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Smart city with Chinese characteristics against the background of big data: Idea, action and risk

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ABSTRACT

Chinese urbanization has generated great impacts on the world since the reform and opening up. However, urban problems, e.g., environmental pollution, resources shortage, and traffic jam, have been more and more serious for urban management and development. Smart city has been put forward as an effective approach to achieve better urban management recently. Smart city aims to realize the integration of municipal service, business, transportation, water, energy source and other urban sub-systems through close combination of human wisdom and information communication techniques (ICTs). As a result, the link and synergy of information could be ultimately established with ICTs, e.g., internet, internet of things, cloud computing. Yet, few studies have been conducted to systematically link smart city with big data in China. This paper aims to put forward a development framework of smart city with Chinese characteristics against the background of big data. Key actions, including rational planning of city infrastructures, the establishment and improvement of long-acting mechanism, the effective performance of city managerial function, are proposed to realize the development idea. Meanwhile, this paper also investigates the risks embedded in development of smart city with Chinese characteristics, e.g., information safety, weak emergency responding capacity and poor independent research and development capacity of core technology. This study can facilitate Chinese local governments to systematically plan smart city before clinging the hot concept in a rush.

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1. The introduction of smart city

Urbanization is the only access to modernization, and has become a general trend of social and economic development around the world. Over the past 60 years, the global urbanization rate has risen 21%, more than 50% of the world population lives in urban area today. Meanwhile, the ratio is predicted to be close to 60% by 2030 (United Nations, 2015). China has witnessed a rapid urbanization since the reform and opening up policy (Shen et al., 2012; Wu et al., 2012; Wu et al., 2016). As shown in Fig. 1, by 2015, Chinese urbanized population has reached 0.77 billion, accounting for 56.1% of the total population of China (National Bureau of Statistics of PRC, 2015). The number of urbanized population is almost 4.47 times as much as that in 1978. Due to the mutual promotion between urbanization and economic development, urbanization has become one of the powerful engines and important driving forces for the healthy and sustainable development of Chinese economy.

Similar with what western countries has experienced, China has been challenged by various urban problems during the rapid urbanization. These problems may include irrational transformation of rural land to urban land, large number of land-lost farmers as a underprivileged group, rural-urban conflicts, environmental pollution, traffic jam and frequent public safety incidents (e.g. Yu et al., 2014; Yu et al., 2015; Peng, 2015; Peng et al., 2015; Bao and Peng, 2016). Meanwhile, urbanization results in a considerable economic disparity between urban and rural areas in developing countries, which has had a consequent significant impact on CO_2 emissions (Wu et al., 2016; Wu, 2016; Hong et al., 2016). In other words, a higher urbanization rate, energy carbon emission coefficient and energy intensity will lead to increased carbon emissions. Therefore, innovation and improvement on cleaner production are

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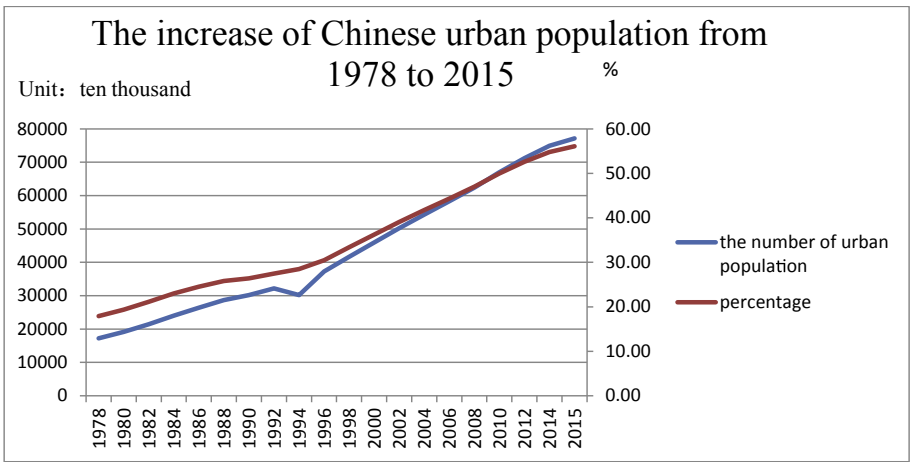

Fig. 1. The increase of citizens in China.

of much importance when facing the increasingly intensified environmental problems in urban areas. Smart city is proposed as a new way that can efficiently integrate various resources based on the collection, store and analyze of big data, by which the optimization of resources distribution can be realized, and the CO_2 emissions can be efficiently reduced. More examples and cases can be found in Section 3. Besides, the difficulty of obtaining and processing large amount of information and transferring such information to better decision-making on urban development and management has also worsen these problems.

