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Stage Models for Moving from E-Government to Smart Government

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Abstract. The emergence of super-applications is a complete game changer in how future governments will deliver e-services and interact with their citizens. With respect to this, the scope of currently established e-government stage models is exhausted. Therefore, this article proposes a "provident stage" as an extension of the Layne and Lee stage model, that adequately addresses the rapid technological development and evolvement of mobile- and smart-government solutions. We argue that super-applications can drive the transformation of e-government towards a yet unforeseen quality level: smart government. This article discusses that transition process, the influence of mobile government solutions in this as well as emerging citizens' expectations for modern government service delivery.

Keywords: Stage models · E-government (eGov) · Smart government (sGov) · Digital government · Super-applications · Provident services · WeChat

1 Introduction

The daily use of social networking applications on mobile devices has a major impact on how modern societies are connected. For governments, a new era of public service delivery has begun. Governments adopt super-applications to their current repertoire of channels for service delivery. Meeting the citizens' needs is part of the modern idea of citizen-centric service delivery. By combining modern technologies with government services, a greater acceptance and data-driven, *provident services* will be able to entirely change the role of governments in modern societies. Exploring this new phenomenon will help to gain a better understanding of the transition from e-government (eGov) to smart-government (sGov) due to the use of super-applications.

Due to the involvement of Big Data and data analytics, proactive government decision-making will reach a new stage of eGov maturity.

Due to rapid technological development and change, existing e-government stage models reached their possibilities to illustrate currently emerging maturity levels of e-government. To address this, we suggest extending common stage models by a *provident stage*, based on the widely acknowledged stage model of Layne and Lee [17, 18]. Our suggested extension is based on evidence from a literature review and, furthermore, evidence from a case study of the super-application WeChat, based on data from Tencent Holdings Ltd. and eight personal open interviews – each 1, 5 h – that we have conducted in the PRC (People's Republic of China). The interviewees have been WeChat users, specialists in the R&D sector, software developers in Beijing, and official WeChat project managers in the WeChat headquarters in Guangzhou.

The technological development put forth the topic of mobile government (mGov). Our research addresses the importance, efficiency and effectiveness of non-state developed applications for the acceptance of e-government services. It aims to verify that super-applications strongly push the transition towards sGov and that they can enthuse citizens with using government e-services. In Sect. 2, we discuss related work regarding the transition from eGov towards sGov. In Sect. 3, we present the case of the Chinese super-application WeChat that exemplifies this rapid development of mobile government solutions. In Sect. 4, we discuss the existing stage model by Layne and Lee and introduce and discuss the suggested *provident stage*. We finish the paper with a conclusion in Sect. 5.

2   Related Works

The existence of synonyms of the term "smart" shows that even a definition that has gained a high level of acceptance in its field of research struggles with alternatives such as, percipient, astute, shrewd and quick. Due to this, they have created a definition of sGov centred on the changes and challenges for public administration and society. "As smart-government, or the organizations and networks within the political jurisdiction (e.g. a city, a town, a nation), will use emerging and nanotechnologies and various innovative strategies to gain a sound understanding of their communities and constitutes (being percipient), they would use that ability to accurately assess situations or people (being astute), show sharp powers of judgement (being shrewd), and then make decisions and respond quickly or effectively (being quick)" [1–4].

The development of smart city initiatives has shown that especially the borders between the terms of smart city and sGov are overlapping. "Therefore, the authors call a city smart when it takes action towards innovation in management, technology, and policy, all of which entail risks and opportunities" [5]. The discussion of attempts to define the sphere of each of the terms has developed two different understandings, which on the one hand state that the term of smart city is only a subset of sGov, and on the other hand scholars see sGov within the smart city nexus.

