

The evolvement of computer-aided urban planning in China

Lin Zhang, Stan Geertman and Yanliu Lin

Abstract

In 2008, China began to implement the "Town and Country Planning Law", which offered a legal protection for public participation in urban planning for the first time. In 2013, China began also to build pilot projects of smart cities, in which people play a more pivotal role in governance. As a consequence, public participation in the planning process will be a major feature of present urban planning, although professional and workable guidance for this practice is lacking at the moment. In fact, there are some path-dependent aspects to urban planning transitions. To better understand the present-day fourth urban planning transition, this article identifies the backgrounds and main contents of the preceding transitions, and elaborates more specifically on the roles of computers in urban planning practices in each transition. It can be concluded that planners had better to combine traditional top down planning approach with the newly adopted public participation based bottom up approach, but few planners put PSS into planning practice compared with the popular academic research by scholars.

Lin Zhang
Department of Human Geography and Planning, Utrecht University, 3508
TC Utrecht, the Netherlands
Email: zhanglinjs@gmail.com

Stan Geertman
Department of Human Geography and Planning, Utrecht University, 3508
TC Utrecht, the Netherlands
Email: S.C.M.Geertman@uu.nl

Yanliu Lin (Corresponding author)
Department of Human Geography and Planning, Utrecht University, 3508
TC Utrecht, the Netherlands
Email: Y.Lin@uu.nl

1. Introduction

The purpose of urban planning has been—and continues to be—to support the achievement of state-led economic goals, whether in the previous era of the socialist command economy or in the present period of the ostensibly socialist market economy (Leaf & Hou, 2006). So, in the beginning of the market reform and opening up, the economic development was emphasized by the Chinese government, while resources and energy utilization, social development and environment protection failed to get the same attention (Huang et al., 2009). With the improvement of people's living standards and awareness in the Justice System, the public increasingly become concerned about the local development and the environment, and is urban planning becoming of great significance in addressing these issues (Wen & Peng, 2012).

With ongoing changes in urban planning policies, cities nationwide have experienced several rounds of urban planning. The discussion and interpretation of urban planning must be grounded in an understanding of the nature of Chinese urban governance, which is itself a contentious and politicized arena (Leaf & Hou, 2006). For example, the purpose of urban planning has been—and continues to be—to support the achievement of state-led economic goals, whether in the previous era of the socialist command economy or in the present period of the ostensibly socialist market economy (Leaf & Hou, 2006). In the transitions from one round to another one can identify path-dependent aspects (Zhao et al., 2011), which are also affected by political, economic, cultural and technological factors. In that, we are especially interested in the technological factors, related to the political, economic and cultural aspects. Therefore, this article highlights the political and cultural context and main findings of the four rounds of urban planning in china, and elaborates on the roles of computer technology in urban planning practice in each round. We consider this of help for the understanding of the present-day position of technology in the fourth round of urban planning transition. Finally, the feasibility of using planning support systems to achieve the fourth transformation of urban planning in the era of big data has been analyzed.

2 The first round of urban planning (1949-1978)

2.1 Evolvement of urban planning from 1949 to 1978

In China, urban planning is implemented by the government primarily to serve the goal of socialist construction, so especially for economic construction. Therefore, practices of urban planning and economic policies are closely related. After the founding of New China in 1949, Chinese government began to recover the economy and implemented a "top-down" planned economy. As influenced by the planned economy, urban planning was regarded as "the extension and embodiment of the national economic plan", and a technical means to implement the economic plan (Chen, 2004). With the changes on economic development policies during this period, urban construction work went through the following three stages: The rise (1949-1957), recession (1958-1965) and stagnation (1966-1978).

The first forum on urban construction was held in 1952, which developed the "Urban Planning and construction program in People's Republic of China (draft)". To promote industrialization, which occurred in China in 1953, the first round of urban master plan was launched according to the Soviet experience (Chen, 1995). The main aims of this round of planning were: to localize 156 key industrial construction projects, to design functional zoning of corresponding cities, and to support corresponding infrastructure and residential construction (Ren, 2000). Urban construction work were gradually improved, such as, "the interim provisions on new industrial cities plan examination" which was issued in 1954, "and the interim measures for urban planning" which was issued in 1956. What's more, special agencies were set up by the central government, provinces and cities to manage urban planning and urban construction during this period (Huang et al., 2009).