The advanced information techniques are changing the world and bring possibilities to solve such urban problems. Internet has exerted a far-reaching and continuous impact on economic and social development since its emergence in the 1960s. In recent years, mobile communication and internet has been organically combined, due to the positive user experience, innovative marketing mode and competitive techniques, the number of mobile internet users first time outnumbered that of PC internet users in 2012 (Luo et al., 2011). Nowadays, shopping on TaoBao (a famous on-line shopping platform in China), taking taxi by Fast Taxi (an app like Uber), enjoying various group-buying or reserving train ticket from 12306 (the official website of Chinese Railway ticket service) are more and more popular and integrated in the daily life in China. In addition, after computer, internet and mobile communication, as another achievement of industrial revolution, internet of things makes various things connected, integrating the physical space and informational space (Sun et al., 2010), prompting the digitalization, informationization and gridding of all things. The burgeoning internet of things, systemized by technologies of computing and service, internet and communication, perception and identification, management and support, endows things with intelligence (Wang, 2009). With the integration of such advanced information techniques and the spatial monitoring tools, e.g. GPS, GIS and RS, it is possible to concert and record the spatiality of human behaviors as big data, by which provides a new thought for the future urban planning and management.

Big data is a fantasy concept around the world. Although it lacks a consensus on the definition of big data, volume, variety, and velocity, or the three 'Vs', which emphasize large amount of data, many formats of recording data, and the high speed of generating data, are usually used to characterize big data (McAfee et al., 2012; Lu et al., 2015). The continuous development of internet, internet of things, and big data analytics makes it possible to build smart city. In fact, smart city is an idea born with intimate relationship with data. In 1980s, with the popularization of LAN and the anticipation of the coming of WAN and internet, people became zealous in equipping city with network technique, and this thought was clearly expressed in *Wired Cities*, a book that was edited and published by Dutton et al. (1987). Before the publication of *Wired Cities*, much concern about the huge challenge that cities would confront from network technique in the future had been put forward in Martin's book, *The Wired Society* (1977) (Martin, 1977). No matter what names are, wired city or wired society, both of them could be seemed as the original conception of smart city. By the middle of 1990s, people found that library, welfare service and many other daily services provided by government could be realized by WAN. Since then, the technique of information and communication has been also applied in fields of emergency service, ambulance, fire control and waste treatment, etc (Batty, 2012). IBM formally stated the concept of smart city. In November 2008, Mr. Samuel J. Palmisano, the former CEO of IBM, firstly stated the conception of Smart city and mentioned the word, "Smart city" during his speech on the forum of business leadership of IBM (Palmisano, 2008), which was held in Istanbul, Turkey. In July 2009, the global business services of IBM held a press conference, during which smart city was formally stated in a research report named *the Vision of a Smart City*. This research report defined smart city as a city that could maximize the payment with limit input of resources by the use of techniques to improve urban services, civilian, business, transportation, communication, water, sources and other urban core systems (Dirks and Keeling, 2009).

Led by IBM, Cisco and other suppliers of network technique, the wave of building smart city has swept the globe (Woods and Goldstein, 2014), in which China is no exception. National New Urbanization Planning (2014–2020) (The Xinhua News Agency, 2014) explicitly requests to promote the development of smart city, and unify the material resource, informational resource and intellectual resource for urban development. The internet of things, cloud computing, big data and other new information and communication techniques (ICTs) are suggested to be innovatively integrated for the social and economic development of cities. National New Urbanization Planning (2014–2020) also points out the direction of Chinese smart city, including broadband access of network, informationized planning and management, smart infrastructures, convenient provision of public service, modernized industrial development and elaborate social governance. Since entering the era of big data, how to build smart cities with Chinese characteristics attracts much attention from governments at all

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