

Research Frontiers and
Global Benchmarking
for Building Intelligent Cities

全球智慧城市 研究前沿与实践标杆

编译 ○ 顾慧超 盛建新 蔡婷婷
陈姝婷 余挺颖 白玉英 林 洪

中国出版集团
世界图书出版公司

Research Frontiers and Global Benchmarking for Building Intelligent Cities

Preface

Prof. Nicos Komninos
URENIO Research, Aristotle University of Thessaloniki
www.urenio.org

Intelligent cities: towards a new planning paradigm

The world is changing. All we know about technology, production, trade, creation and the distribution of wealth is becoming rapidly obsolete. Deep crisis is becoming a permanent feature of developed countries; most dynamic growth regions are to be found in Asia; global innovation investments flow mainly into China and India; G20 is replacing the G7 as the primary venue for economic co-operation. A new world is rising, a global world fuelled by information technologies, intense knowledge flows, user-driven innovation, and global supply chains.

A new generation of cities is rising also: knowledge-intensive, innovative, and intelligent. Intelligent cities are driving and being driven by the above global changes. The contribution of cities in the innovation-led global economy is rooted in their power to create synergies among technologies, knowledge, and skills scattered across the city's population and organisations. Every resident of a city and every organisation located there (be it a business, research centre, university) are carriers of explicit and tacit knowledge. Their relationships of collaboration shape how information and knowledge channels are created, technologies transferred and exchanged, and synergies are created. Digital spaces are facilitating and strengthening such information and knowledge flows.

City leaders all over the world consider innovation institutions and information technologies as critical drivers for addressing the challenges of competitiveness, employment generation, the fight against poverty, and sustainable development. A sea of web-based applications has become already available to improve the ability of cities to manage information, transmit knowledge, use information technology for learning and innovation. Included are: wired and wireless broadband networks, Metropolitan Area Networks, fibre optic cables linking the main organisations and institutions of a city, websites and portals for city branding, virtual cities, social media for creating online communities, city guides, professional directories and lists of businesses and organizations, local marketplaces, advertising multimedia and e-commerce applications, digital spaces for education, research and innovation, environmental monitoring and alert, digital representations of historic sites and districts, virtual tours of monuments and cultural heritage, applications for city management such as automated budgeting, automated property registers, integrated personnel management, automated social security, thematic databases and open datasets, e-government city clouds, applications for journey planning and way-finding, smart energy and water grids, and sensor networks embedded into the physical space of cities.

These infrastructures and applications advance informatisation and innovation in cities offering better communication, online spaces of collaboration, real-time information, and knowledge and information management tools. This extremely rich digital spatiality over the cities has given birth to a family of new concepts such as cyber cities, digital cities, smart cities, intelligent cities, placing emphasis differently on relationships between cities, innovation, and digital spaces¹.

Intelligent cities lead to more effective cities, open innovation systems enabling the global extension of collaboration networks and the participation of users and citizens in innovation. These two novel elements – (i) global innovation networks and (ii) user-driven innovation – become feasible because of the digital spatiality of cities. Some good examples can be found in cities which received awards from the Intelligent Community Forum², in the European Network of Living Labs³, and the CONCERTO cities for energy and environmental efficiency⁴.

The key function of intelligent cities, intelligent communities, Living Labs, and other forms of large scale intelligent environments is to widen collaboration within systems of knowledge and innovation with the participation of overseas suppliers, innovators, citizens, and the end-users. This is achieved through intense networking and information exchange, both at local and global scales. However, intelligent cities are an attractive route to follow, a strategy, and a vision for the future, rather than a fixed urban pattern that has been realized. There is a long way before turning this planning vision into reality. To date, the 'Intelligent City' is a planning paradigm than a realised urban system.

Three-layer structure

Intelligent cities emerge from a combined deployment of knowledge-intensive activities, innovation practices, and digital spaces (broadband networks and IT applications). Digital spaces can improve informational and cognitive processes through information collection and processing, real-time alert, forecasting, online learning, collective intelligence, distributed problem-solving. The role of innovation practices is equally important: primarily to elaborate good solutions to urban problems and challenges, and secondly to create the digital spaces for communication, interactions, and community building. It is the combined deployment of urban activities, innovation practices, and digital spaces that creates more efficient urban systems. Thus, an intelligent city is a three-layer urban system:

The first layer includes the city's activities and clusters in manufacturing, trade, and services. The population of the city, knowledge workers, innovative companies and knowledge-intensive sectors are the fundamental elements upon which intelligent cities are constructed. These activities usually cluster spatially creating business clusters or city districts, smaller cities within cities. Proximity in physical space is a positive factor that enhances collaboration among producers, suppliers, technology providers, and customers within city clusters. Specialization and co-operation advance innovation further. A critical factor at this layer is the intellectual capital of the city population, the cognitive and learning skills of people living in the city.

The second layer includes institutional mechanisms and practices for collaboration in technology and innovation. Characteristic cases are practices and institutions enhancing R&D, strategic intelligence, venture capital financing, technology transfer, collaborative new product development, and new company creation. All these practices should be realised collaboratively, within communities of trust and cooperation. Therefore, critical factors at this layer are institutional thickness in the field of innovation, the social capital of the city's population, and the collective intelligence of the city's population.

