores are characterized as hyper-competitive markets, in which new apps struggle to achieve visibility amongst the millions of other apps in the ecosystem. As Bresnahan et al. depict, [12], native apps have to rely on ratings and reviews to stimulate discovery and aim to get featured on ranking lists within their respective categories. Similarly, MPs also face the disadvantage of limited discovery. Although there are over 60 possible entry points to access an MP, most of them require prior brand awareness. In only a few cases, users can discover completely new MPs, such as the offline access through QR codes or the access through shareability. However, even in the latter case the MP relies on the word-of-mouth effect to gain traction.

Distribution Constraints: Native apps can only be distributed via their respective app stores. In the iOS case, the App Store represents an “obligatory passage point” [14, p. 5], the only channel through which an iOS app can be distributed. Apple’s centralized control of its app store also exerts censorship on whether an app gets approved. As shown by Tilson et al. [14], app stores typically extract a 30% commission from developers’ revenues, decreasing complementors’ motivation to innovate. MP owners currently do not pay such a fee. However, they are restricted by the rules set by Tencent and remain within the walled gardens of the WeChat ecosystem. Approval processes have become more rigorous since 2017. Difficulties may include setting up a developer’s account, getting required certifications and category-specific licenses or

³ It is to be noted that Google Play is banned in China.

content-related censoring. In terms of maintenance, every update to the app will need to be re-approved by the respective platforms in both cases.

Portability: The development of native apps are platform-specific and therefore not portable across different platform environments [25]. For an app to run on a different operating system, it needs to be completely built anew. Given the stark contrasts between the platforms' software development kits and the different capabilities of smartphone devices, this is a challenging task for software developers [29]. This also means that maintenance requires cross-platform handling. On the contrary, MPs are portable across operating systems and hardware devices as long as WeChat is installed. WeChat also supports MP developers with configuration issues to tailor their MPs to the specifications of different devices.

Development Costs: As inferred from the above-mentioned fragmentation issue, native apps are associated with high development costs. These are caused by factors such as the complex development process of building heavier apps, the incompatibility between mobile platforms, the revenue-sharing schemes with the respective app stores and the high maintenance costs. In comparison, MPs forego many of these factors by being integrated into WeChat, which drastically lowers entry barriers for developers, reduces time-to-release, speeds up customer feedback and allows easier maintenance.

Development Support by Platform Host: Native app developers can make use of a wide array of development tools provided by their respective platform owners. For example, these include hundreds of features, APIs, software development kits, debugging tools and performance analysis tools [14, 25]. MP developers had little support when they first started. However, compared to native apps, MPs are typically much simpler to develop. Given that WeChat, as the platform host of MPs, is a native app itself, MPs can take advantage of WeChat's native app capabilities. Additionally, WeChat offers UI frameworks and recently also provides simple-to-use drag and drop builders for use case specific MPs.

Trialability: Trialability refers to the ease of experimentation of new innovations. According to Rogers [30, p. 231], the degree of trialability influences the diffusion of an innovation, especially in an uncertain market. Given the lower entry thresholds to the MP ecosystem, it is relatively easy for developers to start deploying the technology and using it to create new apps. This is because MPs' proprietary framework is very similar to universal ones, which most developers are already familiar with. This keeps the costs of initial entry relatively low and enables a high degree of trialability.

Based on these findings we argue that as of now, it is not a question of whether MPs will replace native apps altogether, but rather in which use cases they are more suitable. By offering an additional channel to serve a niche group of complementors, MPs are able to supplement the one-size-fits-all proposition of native apps. For many smaller brands or services, MPs offer a more cost-effective and thus better suitable development strategy. Given MPs' high degree of usability, trialability and their access to WeChat's expansive user base, there are no prevailing reasons that speak against the development of an MP. This also addresses the notion that native apps and MPs are not mutually exclusive. In practice, the latter oftentimes complement the former as a

supplementary channel, which further expands the applicability of MPs across industries.

Overall, the general consensus remains that MPs are particularly suitable for apps that (1) are focused on specific use cases and infrequently used (“long tail use cases”), (2) integrate O2O experiences or (3) supplement the native app as an additional channel. Larger apps that require higher processing power, tighter integration with the device hardware and the ability to incorporate a set of functionalities necessitate the native app environment. For the foreseeable future, the MP ecosystem and the attainable use cases for MPs are predicted to further increase. In addition to popular use cases including MPs for eCommerce, city services, events and conferences, transportation, education, and corporate internal uses, Tencent is continuously offering new features such as its newly-introduced Augmented Reality Kit [31]. MPs have already become an intrinsic part of people’s everyday lives in China and will continue to impact not only the mobile market, but also many other industry segments.