During the recession stage the focus of socialist construction work shifted from industry to agriculture in the period from 1958 to 1965, and the control of urban expansion was promoted. In 1960, the central government advocated "without urban planning within three years", and as a consequence many regions withdrew urban planning agencies and cut planners, so urban planning work was substantially reduced. Finally, only a little low standard and scattered planning was carried out in the mountains to meet the needs of industrial projects.

The Cultural Revolution was launched in 1966 and one of its aims was to lower urbanization, which translated into a total rejection of urban planning between 1966 and 1976 (Douay, 2008). Also, most engineers and scientists lost their chance to apply their skills and knowledge during the Cultural Revolution. Therefore, this can be identified as the stagnation stage in the development of urban planning in China.

2.2 Evolvement of computer-aided urban planning in China from 1949 to 1978

From a worldwide perspective, in the late 1950s planners started to develop and use computerized models, planning information systems and decision support systems to improve performance (Nedovic, 1999). However in China, the introduction of computers into planning did not happen during the rise stage.

Also in the stage of recession China did not make progress in tools and technologies of urban planning from 1958 to 1965. For one thing, as identified, urban planning work was ignored as the policies and strategies for socialist construction changed. For another thing, computer-aided urban planning was still in its infancy stage of the development process, and did not spread to China.

In the period from 1966 to 1978, in the Western world computers were used to structure and synthesize data to serve management needs, so different kinds of management information systems, such as urban information systems and geographic information systems, were invented. Computer-based mapping technology appeared in this period too. Although so many advancements were achieved abroad, China did not catch up with these developments in new technologies, and did not import foreign technologies or equipment for urban planning as affected by the Cultural Revolution.

3 The second round of urban planning (1979-1990)

3.1 Evolvement of urban planning from 1979 to 1990

Since initiating market reforms in 1978, China has shifted from a centrally planned to a market based economy. To support market economy and socialist modernization, urban planning needed to “get back on track” quickly. In this context, Chinese government introduced a series of measures to promote the development of urban planning. The political reform was a 'trial and error' process in the first stage of the reform and opening up (1978-1990), so there were twists and turns in the development of urban planning (Chen, 2004).

The third national conference on urban construction was convened in 1978 to stress the importance of cities in economic development and the role of urban planning. This conference formulated the “Opinions on strengthening urban construction work”, which stipulated all of the cities and new towns to draw up and revise urban master plan and urban detailed plan. After this conference, the state administration of urban construction has been set up by the State Council, and urban planning organizations in some major cities have been restored or set up (Tan, 2005).

In 1980, “controlling the size of big cities, developing reasonably the middle cities, and promoting actively the growth of small cities” was adopted by the State Council as urban development policy (Gu, et al., 2012). In the same year, the National Infrastructure Committee issued the "Provisional regulations on fixed targets of urban planning" and "Interim Measures of urban planning permission". These policies provided an administrative and technical basis for urban planning.

The State Council promulgated the "Town Planning Ordinance" in 1984, which marked the initial establishment of the urban planning system in China (Huang et al., 2009). Urban System Planning was proposed in this law. Then "Policy of urban construction technologies" was issued to strengthen the guidance of urban planning in 1985. In this year, 324 cities finished their second round of Urban Master Plan, which meant urban planning was resumed (Cui & Zhao, 2014). The main contents of the second round of Urban Master Plan included: the size, development orientation, spatial structure and zonings of a city; urban infrastructure; environmental protection and urban renewal; and construction of residential areas.

After certain amendments to the Land Administration Law in 1988, land use rights to state-owned land could be legally transferred (Moser & Fu, 2014), which greatly accelerated urban construction progress. In 1988, China reformed its land-use and land property system, and the use of land changed from administrative allocation to a paid use, making a large amount of financial resource to be used in the construction of urban infrastructure (Gu, et al., 2012). At the same time, several special economic and technological development zones were established and opened thanks to Chinese economic reform.

3.2 Evolvement of computer-aided urban planning in China from 1979 to 1990

During this period, urban planning methods changed from qualitative analysis to the combination of qualitative with quantitative methods. To store urban data and information, to deal with complex mathematical models and to simulate planning results, computer was adopted to in urban planning too (Li, 2000).

The primary function of computer technology in urban planning was collecting and storing the required data. For instance, in the program of "Residents' travel research in Tianjin" held by the China Academy of Urban Planning and Design in 1980s, computer technology was used to collect and analyze the data of 76,000 questionnaires. There appears to be, the first time that computer was used in urban planning in China (Chen, 1995). Then in the transport planning process, computers were used by the China Academy of Urban Planning to forecast traffic for the urban planning period and spatial distribution patterns of trips in the future (Ye, 1988).