In smart and sustainable cloud-based ICT meta-architecture, the benefits of sGovs and their actions described by government platforms especially can be evaluated. They show the advantages of sGovs for public administration and citizens as well as

stakeholders in the process of open government service delivery. The benefits include lower software development, support, and maintenance costs; provision of higher application portability and interoperability; enhancing smart services; and a shortened time-to-market strategy for services. The involvement of Big Data Management, the Internet of Things (IoT), sensor networks, smart devices, embedded systems, 5G and cloud computing technologies in public administration will allow sGovs to create entirely new ways of governing cities, states or nations. "By introducing new type of knowledge processes such as information collection and processing, real-time forecasting and alerting, collectives and crowd-sourced intelligence, cooperative distributed problem-solving and learning from it" [6, 7], sGovs will reach a new level of interconnection between all kinds of stakeholders for public service deliveries.

Jörn von Lucke [3] has developed a design showing an integrational approach to sGov in public administration. The core of this model shows that cyber-physical systems (CPS) will involve intelligent networking objects such as sensors, actuators, and M2M communication to enhance the development of future public administration. CPSs are heterogeneously networked entities that link and combine real physical objects with digital information and communication systems. These are IT systems as part of devices, structures, or processes that directly detect physical data via sensors and act on physical processes through actuators, but above all that evaluate and store the acquired data. In addition, they can actively or reactively interact with the physical and digital world. For this purpose, they are connected via digital communication devices (M2M) and in global networks. This offers the possibility to use the data and services that are available worldwide [3].

To provide investment security, compatibility, and future viability for governments and stakeholders, the sGov approach must be integrated. The major question in the development of sGov service delivery is to identify what intelligently connected objects the public sector needs and in which CPSs these must be embedded.

As shown in Fig. 1, one must ensure that the objects not only function in a closed ecosystem but that they are also integrated into the Internet of Content (Web 1.0: World Wide Web and Management Networks, Electronic Government), the Internet of Communication (Web 2.0: Social Media, Open Government) and the Internet of Context (Web 3.0: Semantic Web – Big and Open Data, Open Government Data). The design of the Internet of Things (Web 4.0: Smart Ecosystems, Internet of Things, sGov) with its sensor and actuator networks and its services are, from the state's point of view, essential. As one of the last stages, one can define the network communication on a real-time level as the Web 5.0 – the so-called Internet of Thoughts or the Tactile Internet, which supports real-time government.

In his analysis of sGovs, von Lucke [3] has outlined strengths, weaknesses, chances and risks regarding future public administration. Weaknesses of sGov, as he pointed out, are the specific efforts and time for the development of software solutions that requires financial expenses, and insufficient scientific background. Also, its lack of political prioritization, as well as the lack of research and development capacities of new solutions will be considered as weaknesses. Risks that von Lucke's system wanted to eliminate are the lack of creativity and design, the uncertainty of successful implementation, the disruptive nature of changes arising from innovation, the fears resulting from the distorted image of "Glass Citizen", which especially in Germany is
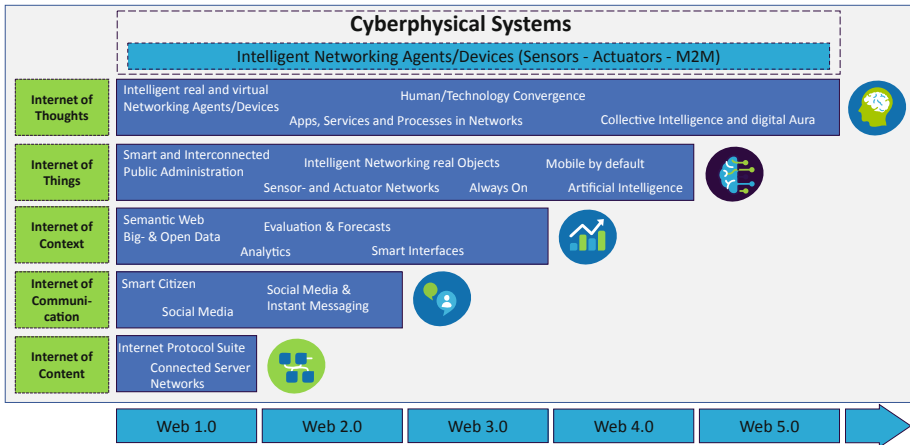
Fig. 1. Integrational approach of sGov solutions and their development.

