Chapter 1 –Cities in Transition

1.1 Introduction

1.1.1 Emerging Technologies are Greatly Changing Urban Life

In the context of the fourth generation of the industrial revolution, emerging technologies have impacted almost all fields worldwide. The concept of the 'smart city' is gradually being formed - using the Internet of Things, cloud computing and other new generations of information technology (Anthopoulos 2017; Komninos and Mora 2018) to change the way governments, enterprises and people interact with each other; to improve the efficiency of resource utilization, optimize urban management and services; and thus, to improve the quality of citizens' lives (Hollands 2008; Washburn et al. 2009; Dirks and Keeling 2009; Toppeta 2010; Scholl and AlAwadhi 2016; Lopes 2017). Digital twin systems that reflect the characteristics of a physical space and interact with a physical space in real time are also gaining attention (Batty 2018). In practice, Germany's 'Industrial 4.0', America's 'Industrial Internet', China's 'Made in China 2025', Singapore's 'Smart Country 2025', South Korea's 'U-City Plan' and other programs have been proposed to promote the development of intelligent manufacturing and the construction of smart cities. With the construction and development of smart cities and the applications of technology, the impact of emerging technologies on cities and society has also attracted much attention (Debnath et al. 2014). In Japan, 'Social 5.0' emphasizes the symbiosis of humans with quality-of-life robots and artificial intelligence (AI), providing customized services for the complex and diverse segmentation needs of users. In China, President Xi Jinping's 'smart society' in his report to the 19th National Congress emphasized that intelligent changes in people's productive lifestyles will more deeply impact all areas of society. These concepts illustrate that the people-oriented perspective of smart social activities is the main characteristic of smart cities.

In recent years, a book titled *The Inevitable* (2016) has attracted the attention of academia (Sayegh et al. 2016; Josep et al. 2019), in which Kevin Kelly forecasted the twelve technological forces that will shape the next thirty years. In his opinion, much of what will happen is inevitable, driven by technological trends that are already in motion. Cutting-edge technologies such as virtual reality in homes, an on-demand economy and artificial intelligence embedded in everything we manufacture will have significant impacts on the way we work, buy, learn and communicate with others. These deep trends, namely, *Becoming, Cognifying, Flowing, Screening, Accessing, Sharing, Filtering, Remixing, Interacting, Tracking, Questioning,* and *Beginning,* are described in this book-

1. *Becoming- everything will always be upgrading. We won't have time to master anything before it is displaced.*
2. *Cognifying- everything will be intelligent. Our new jobs will be to teach machines how to do our old jobs.*
3. *Flowing- everything will be copied. Time has shifted as well; the only things truly valuable are those that cannot*

be copied.

4. Screening- everything will be linked.

5. Accessing- no one owns anything.

6. Sharing- everything is shared. More artists, authors, and musicians are creating more books, songs, films, documentaries, photographs, artworks, operas, and albums every year.

7. Filtering- no one will have time to read anything. A wealth of information creates a poverty of attention. Our attention is our only valuable resource. While the cost of everything trends to zero, the price of human experience continues to increase.

8. Remixing- everything will be "redoable". Immersive environments and virtual realities in the future will be able to scroll back to earlier states.

9. Interacting- everything will be immersive. The best VR (Virtual Reality) triggers deep engagement with other people.

10. Tracking- everything will be recorded. We will record everything we do, all the time, for our entire lives, with total recall.

11. Questioning- everything will be improbable. Impossible things will actually happen all the time. The improbable will be the new normal.

12. Beginning- everything will be one, very large thing.

In this chapter, we also summarize some of the changes that are taking place in the world, especially in China today. These changes have led to changes in urban life from the perspective of technology and people's needs, which can be regarded as the most original motivation for us to propose Data Augmented Design.