Remote sensing (RS) was applied in urban planning in China during the same period to collect information (Chen, 1995). "Remote sensing comprehensive survey and application in Beijing" was launched in 1983, which is the first systematic and comprehensive investigation of a city in China. The purpose was to use aerial remote sensing techniques to collect basic data for urban construction and urban research of the capital city, and to solve the urgent problems in urban and rural construction processes (Ye, 1988). "The applications of remote sensing and computer technologies in urban planning" conference was held in Kunming in 1987, and the Chinese Urban Planning Academic Committee of remote sensing, computer science and new technologies group was established in this conference. This

showed clearly how Chinese urban planning began to apply information technologies (Song & Niu, 2010).

In the 1980s, Chinese planners realized that the benefits of computer technologies had been displayed to them though they themselves were still in the exploration stage. For example, computer technologies could provide informative data and maps for cities; they could timely monitor urban developments, which are useful for urban management; they could have broad prospects in projecting population and traffic, analyzing basic data, simulating optimization programs and achieving scientific management (Ye, 1988). However, as said, the planners were still in the exploration stage of application of computer technologies.

4 The third round of urban planning (1991-2007)

4.1 Evolvement of urban planning from 1991 to 2007

The "Urban Planning Law of The People's Republic of China" was firstly implemented in 1990, so urban planning has a legal basis from then on. The second national urban planning conference was held in Beijing in the next year, and in this conference, the full implementation of the "Urban Planning Law" was proposed, "strictly control the scale of large cities, rationally develop medium-sized cities and small cities" was taken as the urban development policy and all cities were required to make the new urban master plan (Ren, 2000). In the same year, the regulatory detailed planning was listed in the "Formulation methods of urban planning" by the Ministry of Construction, and the regulatory detailed planning began to be compiled in the whole country since then (Huang et al., 2009).

"Development is the last word" became the center of the theory of socialist construction since 1990s, which promoted rapid urbanization and large-scale urban construction. Meanwhile, the urban planning system began to be decentralized, and local government's attention and control on urban construction and planning became unprecedentedly increased (Zhang, 2008). Guangzhou and Nanjing took the lead to compile strategic planning for urban development in 2000, which explored the future of cities from the perspective of strengthening the competitiveness of the city. And then, different kinds of non-statutory planning were compiled in other

cities, such as metropolitan area planning, urban and rural integrated planning, provincial coastal zone planning (Huang et al., 2009).

As per capita GDP reached 1,000 dollars in 2003, China changed from a low-income country into a middle-income country, and faced a critical transition period from the initial establishment of the market economy to the improvement of the market economy (Chen, 2004). The central government adopted the principle of "giving priority to efficiency while taking fairness into account" at that time. The "Formulation methods of urban planning" that revised in 2006 emphasized that "urban planning is one of the important policies in regulating urban space resources, guiding the development and construction of urban and rural area, maintaining social justice, protecting public safety and public interests". Therefore, urban planning changed from a tool that used to achieve economic development goals into a public policy, its redistribution and regulatory functions had been increasingly concerned by the central government (Zhang, 2008).

With the development of market economy, the "Urban Planning Law of the People's Republic of China" which was published in 1990 became to hinder the rapid urbanization since it had been affected by planned economy. So it was replaced by the new edition of the "Urban Planning Law of the People's Republic of China" in 2007, which adopted "scientific development" and "Integration of urban and rural areas" to guide urban planning (Huang et al., 2009). The urban planning system was gradually improved during this phase (Fig. 1).

4.2 Evolvement of computer-aided urban planning in China from 1991 to 2007

Planners have always sought tools to enhance their analytical, problem-solving, and decision-making capability (Mandelbaum 1996). From the late 1980s to early 1990s, computer-aided urban planning was popular in China for more urban planning models were available and computer prices were dropping. CAD and GIS became mainstream (Chen, 1995), and urban construction management or urban planning information systems that were based on GIS were widely used (Li, 2000).

During this stage, the main application of computer in urban planning has changed from relying on statistical analysis software to deal with data storage, management, calculation, analysis and forecasting, to develop professional computer-aided systems. For example, Management Information

Systems (MIS)、Computer Aided Design (CAD)、Decision Support System (DSS)、Geographic Information System (GIS) and Spatial DSS (SDSS) were rapidly developed and used to aid the planning process, analyze data, judge available alternatives and project the future.