an issue of privacy, and lack of permanent funding, acceptance, and participation of citizen in early stages.
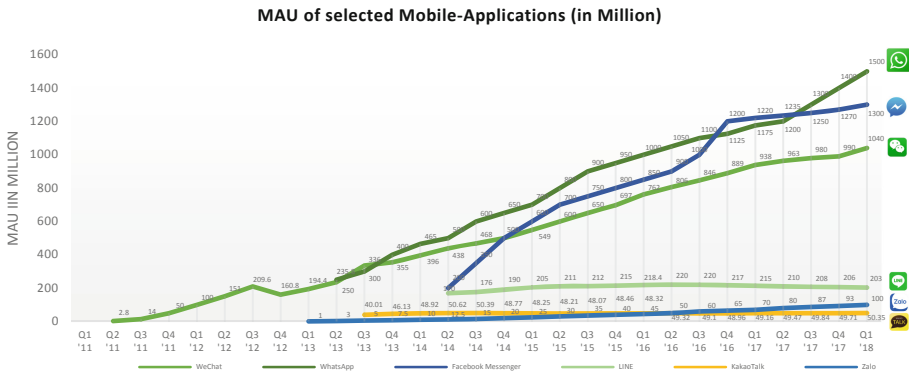
Chances for sGov are the potential for innovation and the given impulses for society, new intelligent networking of things, services and CPS, increasing efficiency and effectiveness, and in the long run reductions in fees and charges for public administration services. He supports his argumentation with an integrated approach to IT, an intensification of networking and interconnection of agencies, as well as a demand of mission statements by smart authorities, smart management and for smart citizens.

3   The Case of the Super-Application WeChat

The super-application WeChat has been developed in a unique surrounding that is characterized by the Great Firewall, and that can only be found in the PRC. In China, the IT solutions are much more focused on the needs and traditions of the users – the regional-cultural background plays an important role in the development of innovative IT solutions. Surely, the development of emergent technologies will also be performed only within a framework that especially focuses to serve its one-party state that has been ruled by the Chinese Communist Party (CCP) since 1949.

WeChat has been developed towards a social networking application that combines functions such as instant messaging, e-commerce and payment services. In the Western World, government e-services are not supported by applications like WeChat. Applications such as WhatsApp and Facebook will need to be analyzed separately due to their more open and democratic and less government-influenced development. Developing countries especially have shown a greater interest and closer connection to innovation and technological change in the past. The acceptance rates for new technologies are higher than in economically mature and developed countries, e.g. in

Central and Western Europe. The increasing use of those applications especially in Asia can be seen in Fig. 2 [8]. This figure compares the most commonly used social messenger applications in the world based on their number of monthly active users (MAU). These applications are mostly used in certain geographic areas. KakaoTalk is used especially in South Korea, Zalo in Vietnam, LINE in Taiwan and Japan, WeChat in the PRC and Facebook Messenger as well as WhatsApp cover the entire globe – except China and politically isolated states.

Fig. 2. Monthly active users of mobile application over the past years.

Super-applications enable possibilities to implement services under the idea of Government as a Platform (GaaP). Therefore, they will be able to provide data information for smart cities and innovative administrative government processes.

Sensors can gather various types of data. Smartphones are great examples for this type of data-gathering. The location, temperature, 3D movements, fingerprints, light, atmospheric pressure and even camera sensors with possibilities for face recognition as well as the recognition of handwriting have built into the new types of smartphones. All that gathered information will be used to improve the user-experience and to measure the behaviour of the user. As mentioned in the interviews given by the WeChat managers in Guangzhou, for WeChat this has always been the basic understanding for the development of their application.