1.1.2 Urban Space also Changes with the Transition of Urban Life

From the perspective of urban planning and design, emerging technologies have a profound impact on urban life and thus on urban space. For example, the emergence of elevators made high-rise buildings possible, extending the vertical space of human settlements. The popularity of cars made the road network the skeleton of the city, expanding people's travel scale. Under the influence of the fourth generation of the industrial revolution, cutting-edge technologies, such as the Internet of Things (IoTs), self-driving cars, smart logistics, drones, virtual reality, and emerging concepts, such as the sharing economy and personalized activity and experiential consumption, have been changing the way we dwell, work, travel and play. Eventually, the form or usage of urban space will also change. Traditional urban space is facing a transformation from conventional functions or forms to new ones, and at the same time, the new form of space organization is also gradually forming. We are expected to understand the influence of new technology on urban life and urban space and apply it to urban planning and design practice.

Some scholars have observed and concluded some changes taking place in urban life and space under the influence of ICT (Information and Communication Technologies) - virtualization (Konrad and Wittowsky 2018), mobility (Konrad and Wittowsky 2018; Ben-Elia and Zhen 2018), fragmentation (Lenz and Nobis 2007; Ben-Elia et al. 2014) and complexity (Shachaf 2008). The emergence of wireless network technology and the popularization of mobile information terminals have allowed people to enter a new era: the mobile Internet era. People's social and working habits are changing because of convenience (Rheingold 2002); that is, the advent of the mobile Internet makes it possible to conduct

online activities anywhere, anytime in multiple ways. Activities that once required a fixed location and connection can now be conducted with greater flexibility, resulting in the ability of users to act and move more freely (Duffy 1997). Kenyon (2008) proposed the phenomenon of "multitasking" when he studied the influence of information and communication technology on residents' use of time and space. It is the "multitasking" of space and time that causes the "fragmentation" of space and time (Couclelis 2000). Moreover, the spatiotemporal boundary between residence, work and leisure is becoming increasingly blurred. People can work in their leisure time or participate online leisure activities in their working time. The living place and working place are "integrating two into one" (Wei et al. 2012). These observations and conclusions provide us with inspiration for understanding urban space in a new way.

Next, we will describe a series of changes that are taking place in cities based on our many years of observation. Technological advances have given birth to the transformation of the driving force of urban development, which has led to the transformation of urban products and services, and the lifestyle of people has also changed. Urban space, as the carrier of urban life, also exhibits the characteristics of the new era. In this chapter, we will discuss in detail the transformation of the urban driving force (Section 2), changes in products and services (Section 3), and new features in urban space (Section 4).

In this context, urban research methods are also undergoing changes. The New Science of Cities was born, unlike the "regional science" embodied in the "old" urban science. The New Science of Cities uses newer technologies and tools that are evolutionary, complex and scientific, more discrete and bottom-up. At the end of this chapter, we will introduce "the study of urban discipline models based on in-depth quantitative analysis and data analytics" – The New Science of Cities. The New Science of Cities is the transformation of research methods and perspectives that led to the birth of the concept of Data Augmented Design, which is the topic and core of this book.

1.2 Driving Forces of Cities are in Transition

1.2.1 Smart Technology Supply

In the era of the mobile Internet, the driving forces of cities are in transition. AI, as technical support, disruptively defines this age and people's lives. Kevin Kelly (2016) noted that "it is hard to imagine anything that would 'change everything' as much as cheap, powerful, ubiquitous AI…. The arrival of artificial intelligence thinking accelerates all the other disruptions… it is the Ur-force in our future…. But a bigger payoff will come when we start inventing new kinds of intelligences and entirely new ways of thinking…." Since science and technology keep advancing, the concept of smartness or intelligence has been seen in every facet of urban life, and self-service stores, smart housing and communities, and other intelligent-technology-supported emerging products have greatly improved the convenience and working efficiency of human life as well as the diversity and accessibility of recreation. Smart people, smart mobility, smart economy, smart environment, smart living and smart governance are six characteristics of smart cities (Giffinger et al. 2007).