Computer-aided urban planning in China had made a series of achievements until 2007 (Qiu Baoxing, 2007):1, More than two hundred cities had established urban spatial information infrastructure systems, which were mainly responsible for providing special data or maps for urban planning and design, urban management and regulatory. 2, nearly a thousand of Urban Planning and Design Institute in China have adopted GIS, CAD, virtual reality technology and database. RS played an important role in the urban master plan, urban construction dynamic monitoring, environmental surveys and illegal buildings investigation (Tan et al, 1998).3, 20 cities and 178 national scenic areas had built remote monitoring systems based on geographic information technology, global positioning technology and remote sensing.

5 The fourth round of urban planning (2008-now)

5.1 Evolvement of urban planning from 2008 to now

Chinese urban planning adopted the top-down approach before 2008, so major decisions as well as the regulation mechanism of planning were decided by the central government or the local government, while the public played just a minor role in the urban development process. In this model of urban planning the only interaction is among traditional actors, namely the political leadership and the planners who act as experts (Douay, 2008). With the exploration of bottom-up models of government in China, the time was ripe for Chinese government to foster public debate that can be applied to improve the quality of human settlements in 2008. In this year, China began to implement the "Town and Country Planning Law of the People's Republic of China", which offered a legal protection for public participation in the urban planning process for the first time, and marked that the bottom-up approach in urban planning was legally approved. This Law promoted urban planning models to get altered from top-down toward the combination of top-down and bottom-up. This meant that urban planning entered a new round.

Driessen et al. (2012) developed five modes of governance based on the roles of and relations between the state, the market and civil society. These governance modes include centralized governance, decentralized governance, public-private governance, interactive governance and self-governance. Public participation is tightly related to interactive governance and self-governance, in which citizens can play a role in the decision making process. Public participation has some bearings of public policy and is based on the belief that those who are affected by a decision have a right to be involved in the decision-making process (Lansdown, 2001). Participation in urban planning has increased mainly since the 1990s (Vonk, Geertman, & Schot, 2007). Recently, public participation in urban planning has become increasingly important in China. For one thing, Chinese government began to build pilot smart cities in 2013, in which people play a pivotal role in cities to become “smarter”. Urban planning based on governance with multiple stakeholders is necessary to smart cities (Nam & Pardo, 2011; Naphade et al., 2011; Santé-Riveira et al., 2008; Ylipulli et al., 2013). For another thing, urban plans are more likely to be implemented when they are based on the collaboration among the state, the market and civil society.

In such a context, the view of urban planning is changing from as politics to as collective design. Public participation in the whole planning process will be the major feature of the current round of urban planning.

5.2 Evolvement of computer-aided urban planning from 2008 to now

To develop technologies that ensure informed participation has been identified as one of the research challenges for smart cities (Batty et al., 2012). The most efficient way to acquire useful local knowledge would be through a map-based application enabling a good communication between planners and stakeholders (Narooie, 2014). New sources of urban data, the articulation of urban problems, plans and policies, and all the apparatus used in engaging the community in developing smart cities require new forms of online participation making use of the latest ICT in terms of distributed computation and state of the art human computer interaction (HCI) (Batty et al., 2012). New kinds of software are needed to support public participation in urban planning. The term ‘planning support systems’ first appeared in an article by Britton Harris in 1989, and is defined as geo-information-technology-based instruments that are dedicated to supporting those involved in planning in the performance of their specific

planning tasks (Geertman et al., 2013). Some kinds of planning support systems (PSS) could display data in forms which are easy to understand by a layperson (Hanzl, 2007) and facilitate interpersonal communication to achieve collective goals.

According to their main application orientations, PSS could be classified as: “informing PSS,” “communicating PSS,” and “analyzing PSS” (Vonk, 2006). From the viewpoint of participation, “Informing PSS” can make the public gain greater access to information and enhance the possibility of meeting people with different backgrounds. “Communicating PSS” can provide a communication platform for various actors involved in urban planning. Different kinds of communication platform will generate different modes of communication and decision-making. “Analyzing PSS” enable experts to use big data to make spatial modelling or network analysis or perform suitability or assessment analysis, so a reasonable planning proposal can be proposed. The advantages that such technologies poses when compared to more traditional forms of face-to-face participation are considerable (low cost, easy access to information, flexibility of space and time, resource sharing, increased users, ease of management of informative content, measurement of results, etc.) (Rotondo & Selicato, 2012).