5.2 Implications for Platform Owners

Considering the significance of MPs in China’s mobile platform ecosystem today, many implications arise for the role of native apps and platform owners as well as their native app stores. Beyond the scope of China’s mobile landscape, several implications even extend to reach Western platforms and companies. Although the discussion is based on the interpretation of our findings, it provides a general outlook on where this novel phenomenon may lead.

When comparing MPs to native apps, it is important to consider their pursuits of different purposes. An MP does not have the same goal of achieving long duration of usage or providing a bandwidth of functionalities. Contrarily, its purpose is to provide one tool, one particular service in a simple and convenient way. An MP session is meant to be short, straightforward and task-oriented. The report by 31Ten [23] visualizes this notion in Figure 2, which was recreated for the purpose of this study. The graph illustrates the target spot for the implementation of MPs, determined by the two variables: frequency of use and the amount of required user resources in terms of complexity and time to accomplish a task. The bottom-left half of the graph is where an MP is suitable. The upper-right half indicates the area, in which an MP should complement a native app. The so-called “sweet spot” resides in the area indicated by the pin, where both variables are low. The graph suggests this area to be the one, in which an MP is most suitable and most likely to excel. Due to MPs’ success in serving this “sweet spot” across industries, they have affected the mobile ecosystem in an exceptional way: The perception of app usage has changed amongst smartphone users in China and people are downloading less apps.

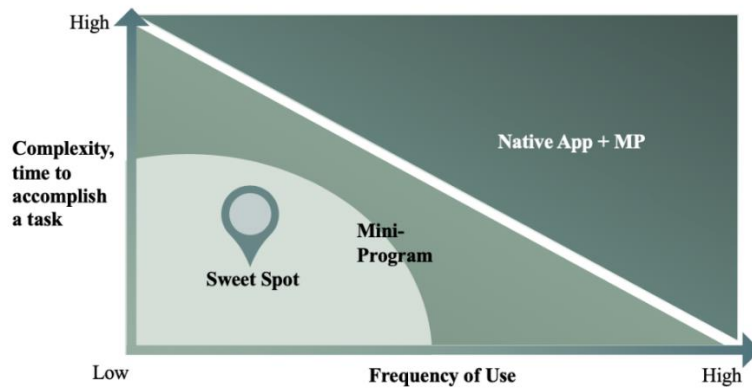


Figure 2. Platform Choice based on Frequency of Use and Required User Resources [cf. 23]

A general consensus concludes that while MPs will replace a part of app stores, both types of ecosystems will continue to co-exist in the foreseeable future. One interview partner elucidates his opinion on the matter and highlights an MP's dependence on the native app to exist.

5.3 Implications for Research

This study contributes to mobile platform ecosystems research in Information Systems for a number of reasons. First, prior analysis of mainstream literature reveals that research in this field is predominantly discussed within the Western (Euro-American) socio-technical context [cf. 32]. Contrarily, this study is set in a non-Western context, specifically focusing on the mobile app industry in China. Hence, this study enriches the conversation not only by introducing a new technological phenomenon, but also by widening the scope of research geographically. The case of MPs as an additional type of mobile app is relevant for the overarching mobile industry in theory and practice [cf. 33]. It exhibits new possibilities beyond the scope of Western standards and accentuates considerations for the future of mobile apps.

Next, concurrent to the growth of native apps since 2007, research shows that it has become increasingly more difficult for complementors of app stores to build successful native apps [e.g. 10, 11]. Such observations put into question whether native apps present the appropriate means and feasibility to realize all types of digital business strategies. This notion considers the complementors that struggle with the high development costs of native apps and the fierce competition within app stores. Additionally, many complementors further face the opportunity cost of losing potential customers that may be interested in the product, but reluctant to download the app.

To address such concerns, prior research propose development strategies, which exploit web apps [e.g. 25, 29], or more recently, hybrid apps [34, 35]. To an extent, these types of apps have been able to address certain restrictions such as fragmentation across operating systems, compatibility concerns or the high costs of native app development. However, thus far, they have not matured enough to substitute native

apps on a larger scale. To date, there is lack of a clear consensus in literature regarding the overall applicability of these strategies. Therefore, aside from MPs there has not yet been another phenomenon that manages to circumvent physical download, offers native app-like features, and arises out of the interests of end-users and third-party complementors.