However, these intelligent technologies are challenging human beings in unprecedented ways: currently,

intelligent products, such as robots, are replacing human labor in low-tech, hazardous, or repetitive jobs and radically changing the climate of the workforce market in all industrial sectors. According to the report, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* released by McKinsey Global Institute (2017), up to 800 million individuals worldwide could be displaced by automation and will need to find new jobs by 2030. Of the total displaced, 75 million to 375 million individuals may need to switch occupational categories and learn new skills. In 2018, by analyzing the tasks and technologies of more than 200,000 workers throughout the world, PricewaterhouseCoopers Taiwan noted that the impact of automation on labor in all industries will reach 30% by the mid-2030s. The top three industries most likely to be impacted by automation are transportation and warehousing (52%), manufacturing (45%) and construction (38%).

Fortunately, the urban planner and geographer Michael Batty (2018) argues that "the real power of AI may well come from collaborations of man and machine, working together, rather than ever more powerful machines working by themselves." For instance, highly routinized short-term cycles can be predicted using AI, but "there are some hard choices involved in producing any plan for long-term development… and it is difficult to see the kind of design and decision-making involved in such planning being replaced by an AI…. Doubtless, the development of AI… will be useful in extending our understanding of how the high-frequency, real-time city actually functions, but it is difficult to see how such methods will ever dominate plan-making and design except in the very short term" (Batty 2018).

1.2.2 Individual Demand for Instant Service

In addition to the smart transformation of cities caused by technology, in this era of rapid development, on-demand services are provided for people's real-time needs. Kelly (2016) argued that "our appetite for the instant is insatiable. The cost of real-time engagement requires massive coordination and degrees of collaboration…. Our lives are accelerating, and the only speed fast enough is instant… on average communication technology is biased toward moving everything to on demand. And on demand is biased toward access over ownership…. The expectation shifted so fast…. Now in the third age, we have moved from daily mode to real time." In China, this phenomenon is more prominent. People rely on a variety of Internet platforms to find products or services that meet their needs. Taobao and JD.com (Chinese version of Amazon) serve as e-commerce platforms to provide convenient shopping services for people and to deliver products to customers. Meituan and Ele, as typical O2O (Online to Offline) platforms, provide more timely service to customers. This individual demand for instant service will inevitably change citizens' lifestyle and ultimately change the functional distribution and urban pattern of the city. Sharing concepts that things are used but not owned also thrive in this context.

1.3 Transitions of Products and Services

As Batty (2013) said, "our technologies enable us to share and communicate at a distance…. The global world that has emerged is dissolving our reliance on material movements in favor of the ethereal and the social. Information is replacing as well as complementing energy." The physicality of flows between energy and information, manifested as materials, people, or ideas, exists in real Euclidean space but is often hidden from our immediate senses as in cyberspace or information space, which may have no

geometric bounds. Based on these flows and networks, information products, durables and services in cities are also in transition.

1.3.1 Flowing, Fragmented, Crowd-Innovated, and Algorithm-based Information Products

Over the past two or three decades, the age of information mobility and information spread among media has no longer relied on certain forms but has continued to change. This change will continue in the coming decades. Information products such as music, text, image, video, video game, website, software and education have become an important part of our lives. Flowing, fragmented spreading, crowd-innovating and reliance on algorithms are the four main characteristics of information products. These products often have four phases: mobility-fixed and rare physical products, massive and cheap flows that are spread, various information sharing flow services, and crowd-innovated flows that are open and always changing. Currently, sweeping information-flow services reduce the cost of information creation and enable ordinary people to act as agents of creating and spreading new information. In addition, information mobility is characterized by its fragmented spread, which responds to today's fast lifestyle but results in a decline in people's time and attention for in-depth reading, learning and thinking. In addition, the decreasing cost of information creation shows the large commercial potential of crowd-innovated and sourcing information, encouraging the boom in nonelite music, films, books, and other art forms. Finally, the algorithm-based online platform is a characteristic feature of information mobility and influence. Today, people can easily obtain diverse instant information (such as information about real-time traffic, shopping and daily consumption, and tourist attractions) from these online platforms. Individuals become accustomed to or even overdependent on such information, which eliminates uncertainties and possibilities in one's daily life, shaping a city built on massive algorithm-processed results rather than individual preferences. When people are highly reliant on Internet information and are guided by formulated algorithms, the urban physical environment changes dramatically.