In the next step, analytics will be able to predict user preferences and calculate risks of decision-making. Analytics help to define new levels of verification to securely store any kind of information on the user's personal device. "With the mobile Internet extending to IoT in recent years, Chinese Internet enterprises have emerged as the most dynamic actors in the development of IoT, and have been strongly influencing the patterns, models and industrial ecological system of China's IoT development. Major Chinese Internet companies have entered the field of IoT through wearable intelligent terminals, smart home, mobile health care, IoV, security, [virtual reality (VR), artificial intelligence (AI)] and other businesses, and have made rapid development in some of these areas" [9].

One of those examples is the super-application WeChat, which "can communicate with home appliances, toys, routers, wearable devices, sports equipment and other types of smart devices, and help to interconnect intelligent devices and hundreds of millions of Wechat users" [9–11]. With WeChat, not only can people be connected and relationships maintained, but also connections between people and objects or connections between objects can be made. IoT has become reality in China through WeChat. As follows, WeChat will be used to define this new stage of transition of government e-services.

The involvement of data analytics and the implementation of mobile government in the set up, and agile system that can be used on cloud services, also outlines the before mentioned definition of sGov. The developed *provident stage* uses the data that is gathered by governments to better serve citizens' and clients' needs. Hence, this stage plays a major role in the transition process of government. The implementation of emerging technologies and innovation that can be driven by IoT in the public sector, has shown a move towards a more digitalized and more open and interconnected type of government, as outlined in the conducted interviews with interviewees from the R&D sector. This shows that governments will be able to push their transition on the new level, due to the implementation of super-applications to reach the more advanced type of government – sGov.

4   Extending Stage Models from eGov to sGov

The transition of government is a wide term. Due to the involvement of information technologies, governments have been pushed towards the implementation of those technologies. The wide range of possible changes in governments have shown major improvements in organizational structures of government as seen in Fig. 1. eGov has been a way of better serving the citizens using new technologies and through new channels. It has also changed the entire process of services that governments provide and has changed the entire organizational structures of governments.

Several different stage models for eGov have been developed by scholars in the past. Those stages have some basic features in common. "All of them bring to bear a differentiation in describing the development from the simple information service to a more refined one-stop government" [12]. Some scholars especially worth mentioning are Layne and Lee. They offer the general bases of analysing stage models in present work, because it has been the most general but also the most often referenced model over the past years. Several others, such as Hiller and Bélanger [13], Andersen and Henriksen [14], and Klievink and Janssen [15], have been used to shape the right understanding for developing a stage model extension for a new and innovative way of government that is mainly data-driven and proactive.

Various contributions have pointed out problems that need to be overcome to be able to reach the next stage of eGov. Some of them have shown that government officials on lower and higher levels are likely to resist any changes and development in established systems and processes.

Being able to overcome this barrier will drive the transition of government towards a more digitalized and future-oriented government that can have the ability to serve their citizens better than it did ever before. Action areas to become more open and as well predictive are the community engagement and co-production of services, financial investment, automation, collaboration, and governance. To be able to transform government service delivery from eGov to sGov, agencies must collaborate and provide a seamless integrated service delivery across all domains.

4.1   Existing Stage Model by Layne and Lee

Governments do not change for intrinsic reasons but are led by visions of eGov emerging in society. Those visions are shaped by ideas and a new understanding of governance based on a citizens-centred concept instead of a traditional bureaucracy-centred vision. These kinds of visions are driven by a result-centred and market-centred ways that are actively promoting innovation [16].

There are four objectives that describe the change in governments due to the help of information technologies. From an organizational point of view, it can be said, that governments try to internally enhance the cooperation and collaboration between several government divisions among several levels and various locations. The new way of government will also provide better services to external entities such as businesses (e.g. elimination of redundant data collections and their reduction of transaction costs). Focused on the delivery of services to individuals, governments have set their visions to provide services to their citizens that are working to improve the government-citizen relationship that has been difficult in the past. Lastly, from an individual perspective, governments try to improve their internal processes to boost efficiency and effectiveness of their own administration.

