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Alternative Planning and Land Administration for Future Smart Cities

According to urban scholars, industries, and governments (1), (2), future cities are only smart when investments in human and social capital (smart people), traditional transport (smart mobility), and modern digital infrastructure (ICTs) fuel smart sustainable development. The sustainability elements in a smart development refer to high quality of life (smart living), productivity (smart economy), and a wise management of natural resources (smart environment), through participatory governance (smart governance). The long-term planning approach with its central aim of changing the urban form using zoning regulations and improving transportation may no longer be the only conceivable solution (3). Participants in planning and land development processes formu-



lating plans today are predominantly land developers, entrepreneurs, and landlords. However, community groups are increasingly active participants, providing a counterbalance to the profit-driven agenda of corporations (4).

The smart cities model for planners and land administration organizations is beyond the

scope of automated routine functions serving infrastructures, individual buildings, and persons. It is an integrative and collaborative approach that facilitates a network and stream of continuous information to plan for equity, quality of life, and efficiency in cities (5). These are data about the spatial transformation of land, movement

of people, and other urban entities. The collection of such data is used to drive evidence-based decisions for the provision of city services, city governance, and the future of physical and social forms (5)–(8).

Current investments in infrastructure, particularly ICT, are producing new urban and regional environments. These generated spaces in urban and suburban areas are vastly different from our previous experience, often regarded as digital urbanism (9). For example, the development of digital work hubs across South-East Queensland, Australia, provides collaborative and networked workspaces by locating diverse activities in suburban areas. Such an approach holds promise in being able to improve the vitality of small towns. Information emerging for planners and decision makers from ICT has provided opportunities to enhance their understanding of urban environments (10).

Toole *et al.* (11), for example, used mobile phone data (call data record) in Boston to investigate how the real activity characteristics of each land use differs from its regulated zoning. In another example, the City of Portland in the United States used a fitness App as a planning tool to exploit big data, identifying the optimal solution for designing a path for cyclists and improving road intersections (12). The continuous type and frequency of data informing planners and decision makers, therefore, are challenging conventional approaches that once relied solely on authoritative historical government data collected in discrete time intervals. Real-time urban sensing, geo-tagged crowd sourced data that support collaborative and multi-dimensional, multi-spatial urban models demand a significant change from convention-

al urban planning and management to a smart city planning approach.

Current statutory planning and land administration systems, however, are unable to bring together all the various and disparate sources of information (13). To date, planning and land administration organizations have been tightly controlled by the regulatory process, which has limited new and innovative approaches to planning (10). This is one reason that planning and land administration systems are not fully exploited to take advantage of the available digital infrastructure to offer electronic services, and integrate interdisciplinary spatial data sources (14) in the practice of governance (15). In addition, current planning measures suffer from a lack of coordination and unintegrated technologies that could be harmonized, carrying new opportunities to improve the realization of urban quality of life. A fundamental requirement for overcoming these gaps is to redefine interdisciplinary urban indicators, enabling planners and decision makers to undertake a holistic assessment of urban quality of life from a smart city planning point of view.

The ISO international standards organization developed a key standard ISO/DIS 37120 “Sustainable development and resilience of communities-Indicators for city services and quality of life.” ISO 37120 defines methodologies for a set of such indicators, organized in 17 themes around social, economic, and environmental development. The aim of these interdisciplinary indicators is to steer and measure the performance of cities on providing services and quality of life. As such, there is a great opportunity for urban planners and land administration organizations to adopt the interdisciplinary urban quality of

life indicators for comparable and verifiable decision making. The ISO 37120 indicators can act as drivers for the adoption of a smart city planning approach, as they incorporate two key features:

- 1) The development and communication of data needed for most of the ISO 37120 indicators requires geospatial data as smart technology (16).
- 2) Achieving these indicators needs innovative tools enabling the integration of geospatial data and ICT-driven data.