To further accentuate the latter point, Hao et al. [2, p. 4] claim that WeChat has become a “business development platform”, presenting a better alternative to traditional app stores for many small companies and start-ups. Interestingly, this also invites the conversation to regard the MP ecosystem as an emerging strategy, which challenges the dominance of market leaders amongst mobile operating system providers. Basole and Karla [36] indicate the conspicuous dominance of Apple’s App Store and Google’s Android market. Naldi [37] shows that a clear oligopoly currently shapes the imbalanced market landscape and warns that this may incentivize dominant players to take advantage of their positions, giving its customers little bargaining power to voice concerns. WeChat’s MP ecosystem challenges this notion by offering customers an additional platform choice, which diffuses the concentration in the mobile operating system market.

5.4 Limitations and Future Research

By discussing the case of MPs, this study sheds light on new possibilities in this field of interest and encourages future research to build up upon this study in following ways. First, this research strongly encourages future studies to build up upon the rich descriptions of MPs provided in this study and derive conceptual frameworks and theories [38] by focusing on both breadth and depth. During this study, many parallels of the MP ecosystem to traditional app stores have been discovered, which opens up significant research opportunities. These include aspects such as governance, architecture and the interaction between participating parties [39]. Second, due to the continuous changes occurring in the MP ecosystem, future studies could extend their scope and analyze the dynamic changes happening over time. Third, it would be beneficial to include Tencent as an additional perspective to obtain a more comprehensive understanding. Lastly, this paper discusses the implications of MPs for native apps and Western technology companies. We thereby compared MPs and native apps in order to illustrate the characteristics of MPs best. A better suitable comparison might be to consider progressive web-apps or hybrid apps as a Western counterpart to MPs. This could enhance a deeper understanding of the emerging technologies of the post-app era and depict its implications for the global mobile platform ecosystems.

6 Acknowledgements

We thank the TUM Global Incentive Fund for funding the travel associated with this research and Dr. Sunghan Ryu from Shanghai Jiaotong University for insights and guidance.

References

1. <https://www.comscore.com/Insights/Presentations-and-Whitepapers/2017/The-2017-US-Mobile-App-Report>, (Accessed April 29, 2019)
2. Hao, L., Wan, F., Ma, N., Wang, Y.: Analysis of the Development of WeChat Mini Program. *Journal of Physics: Conference Series*, (2018)
3. Lee, K.-F.: *AI superpowers: China, Silicon Valley, and the new world order*. Houghton Mifflin Harcourt (2018)
4. Business Insider, <https://www.businessinsider.com/wechat-mini-program-growth-2018-11?IR=T>, (Accessed 13.08.2019)
5. TechBuzz China, <https://pandaily.com/ep-37-the-wechat-mini-program-the-end-of-apps-or-not/>, (Accessed 29.04.2019)
6. Staykova, K.S., Damsgaard, J.: Platform expansion design as strategic choice: The case of WeChat and KakaoTalk. *Twenty-Fourth European Conference on Information Systems*, Istanbul, Turkey (2016)
7. Yang, X., Sun, S.L., Lee, R.P.: Micro-innovation strategy: the case of WeChat. *Asian Case Research Journal* 20(02), 401-427 (2016)
8. <https://blog.prototypr.io/why-chinas-super-apps-will-never-succeed-in-the-us-64c686c8c5d6>, (Accessed August 09, 2019)
9. Tiwana, A.: Evolutionary Competition in Platform Ecosystems. *Information Systems Research* 26(2), 266-281 (2015)
10. Racherla, P., Furner, C., Babb, J.: Conceptualizing the implications of mobile app usage and stickiness: a research agenda. Available at SSRN 2187056 (2012)
11. Inukollu, V.N., Keshamoni, D.D., Kang, T., Inukollu, M.: Factors influencing quality of mobile apps: Role of mobile app development life cycle. *arXiv preprint arXiv:1410.4537* (2014)
12. Bresnahan, T.F., Davis, J.P., Yin, P.-L.: Economic value creation in mobile applications. In: Jaffe, A.B., Jones, B.F. (eds.) *The changing frontier: Rethinking science and innovation policy*, pp. 233-286. University of Chicago Press (2014)
13. Sorensen, A.T.: Bestseller lists and product variety. *Journal of Industrial Economics* 55(4), 715-738 (2007)
14. Tilson, D., Sorensen, C., Lyytinen, K.: Change and control paradoxes in mobile infrastructure innovation: the Android and iOS mobile operating systems cases. *45th Hawaii International Conference on System Sciences*, pp. 1324-1333 (2012)
15. Eaton, B.D.: The dynamics of digital platform innovation: Unfolding the paradox of control and generativity in Apple's iOS. *The London School of Economics and Political Science (LSE)* (2012)
16. Yin, R.K.: *Case study research: design and methods*. Sage Publications, Thousand Oaks, CA (2003)
17. Baxter, P., Jack, S.: Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report* 13(4), 544-559 (2008)
18. Urquhart, C., Fernandez, W.: Using grounded theory method in information systems: the researcher as blank slate and other myths. *Journal of Information Technology* 28(3), 224-236 (2013)