The third layer includes broadband networks, digital applications and e-services that make collaboration and innovation development easier. This tangible and intangible infrastructure creates virtual innovation environments, based on multimedia tools and interactive technologies, which operate in four fundamental pathways towards innovation: market and technology intelligence, technology absorption, collaborative new product development, and product marketing and promotion. However, the effectiveness of broadband communication, web apps and virtual spaces are extremely limited if disconnected from creative organizations, people, and innovative city clusters.

The higher efficiency of this system is due to the integration. Intelligent cities bring together knowledge-intensive activities, institutions for cooperation, learning and innovation, and digital communication spaces to maximize problem-solving capabilities. Thus the concept of "intelligent city" refers to all the three aforementioned aspects of the physical, institutional, and digital space of a city. Speaking literally and not metaphorically, the term "intelligent city" describes a territory (community, district, cluster, city, even a region) disposing simultaneously the following characteristics:

1. Creative populations and clusters or districts of activities relying on information and knowledge flows (Layer 1);
2. Institutions and practices for innovation, collaborative innovation mainly, enabling cooperation for acquiring, adapting, and advancing knowledge and know-how (Layer 2);
3. Broadband infrastructure, wired and wireless, digital spaces, applications and e-services, online knowledge management tools, data centres and processing (Layer 3); and
4. A proven ability to innovate, resolve problems, improve performance in all domains of cities – economy, utilities, energy, quality of life - since the capacity to innovate and resolve problems are critical factors for documenting intelligence⁵.

What emerges from these components is a combination of individual, collective, and artificial intelligence, which arises from people, cooperation for innovation, and ICT infrastructure and applications. The spatial intelligence of cities comes from the combined intelligence of the city's population, collaboration in innovation, and smart environments that support community and innovation.

Impact

All domains of the city can be substantially improved through intelligent city planning and governance. Below, a series of different domains are listed as potential fields of intelligent city planning:

- *Urban economy*, including all production sectors and clusters of manufacturing, logistics, financial services, commerce, tourism, education, and districts such as CBD, historic centre, shopping centres and malls, industrial areas, technology and business parks, university campuses, port and airport hubs, sport and recreation areas.
- *Quality of life - Living in the city*, including aspects of consumption and well being, improving the quality of life, bridging social and digital divides, monitoring the environment, offering safety in public spaces, and social care services.
- *City infrastructure / utilities*, including transport and mobility, the smart grid for energy-saving and alternative energy sources, water and waste disposal networks.

- *Governance*, including management of citizens requests, offering administration services to citizens, all-inclusive decision-making and e-democracy, planning, monitoring and measurement of city's working and performance.

All these domains are considered from the same perspective: as potential fields in which communities, collaborative innovation practices, and ICTs are brought together to address challenges and problems more efficiently. Turning city clusters and districts to intelligent is deploying broadband networks and digital spaces to improve their functioning and performance with better products and services, lower operation costs, larger market shares, higher citizen satisfaction, less CO2 and limited environmental footprint. The great challenge is infusing "intelligence" into the various sub-systems of a city; make them more efficient not only through artificial intelligence and ICTs but also through collective intelligence, collaborative actions and institutions.

There are many different ways for improving city intelligence. We have called these alternative trajectories "variable geometries of spatial intelligence of cities"; they correspond to different ways that innovation institutions and digital spaces are combined to increase the problem-solving capability of communities. Some well-known paths are "*orchestration intelligence*", which stems from organised workflows within a community combining people's skills, collective know-how, and machine intelligence; "*amplification intelligence*" which is based on learning, up-skilling and talent cultivation within the city's population using open innovation platforms and ICT infrastructure offered by the city; and "*instrumentation intelligence*" based on streams of data and information generated from the functioning of cities, gathered from sensors and smart meters, which enable more informed decisions to be taken by citizens and city organizations⁶.

Monitoring, measurement and assessment are indispensable practices for identifying the impact of intelligent city planning. Without monitoring and measurement, most intelligent city aspects related to innovation and digital interaction will remain hidden into log files. Progress in the performance of cities, their economy, wealth, environment, energy consumption, CO2 emissions, is the only secure way for documenting increases in spatial intelligence. But, apart from documenting impact, city data and analytics can provide insights for assessing behaviours and use patterns and allow for the identification of new service opportunities and better urban sustainability.

¹ Schaffers, H., Komninos, N., Pallot, M., Trousse, B., Nilsson M., and Oliveira, A. (2011) "Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation", *The Future Internet, Lecture Notes in Computer Science*, Vol. 6656, pp. 431-446

² <http://www.intelligentcommunity.org/index>

³ http://www.openlivinglabs.eu/llmap_cc

⁴ http://concertoplus.eu/cms/index.php?option=com_content&view=frontpage

⁵ Komninos N. (2008) *Intelligent Cities and Globalisation of Innovation Networks*, London and New York, Routledge.

⁶ Komninos, N. (2011) "Intelligent Cities: Variable geometries of spatial intelligence", *Journal of Intelligent Buildings International*, Vol. 3, pp. 1–17.