Based on those four objectives, scholars have developed stage models, each having a different approach and, therefore, differing in the number of stages.

Layne and Lee [17] have developed their stage model on the basic understanding of eGovernment as a chaotic and unmanageable development of government-citizen interactions. In this sense, they claim the importance of dividing the development into distinguishable stages. Therefore, they have developed the four stages: (1) catalogue; (2) transaction; (3) vertical integration; and (4) horizontal integration.

The integration of government agencies, as described by Layne and Lee, has been unique. "In Layne and Lee this is divided into vertical; cross-hierarchical integration and horizontal; cross-functional integration. The other models do not separate the cross-functional and cross-hierarchical integration from each other" [12, 18].

The model is based on technical, organizational and managerial feasibility. The authors define their model as a framework for an evolutionary phenomenon that is called – eGov.

The first stage of the model delivers static or just basic information by using websites. Besides basic information delivery, the functions of this stage are the publication of documents and the possibility of downloading form sheets. Therefore, this information is of a general nature and mostly pays attention to the agency or

department itself. The established online procedures of government departments and their agencies tend to be created in a mainly decentralized way. There will be no interaction between government and citizens and no cooperation among agencies. The move into this stage is initiated by external pressures arising from client (e.g. citizens' and businesses') expectations.

The second stage of the Layne and Lee model extends the previously established possibilities of the catalogue stage. In general, it allows citizens to fill in online forms for governments. This shows that a transaction between government and citizens has been established. For Layne and Lee, this stage represents an internal focus shift that moves agency systems onto the existing websites. Examples of this stage are the renewal of the residence parking permits (e.g. in the Federal Republic of Germany), the renewal of licences, the possibility of paying fines, and checking evidence online (e.g. in the United States of America and the Federal Republic of Germany). A full integration of agency systems has been archived achieved in the next stage of the model. This full integration allows the citizens not only to view information but in addition helps them to post their own information and responses directly into the agency systems. Direct and personal interaction with government officials will be reduced and a greater location-independence can be seen [12, 16, 18].

In the third stage of the model, a vertical integration has been introduced. This stage differs from the other stage models proposed in the literature. The vertical integration most likely focuses on the transformation of the delivered services rather than on the automation of already existing business processes. It describes the process of integration into a vertical cross-governmental way. In comparison to the first two stages, this stage focuses on the development and the integration of agency systems with the help of web interfaces. In addition, the Layne and Lee model focuses on organizational changes. This is highly important to promote the change in government structures using information and communication technologies. In this third stage, the possibility of connecting government agencies on different levels occurs and offers practical functions such as the "integration of local level business license application [that] is being linked to state and government level to obtain an employer identification number [(e.g. in the United States of America)]" [12]. A linkage of local- and state-systems on higher-levels brings this stage to its maturity.

The last and fourth stage of this model describes the horizontal integration and focuses on the integration of systems on the same level of government. Several agencies offer one system for their service delivery to their clients. Even though several agencies deliver different services and functions, the information regarding the client that they have in common can be communicated and shared. A functional example is the possibility for the clients to pay their business fees and taxes to several government entities. This will be possible due to the interconnection of agency systems that makes it possible to divide the payment and deliver it to the right agency [12, 16, 18].

For the Layne and Lee stage model, the importance of outlining the change of organizational structures due to the implementation and interconnection of agency systems shows that the transformation of government systems does not only include the delivery of services that they provide. It also underlines the internal aspect of change that needs to be done to reach the expectations of modern government.

4.2   Extension of Current eGov Stage Model

With the implementation of super-applications in the delivery process of government services, the terms "fast and effective" have taken on a new definition and understanding. It is above the so far seen eGov approach that delivers information and services to their citizens over the Internet. Due to the wide distribution of smartphones all over the world, the Internet has become part of people's lives. The Internet is now accessed directly from the people's pocket and it has become mobile.