1.3.2 Sharing, Service-oriented, and Individual-Requirements-based Durables

As urban productivity increases, people's attitudes toward durable goods have also changed. The first change is the notion of "sharing", which means durables can be used but not necessarily owned. The idea of sharing has been introduced into all urban sectors over the past few years. The sharing economy is redefining individuals' lifestyle. People can exchange idle belongings, property, knowledge and experiences on third-party platforms supported by information and communications technologies. Durables such as bicycles, automobiles, houses, offices, wardrobes, umbrellas, power banks, and washing machines are no longer simply supplied as commodities but as services. The sharing economy makes use-on-demand work rather than use-on-ownership. The second change is service-oriented industries. It is predicted that service industries will enjoy the greatest job market, which is dominated now by manufacturing industries. A service can be launched in many forms that can generate more added value than that of a product, which is why a large amount of money is pouring into service industries. In addition, this age of the Internet is characterized by increasing decentralization and the diversity of individual lifestyles. Beyond the homogeneous mass production in the Industrial Age, technologies such as 3D printing have considerably lowered manufacturing costs; social and economic development also increases suppliers' resources, which significantly encourages individual requirements-based durables. With technological supports such as high-speed computing and the IoT,

cities in the future will not only meet citizens' basic living demands but also be able to radically improve resource allocation, spatial optimization, and citizen service by various real-time needs computing.

1.3.3 Home-based, Self-assisted and Experience-oriented Services

With the increasing demands in this era, the service industry also benefits from the mobile Internet, which has resulted in some new forms of services. Transportation development and advances in information and communications technology have together redefined the supply-demand relations of urban services: a more precise supplier-consumer matching mode is formed. Home-based services, such as food delivery, hairdressing, car washing, and cellphone repair, no longer require a physical store, which would vacate a large amount of urban space and encourage the emergence of living-commercial space in cities. All these changes have challenged the existing standards of urban spatial planning and construction. At the same time, many consumables and services are supplied to the public 24/7 in self-assisted forms, such as car washing, convenience stores, and book stores. In this way, services are available all day, saving labor costs and meeting people's immediate use on demand. Under the impact of the former two new service forms, services in traditional urban commercial spaces are also changing. Experience-oriented services are becoming an indispensable content in the physical commercial space. In other words, people pay more attention to experiences in the physical commercial space than to buying a specific product. Commercial space becomes a mixed place for a variety of activities, such as shopping, dining, entertainment, socializing and education. These changes in products and services in cities not only efficiently save the time and travel costs of both suppliers and consumers but also help relieve traffic pressure by reshaping the flows of urban population and goods. In the future, urban planners, designers, researchers, and decision-makers are expected to respond to these changes.

1.4 Transitions of Urban Space

Cities are the earliest Internet of human beings. Compared with the countryside, the advantage of the city is its close-range and high-density interpersonal communication space, which brings about an efficient social organization structure. However, compared to cities, the Internet is a more efficient interpersonal machine that is constantly changing the spatial structure, resource allocation, functional layout and information retrieval of cities.

1.4.1 Fragmented, Distributed and Mixed-use Urban Space Restructuring

On the macro scale, urban spatial structure is affected by flow and network. Batty (2013) argues that "there is little doubt that automation and instrumentation of retailing, transport, health, house buying and a variety of other traditional spatial behaviors is changing the way in which the city is structured spatially". The new location theory in the age of the Internet is gradually formed: physical spatial locations are changed or even disrupted by network-space locations, resulting in fragmented urban space patterns, the decentralized distribution of urban resources, and mixed urban land uses. In restructured urban spaces, the information hierarchy built on physical spaces is shifting toward a flat network-based structure. The Internet has given new opportunities for fragmented spaces deep in cities, freeing them from traditional space locations and re-establishing their appeal through online evaluations.

