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Article

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Harnessing iCity of the cyber and physical worlds



Rapid urbanization in China and other Asian countries over the past few decades can be viewed as representative of the urban development process occurring under the conditions of time compression. In contrast to when this process occurs in normal times, when it occurs within limited amounts of time and space, the resulting rapid growth of cities and expansion of associated activities can lead to various urban problems, including shortages of land for housing, as well as traffic congestion and negative environmental impacts.

The two main driving forces of urban development under time compression are information and communication technology (ICT) and physical development. In a sense, the former creates a cyber world of human activities whereas the latter results in a physical world of the built environment. The two worlds reinforce each other and constitute the urban development process, with different time compression effects.

Cities characterized by ICT are described with terms such as Smart City, Informational City, uCity, and iCity. The term iCity gained popularity at an early stage (e.g., Carmagnola et al., 2006, pp. 1–6; Govindaraj, Ash, Hull, & Lu, 2007) for conveying the sense of informed urbanism, and the concept has continued evolving with the advance of information technology (Seif & Hu, 2016). However, we are still just beginning to understand the dynamics of urbanism through the lens of time compression. For example, ICT speeds up and compresses information flows that trigger various activities and construction in the iCity. On the other hand, rapid construction, if located properly, attracts more people into the iCity, resulting in more need for interaction, which can be served by ICT.

The cyber and physical worlds in the iCity are both complex systems. For example, in the cyber world, the distribution of Internet nodes self-organizes into nested networks. In the physical world, the spatial structure of the city self-organizes into a complexity of communities. Together, the two worlds in the iCity form a giant complex spatial system that defies traditional analytical methods and creates unprecedented challenges for urban planners and managers. As with urban development under time compression, we are just beginning to understand the iCity as a complex system through the lens of Big Data and Complexity Science.

Sharing is a natural response to the planning challenges under time compression and complexity. Sharing makes efficient use of resources. For example, bicycle sharing is conspicuous in most megacities that apply iCity concepts in China, such as Beijing, Shanghai, and Hangzhou. Car sharing and house sharing are booming in some Asian cities. Resource-sharing initiatives such as these create promising opportunities for new industries to emerge. They also change the ecology of the urban economy. We need not only a new way of looking at the iCity through the lens of cyber and physical systems (CPS) (Rajkumar, Lee, Sha, & Stankovic, 2010), but also a new way of planning and managing the iCity through the lens of emerging sharing industries.

The five articles in this special issue demonstrate the diverse practices relating to iCity in Eastern, Western and Southern Asian countries of Japan, Iran, Turkey and India. They are insightful for considering the challenges and research directions. Yan and Sakairi gave a comprehensive review on the development and application of cyber and physical IoT systems in the dimension of geographic space as expressed by term of Geo CPS. Two forms of Geo CPS are discussed: pseudo-CPS (PCPS), which projects spatial data onto a display without interaction among data sources, and true-CPS (TCPS), which handles data sources deeply and semantically. The authors conclude that while PCPS already has wide industrial applications, TCPS is still in its infancy. New schemes and platforms are needed for data sharing, processing, security, and privacy.

Nakayama and Yan analyze the role of convenience stores for the “last mile” of delivery service. The convenience store market has ballooned in Japan and worldwide as a new retail business model since the 1970s. Every convenience store in the physical world is a compressed information node for receiving services from the cyber world. However, the information flows are not equally distributed in iCity. There are information divides and service gaps between city centers and suburbs, transportation hubs and less-convenient rural areas.

Those gaps are sometime referred to as a food desert or delivery desert in physical cities such as Tokyo, or differentiated in terms of poverty in the Iranian city of Sabzevar, in the article by Rahman Zandi. Urban poverty zones correspond to areas of unofficial

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settlements and extended villages, while zones with less poverty are mostly located in the city's central neighborhoods, housing mostly government employees, the salaried, and those with high-paying jobs. Eliminating inequalities in urban neighborhoods remains a challenge for most cities. iCity could play a leading role for achieving national and global targets such as the UN's Sustainable Development Goals (SDGs).

A shared business model such as the Cab Aggregator from the Indian city of Kolkata, covered in the article by Anindya Basu, is a good example. In cities with less public transport, commuters can benefit from cab-like app-supported car-sharing services in terms of better availability, reliability, cost effectiveness, safety, cashless options, driver behavior, comfort, and absence of the need to bargain. Admittedly, there are issues regarding transparency and surge pricing, while drivers are content with their improved earnings. iCity holds promise by harnessing fragmented and finite resources into shared platforms.

On the other hand, Gizem Erdoğan's article presents a strategic perspective of iCity on the physical environment with the “lights out factory,” which means factories that are fully automatic and intelligent, and need no lights. In an iCity where the cyber and physical worlds are integrated completely, the lights out factories will become widespread due to the energy savings and considerable reduction in labor costs, and this will bring a transformation to land selection for industrial plants. New land selection criteria for lights out factory districts are discussed in terms of using spatial patterns effectively. In this sense, iCity casts questions to urban planners for transformative urban structure and working-living styles. Until the fourth industrial revolution, cities have always directed spatial development according to land selection for industrial plants. In the new era, the elimination of the labor force will overthrow this conventional urban model and reshape the urban planning chain. In this context, urban planners will have to deal not only with the dynamics of the lights out factory land selection, but also with idle production sites in the city center, the transformation of urban systems working with these areas, the urban residential areas to be reshaped by the transformed labor force, and the revitalized communities and green circulation systems.

The potential impact of iCity on the physical built environment is significant. The experiment is ongoing in Chinese cities. The City Brain project in Xiaoshan City and Hangzhou City (Yan and Sakairi) has demonstrated the future of smart cities where no traffic signals or operators are needed on the streets. This is a totally different situation from what we are living in now. Meanwhile, all of this requires innovation in urban management.

Until now, most facilities and assets have been managed in closed environments in the physical world. In closed environments, systems and business models are built upon well-defined conditions within a limited system boundary, for instance, when a robot stands behind the reception desk to receive visitors, or an operator touches a screen to communicate with the machine.

Going forward, more will have to be done in open environments. Here *open* means sharing, co-existing, and co-habiting with different systems, and collaborating and cooperating with diverse stakeholders, including governments, corporations, the private sector, and citizens, etc. The boundaries of the openness will determine the complexity of the cyber and physical system, which could be a front desk between a robot and a customer, a closed field at a construction site, a floor in a hospital, or a vast motorway network. Working in such a diversity of open operating environments in geo space can be very exciting. Meanwhile, if we are to embrace iCity better, all of this requires a high level of sophistication in terms of data policies, security, technical specifications, social norms, and so on.

This special issue was inspired by a discussion at the 2018 Inter-University Symposium on Asian Megacities in Hangzhou. We appreciate the contributions of Professor Han Haoying and his colleagues for hosting the symposium. We also thank the panel members and participants for deepening the discussions on iCity.

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