In this background, PSS have been studied by an increasing number of researchers in China. PSS was introduced in China by Liu in 2003 (Long, 2007), as the writer translated the paper “Planning Support System as an Innovative Blend of Computer Tools: An Approach for Guiding Decisions on Industrial Locations in Punjab Province, Pakistan” and published it. Then, the concept model of “WHAT IF!” was described in 2005 (Du & Li, 2005), the authors also used a practical case to discuss its application to decision-making in urban planning process. The framework of PSS has also been studied (Long & Mao, 2010). Due to the great benefits of PSS for urban planning, the usage of PSS in planning processes is increasingly popular in China now, such as Low-carbon urban planning model, the assessment of urban traffic carrying capacity, bus card data mining models, etcetera.

5.2.1 The practice of computer-aided urban planning

In 2012, the local government of Beijing issued a notice about ‘restoring housing levy for the Bell and Drum Tower Square renovation project’, which meant 66 historical buildings in the neighborhood would be demolished. To protect cultural heritage, Peng Wang, a planner, builds the Bell and Drum Tower neighborhood team on Sina Weibo. The team also asked

Dr. Zhou to create a WebGIS (a type of Web-based PSS) called “The protection of the north axis: community participation and communication website for Beijing's ‘Bell and Drum Tower’ neighborhood regeneration project” (Lin, Zhang, & Geertman, 2014). The members of the team and local residents took photos of historical buildings and wrote comments about this project.

The attitudes of different stakeholders for this project are different. Most of the citizens of this neighborhood hold positive or neutral attitudes for the poor living condition, while many other stakeholders hold negative attitudes from the perspective of cultural heritage protection (Feng & Li, 2013; Lin et al., 2014). Finally, the local government abandoned the planned large-scale demolition and instead carried out small-scale renovation (Lin et al., 2014).

6 Conclusions

With the changes of political, economic, cultural and technologic factors, urban planning in China evolves from one round to another. Each round of urban planning was made to solve new problems in the socialist construction. The Chinese management system is gradually changing in the contemporary society, and urban planning models are changing from top-down toward the combination of top-down and bottom-up. Urban planning is facing new problems, such as how to combine bottom-up and top-down in the urban planning process, how to support the public express their opinions and how to ensure their opinions been respected by the government and experts.

International research experience show that participation platforms based on “informing PSS,” “communicating PSS,” and “analyzing PSS” can improve public participation in urban planning practices. Moreover, ICT-based public participation can challenge the traditional centralized governance, decentralized governance and public–private governance towards interactive governance and self-governance. Therefore, there is a growing support for PSS in China recently. Researchers focus on the theory, the framework and the instrumental characteristics of PSS, however, there still exists underutilization of PSS in planning practice. In other words, few planners put PSS into urban planning practice compared with the popular academic research by scholars. The further research on PSS should focus on improving its relevance for planning practitioners.

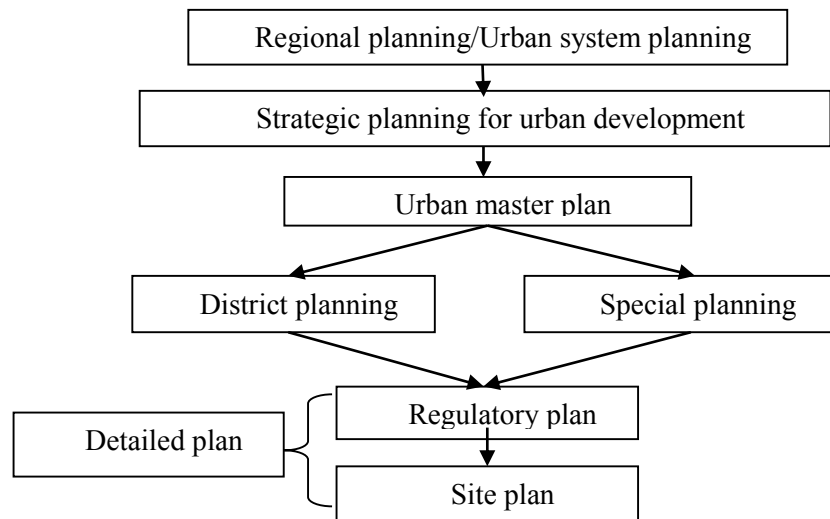


Fig 1. Urban planning system in China

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