All this has made it possible to access government services over the browser on the clients' smartphones and entirely new problems occurred that have questioned the accessibility and verification functions for government e-services. "With a rapid proliferation of smartphones, public smartphone applications have emerged as a new technology and innovative way to achieve smarter government. […] [G]overnment agencies have followed the trend of the rapid proliferation of public applications without considering how high-level citizen-centric services could be delivered through the public applications" [1]. Therefore, governments had to face the lack of acceptance of their mobile e-services. The use of data that has been given by the clients, has made governments a powerful stakeholder regarding to Internet technologies in a data-driven world.

Data-driven government that will be able to proactively use and deliver information to their clients would be the next generation of government. Sirendi and Taveter even argue that "designing proactive services of e-governance should be seen as the next stage in service design for e-governance. […] [P]roactive public electronic services should be designed in a way that supports the automation and intelligent processing of already available information to reflect the purpose of meeting the needs of different stakeholders yet maintaining a people-first-policy" [10, 11, 19]. This new type of government is able to serve its people's needs in a better way than they were able to deliver services ever before. At the same time, they will be able to provide decision-making to serve their people even before they know that they need to be served by the government.

Based on this new understanding of government, a new stage for describing this transition of government will follow. In this case, it can be said that due to the rapid growth in demand of government e-services for mobile devices and the occurrence of data-driven government that will be able to proactively serve their citizens and enterprises requires a new stage to define the maturity of governments in the transition process from eGov to sGov.

Therefore, the authors propose an extension of the Layne and Lee stage model, as shown in Fig. 3. This fifth stage extends the existing stage model and focuses on the delivery of this service and the use of government data. This stage will be named as the *provident stage*. Due to the use of analytics and artificial intelligence (AI), a new way of governing citizens will be implemented. Data-driven governments are currently in this stage and they will, on a more mature level of this stage, actively invest in deep data analytics and AI. Its decision-making is based on Big Data and will be able to proactively serve its citizens in the future [7]. The delivery of e-services in this fifth stage supports the use of smartphones and developed implemented mobile government applications.

Considering the use of super-applications in this transition from eGov towards sGov, archiving this stage will be possible by implementing eGov services in daily-
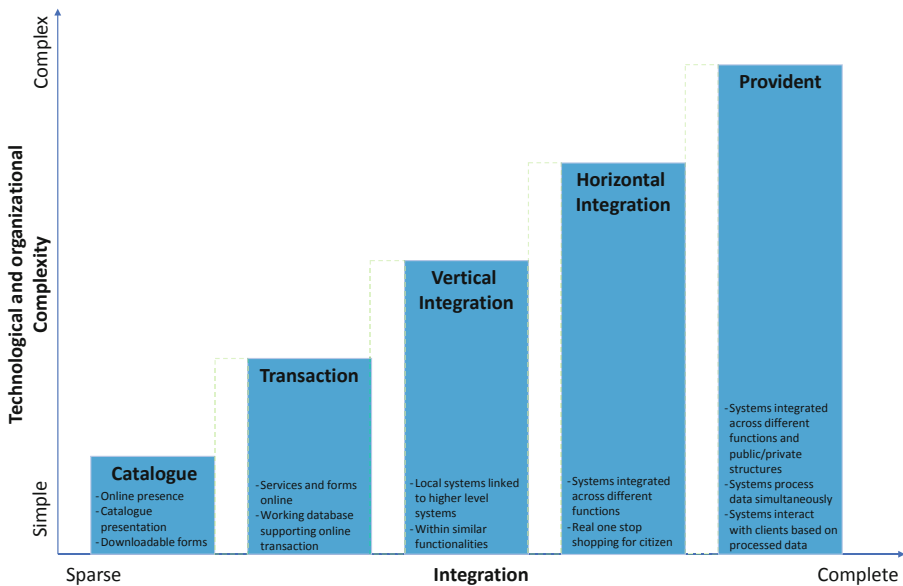
Fig. 3. Extension of the Layne and Lee stage model including the *provident stage*.

used super-applications. In this *provident stage*, organizational structures of government will not be entirely changed anymore. Policy adjustments and new legislative procedures will help to legally connect third-party applications and data-security laws for government databases. Data gathering due to the help of those implemented e-services will offer new possibilities for governments to predict economic changes and movements of society on the long- and short-term scale.