19. Gioia, D.A., Corley, K.G., Hamilton, A.L.: Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational Research Methods* 16(1), 15-31 (2013)
20. Wiesche, M., Jurisch, M.C., Yetton, P.W., Krcmar, H.: Grounded theory methodology in information systems research. *MIS Quarterly* 41(3), 685-701 (2017)
21. SCMP, <https://www.scmp.com/business/article/2129987/tencent-takes-aim-apple-and-google-app-stores-wechat-mini-program-push>, (Accessed 11.08.2019)
22. Dragon Social, <https://www.dragonsocial.net/blog/wechat-mini-programs/#What>, (Accessed 29.06.2019)
23. 31Ten, <http://www.eusmecentre.org.cn/>, (Accessed 13.08.2019)
24. Ngu Phuc, H., Do van, T.: Selecting the right mobile app paradigms. 2012 Fifth IEEE International Conference on Service-Oriented Computing and Applications (SOCA), (2012)
25. Holzer, A., Ondrus, J.: Mobile app development: Native or Web? Workshop eBusiness(WeB), (2012)
26. Smith, C.: 75 Interesting Google Play Statistics and Facts (2019) | By the Numbers. (2019)
27. TechCrunch, <https://techcrunch.com/2019/01/29/apples-global-active-install-base-of-iphones-surpassed-900-million-this-quarter/>, (Accessed 13.08.2019)
28. TechNode, <https://technode.com/2018/03/05/wechat-1-billion-users/>, (Accessed 13.08.2019)
29. Charland, A., Leroux, B.: Mobile application development: web vs. native. *Communications of the ACM* 54(5), 49-53 (2011)
30. Rogers, E.M.: *Diffusion of innovations*. The Free Press (1983)
31. WalktheChat, <https://walkthechat.com/wechat-launched-augmented-reality-mini-programs-3-other-news/>, (Accessed 13.08.2019)
32. Schreieck, M., Wiesche, M., Krcmar, H.: Design and Governance of Platform Ecosystems - Key Concepts and Issues for Future Research. Twenty-Fourth European Conference on Information Systems, Istanbul, Turkey (2016)
33. Manner, J., Nienaber, D., Schermann, M., Krcmar, H.: Six Principles for Governing Mobile Platforms. 11th International Conference on Wirtschaftsinformatik, Leipzig, Germany (2013)
34. Khanna, R., Yusuf, S., Phan, H.: *Ionic: Hybrid Mobile App Development*. Packt Publishing Ltd (2017)
35. Que, P., Guo, X., Zhu, M.: A comprehensive comparison between hybrid and native app paradigms. 2016 8th International Conference on Computational Intelligence and Communication Networks (CICN), pp. 611-614. IEEE (2016)
36. Basole, R.C., Karla, J.: Value transformation in the mobile service ecosystem: A study of app store emergence and growth. *Service Science* 4(1), 24-41 (2012)
37. Naldi, M.: Concentration in the mobile operating systems market. arXiv preprint arXiv:1605.04761 (2016)
38. Urquhart, C., Lehmann, H., Myers, M.D.: Putting the 'theory' back into grounded theory: guidelines for grounded theory studies in information systems. *Information Systems Journal* 20(4), 357-381 (2010)
39. Hein, A., Schreieck, M., Riasanow, T., Setzke, D.S., Wiesche, M., Böhm, M., Krcmar, H.: Digital platform ecosystems. *Electronic Markets* (2019)