Spatial information technologies, particularly geo-located sensors, are essential for developing and communicating data required for most of the ISO 37120 indicators (17). For instance, the recreation category of ISO 37120 (clause 13) is divided in two indicators of “square meters for indoor recreation space per capita” and “square meters for outdoor recreation space per capita” (clauses 13.1 and 13.2, respectively). Spatially-enabled network sensors and technologies can generate such data for indoor and outdoor spaces (i.e., satellite imagery, 3D cadastre, etc.) (18). Furthermore, for achieving these indicators, spatial “flows” are also important for understanding recreational space (17). Supporting indicators could be the number of users of recreational space, the means and times users access and utilize these spaces, and demands on environmental aspects such as flows of energy, water use, and waste production in a given space. In addition, these spaces and their spatio-temporal attributes are connected to neighboring or nearby non-recreational areas. Urban planning and land development organizations will need this kind of spatial and temporal information to optimize and maximize benefits for society.

The increasing technological orientation of data and information pertinent to the urban form and related activities can be exploited through the adoption of a smart city planning approach. The available digital infrastructure and investment in ICT are instrumental in overcoming the lack of interdisciplinary integration for planning future cities. The smart city planning approach that incorporates these improvements will therefore potentially provide a vehicle to achieve this end. It is imperative that this approach, as an alternative to conventional planning, is able to monitor spatial “flows” and preferred activities in urban and regional spaces, and to provide reliable evidence for data-driven planning and decision making. The ability to do so is of growing importance especially in our current digital milieu, where an unprecedented volume of data is being produced in cities. Notwithstanding, there are technical, legal, ethical, and policy related concerns that need to be addressed. From a technical point of view, standardization, spatial digital interoperability, and data harmonization are fundamental considerations (6). Legal and ethical issues include privacy, data protection, and retrospective access to information for secondary uses, where the primary consent did not foresee other uses (19)–(22). Policy concerns relate to over-reliance on an entrepreneurial route to smart cities (23). These are being recognized as key challenges and policy imperatives by researchers, practitioners, and governments around the world (21), (24).

In this article we have attempted to highlight a range of data dimensions and modeling considerations that need due attention to support smarter planning, land administration, and management. In terms of the future, we have emphasized the role of a smart city planning

approach in the genesis of new connections across and between wider societies in supporting the delivery of a vision of realizing more sustainable city futures. We have added another dimension to the range of opportunities that have been suggested in the literature as the basis for a future research agenda on smart cities (5), (24), (25). These are all predicated on having access to a vast array of digital datasets that are integrated, standardized, and available in real time. It is incumbent upon us to realize the opportunities that can be offered to the broader community by extending beyond our traditional governance approaches. We need to play a role in delivering a more sustainable and smart society in our urban future. The advent of big data and smart cities provides such an opportunity.

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created fundamental social problems. The knowledge of agriculture replaced hunter-gatherer societies with fixed communities with permanent borders. That allowed the exploitation of others' labor, and created permanent social classes because people could not easily leave their physical location. The knowledge of industrialization replaced blood-based communities with work-based communities. That created merit-based societies with conditional acceptance and rejection of those who could not perform, leading to work as the basis of identity and personal value, and decreasing emphasis on family and child rearing. It created the constant risk of losing one's community identification when one cannot perform adequately, leading to loneliness, depression, and anxiety related illnesses. A digital economy is replacing work-based communities, with interest- and lifestyle-based virtual communities connected by communication technologies. That leads to individuals being the social and economic unit, with memberships in many ephemeral communities. This is likely to be the age of pretense and opportunism with no sense of permanence or enduring relationships. Individuals are likely to assume many identities with dif-

ferent personalities during their lifetime, and even simultaneously. These fractured personalities are likely to lead to a crisis of trust and reliability, and consequently a plethora of cognitive illnesses such as attention deficit disorder, paranoia, and schizophrenia [12].

The solutions require enhancing virtual communities with physical qualities such as economic cooperation, resource sharing such as housing, food, and sex, cooperative child rearing, and joint vacations. Enforcing community principles and lifestyles may create a sense of identity and permanence that transcends the virtual world and spills over to the physical world [2].

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