This new way of implementing e-services and analysing the way they input data will surely have an impact on the policy outcomes. By implementing agile delivery procedures that are based on the citizens given data, new ways of customisation for e-services will occur. "In the context of an architecture of consumption, agile delivery is an extremely powerful approach, since it allows the recombination and reuse of standard building blocks, closely customized to user's requirements" [20].

This newly and fully citizen-centric approach for government e-services has become a goal for the delivery of those services. This proposed extension of the Layne and Lee stage model shows that even the general stage model will reach its maturity due to the development of ICT and its implementation by government agencies.

5   Conclusion

The novel idea of combining super-applications and the use of eGov service delivery has shown a remarkable change in the way future governments will deliver and interact with their citizens and country-based enterprises. The case study has addressed new ways of interaction between governments and citizens, which have been developed and

used by the citizens based on the interviews that were conducted with the eight interviewees in the WeChat context. This adoption of mobile government service delivery has reached a new stage of the currently used and widely spread eGov stage models.

The *provident stage*, which has been developed and introduced here, outlined the move from eGov to sGov due to the use of super-applications and the hardware that will be supported. The case study has shown that super-applications have been a driver for the transition process from eGov towards sGov. This innovative way of software development and the implementation of new sensor technologies and tools into just one application has made it possible to support almost every personal situation of life. In this case, it has adopted people's needs and their circumstances of life to reach any of the needed reasons to be used on the people's mobile devices. Those super-applications have become part of their daily life over the past years and young Chinese especially cannot imagine a life without WeChat anymore - as mentioned by WeChat users and interviewees from the R&D sector in the interviews.

The application has had a major influence on the development of the entire market and the development of Chinese society over the past years. The interviewed software developers and scientists have said that the development over the past years has shown that WeChat is - compared to other applications - one of the early adopters of new possibilities that technology offers. They outlined that the framework for implementing and adjusting services within the application has always been at the forefront. It has changed online and offline business models, it has created entirely new business models and it was able to implement already existing models.

WeChat's existence has increased the users' ability to easily communicate with friends, businesses, and governments. The implementation of public services in WeChat has created the first steps for governments to directly interact with their citizens over their personal mobile devices. For the interviewed users, this has been revolutionary, but it has not changed the way Chinese sense their government.

This implementation process for eGov services specifically explains the first sub-sidiary research question that asked for the ways to implement government services though through GaaP based on super-applications. The platforms that have been developed to offer several services on WeChat have created the possibility for individuals from all over the world to develop microblogs, games, remote controls for any kind of hardware in IoT and many other innovative ideas. By using location services, the service delivery has been shaped especially for the users and just offer services that have been available in their area.

The research has outlined that especially with the use of super-applications, the transition process has led towards a mature level of eGov. While introducing a next stage for the Layne and Lee eGov stage model – that has especially been focused on Big Data and proactive service delivery due to Non-Stop-Shops – the use of super-applications on next-generation smartphones has been a driver for this process of transition towards sGov.

Summarized, it can be said that due to this research the understanding of mobile service delivery needs to become part of the policy-making process of Western/European governments and supranational organizations in the near future. Innovative ways of service delivery will guide public administration towards a more

interconnected, efficient and effective approach on how to govern a country in the 21st century. Making governments smart will increase the trust and positive attitude of citizens towards governments and their service delivery.

Further research could be conducted to draw out specific cases in Western/European countries and to underline this next generation move towards smart government. This will push this framework to a more practical level.

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