1.4.2 Transition of Traditional Urban Space

In the age of sharing, the traditional urban land-use mode would also be restructured or upgraded. Maker space, coworking space, and even co-living space have gained momentum over the past few years, which has accelerated the integration of teams and talent, innovation and entrepreneurship, online and offline resources, incubation and investment support, and so on. The Vanke Group first proposed the idea of a City Supporting Service Provider in 2014 to set up a new sharing business and the corresponding spatial forms by 2024 by integrating technological achievements. Vanke also completed the Design Commune in 2017 in Shenzhen, which is a mixed-use community for rent that combines working, living, and commercial spaces together for various needs in a resource-saving way. The low rent of the Design Commune has attracted a number of business groups, and many full-industrial-chain entrepreneurial neighborhoods of various sectors have been formed. The commune truly provides great convenience through home-workplace blending. Such practices are increasingly seen in metropolises in China and abroad. It is predicted that the current centralized, large-scale urban public spaces will be transformed into massive smaller spaces to serve micro communities. Barcelona, for example, is a city where microsquares are ubiquitous and form a vigorous network of urban public spaces. Additionally, the number of public spaces with natural landscapes is increasing to meet people's desires to return to nature. Moreover, the commercial space is shrinking in size to serve chain business for self-assisted, scenario experience-based, and entertaining services.

1.5 Conclusions

Changes in lifestyle throughout human history are caused by changes in production modes, and changes in production modes are driven by technological innovation and productivity development. This chapter introduced two driving forces of cities in transition-smart technology supply and individual demand for instant service. These two driving forces have led to changes in products and services. We divide products and services into three types based on their forms, each of which presents multiple characteristics. The first type is flowing, fragmented, crowd-innovated, and algorithm-based information products, which are brought about by the progress of information and communication technology. The second type is sharing, service-oriented, and individual requirements-based durables, and this type is beginning to affect the way of life of urban residents more and more deeply. The third type is home-based, self-assisted and experience-oriented services. These services could free people from many day-to-day nonprofessional jobs and provide people with more flexible time and place for entertainment, which is hoped to improve the quality of people's lives and rest time efficiency.

As mentioned above, cities are undergoing tremendous changes, so the science of urban space or urban problems should also take note, and new techniques and ideas are needed to help us understand our cities. According to Michael Batty (2013), as our technologies enable people to connect ever more easily and in many new ways, our understanding must be enriched by the studies of networks, interactions, connections, transactions, and every other possible way in which we are able to communicate with one another. Thus, the science of cities, as an interdisciplinary subject, studies different urban problems based on multidisciplinary research results. With the rapid development of new technologies and data, represented by computer technology and multicity data, the concept of a new science of cities proposed by Batty (2013) is a proposal for a new way to understand cities and designs not simply as places in

space but as systems of networks and flows. This new science can be defined in a way that embraces the new data and provides a clear testbed for applications to problems relating to the big questions of our time, including inequality, aging and the future of work, all of which have enormous spatial as well as temporal variations that need to be understood and explained (Batty 2019). In the book *The New Science of Cities*, Batty concluded with some models to understand the science of cities from six different perspectives that we think about cities, namely, the growth, hierarchies, urban structure, distance, fractal growth and form, and urban simulation, and illustrated some good models of design that lead to decisions.

The introduction of the new science of cities has inspired the formation of the theme of this book: *Data Augmented Design* (DAD) methodology. We also look forward to a more quantitative and scientific approach to help understand the changes that are taking place and are about to take place in our cities and to enrich current urban planning methods. However, unlike the new science of science, DAD not only presents a series of tools for quantitative analysis and urban studies but also focuses on the transitions of urban space and urban life. The content in this chapter is the foundation of DAD, which in turn, reflects the important issues we apply in design and research.

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