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Prospects for an Intelligent Planning System

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A Computational Approach to Planning

The creation of an intelligent planning system that draws together all the data for a city and uses these, in combination with the algorithmic encoding of planning policy and law, to automate the production of optimal strategic plans and recommendations for rational planning decisions, has long been an ambition for a subset of planners and urban policy-makers. Writing in 1965, Melvin Webber proposed the creation of intelligence centres that would collate and interlink data, supply analysis and forecasts, formulate strategic plans, aid incremental, multi-centered decision-making, and enact a scientific morality in urban affairs. An intelligent planning system, he hypothesised, would tackle subjective opinion, clientelism and vested interests, learn from its actions, be more efficient, and lead to more effective outcomes (Webber, 1965).

In 1969, Jay Forrester set out a cybernetic approach to planning and cast the city as a system of systems. Each system, Forrester (1969) postulated, could be broken into its constituent parts and processes, be modelled and simulated to capture its essence, and these models used to plan and operate its functions. In the 1970s, the systems perspective cast planning as an evidence-informed, structured, rational, applied science that could be performed computationally. In the 1980s and 90s, GIS became a platform for drawing together and analysing spatial data and creating spatial planning intelligence about places. GISs were complemented by spatial decision support systems and expert systems that encoded planning rules and practices and could guide decision-making (Kim, Wiggins, & Wright, 1990; Klosterman, 1997). This was accompanied in the 1990s by initial experimentation with 3D urban and landscape models, and virtual reality (VR) technologies that could convey the topography of existing and planned future environments (Doyle, Dodge, & Smith, 1998).

Cybernetic thinking re-emerged in the 2000s with the growth in big data – real-time data concerning a system's performance – and more advanced computation, including artificial intelligence (Krivỳ, 2018). Intelligent transport systems such as road traffic control became increasingly automated, with real-time data from sensors, inductive loops and cameras being used to automatically adjust the phasing of traffic light sequences, but also to underpin transport modelling and simulation to increase operational efficiencies and inform infrastructure planning at a strategic level (Coletta & Kitchin, 2016). This has been accompanied by open data initiatives to make urban data more widely available, urban dashboards that provide public tools for making sense of such data (Kitchin, Lauriault, & McArdle, 2015), and a plethora of applied urban informatics and urban science projects and apps (Batty, 2013). In some cities there are initiatives to create intelligent operations centres: facilities in which several systems and their data are integrated into a single control room to enable a more holistic view of city services and infrastructures. For example, the Centro De Operacoes Prefeitura Do Rio in Rio de Janeiro, Brazil, draws together administrative, statistical and real-time data from thirty two agencies and twelve private concessions (e.g., bus and electricity companies) in order to manage day-to-day operations and plan the city (Luque-Ayala & Marvin, 2016).

3D technologies, such as 3D GIS, BIM (Building Information Modelling) and CIM (City Information Modelling) are increasingly being explored as platforms for creating and utilising spatial intelligence for urban design and planning. BIM enables the full build cycle for a project to be viewed and queried within one system, including a detailed, interactive 3D model (rather than hundreds of 2D plans, sections, and elevations), and allows users to dynamically update and recalculate scheduling and quantities of materials with changes in design or specifications (Crotty, 2011). CIM extends that idea to the city level by creating a 3D city model populated with associated data and enhanced with analytic tools that enable the examination of spatial relationships, and the simulation of urban processes under different conditions, to facilitate informed decision-making concerning city management and planning (Thompson, Greenhalgh, Muldoon-Smith, Charlton, & Dolník, 2016). More recent efforts are rallying around the concept of Digital Twin – digital representations of assets, processes or systems in the built or natural environment – which is now being championed in the UK as a new means of managing urban systems and infrastructures throughout their lifetime (Bolton, Enzer, & Schooling et al., 2018).

Our own work on the Building City Dashboards[3] project is charged with creating a set of open spatial technologies that can help support planning functions in Dublin and Cork. Conducted in partnership with the four Dublin local authorities and two Cork authorities, plus the Central Statistics Office and Ordnance Survey Ireland, the aim is to assemble as much longitudinal data about the city as possible, preferably with a sub-county granularity and less than yearly. An associated set of tools will be provided including urban dashboards designed to be accessible for users with different levels of data and statistical literacy (general public, policy-maker, professional analyst), and incorporating data stories (narrative richly supported by data visualisations), task-based tools (interactive visualisations), and analytical tools (statistical analysis, predictive models and simulations)[4]; a prototype planning-orientated CIM supporting desktop, augmented reality (Hololens) and VR (Vive, Occulus) applications; projection mapping data onto a 3D physical architectural model of the city; and mobile apps. A significant component of the project is to determine a set of principles and guidelines for the production of these systems, and to examine in detail the politics and limitations in their creation and use (Kitchin et al., 2015).

Challenges in Creating an Intelligent Planning System

Despite the development of, and significant investment in, planning-related digital technologies – and more broadly big data and artificial intelligence – their use is constrained within planning systems worldwide and the dream of an intelligent planning system remains unfulfilled. While GIS is well embedded as a supporting technology for regional and urban scale planning, and BIM is being mainstreamed in the Global North for the design and management of larger architectural, engineering and construction projects, other planning-related digital technologies are used only partially or remain in an experimental phase. Moreover, much of the planning profession is wary of a computational, technocratic approach to planning practice. As such, the prospects for the creation and mainstreaming of a holistic intelligent planning system remain problematic. The challenges stymying such a vision are two-fold: technical, and institutional and political.

Technical Challenges

Producing an intelligent planning system is not a trivial task. As noted, the technologies discussed above have been in development for decades. GISs have continually evolved since the 1960s and only became adopted for mainstream use in the 1990s. There have been prototype 3D technologies for close to thirty years, yet it is only recently that they are starting to be used in professional planning, mostly on a trial basis. CIMs are still in the early phases of development and, from our own experiences of trying to develop one, they continue to pose significant challenges. On the one hand, these challenges are software related, requiring the use and integration of different platforms and packages that each have their limitations, often necessitating the development of new workflows and the creation of bespoke code to bridge shortcomings. This has been a significant challenge in our work, since there are as yet no fully functioning open source solutions for the creation of CIMs, and the game-engine visualisation software used for optimally displaying 3D environments is not generally configured to be used like a 3D GIS (using different coordinate systems and often lacking the required spatial precision, for example). In addition, artificial intelligence systems for planning are still in their infancy and require substantial development to reach sufficient maturity and trust to underpin intelligent decision-making. Again, we are having to build and experiment with analytic predictive modelling and simulation tools rather than using established off-the-shelf products.

On the other hand, there are still significant issues with respect to data. Detailed, up-to-date and well maintained 3D models of landscapes are still relatively uncommon. More generally, there are ongoing issues of access, coverage, representativeness, quality, completeness and metadata with respect to urban data. Indeed, our work has highlighted just how difficult it is to assemble relevant, timely, granular, high quality, interoperable datasets. We have struggled to gain access to some data, have very little metadata concerning data provenance and quality, and lack methodological transparency regarding the data we can access. We also have to perform significant data wrangling to create workable and meaningful datasets (McArdle & Kitchin, 2016). As a result, there are significant gaps in our attempts to produce digital representations for each city, and what data we have assembled is often far from ideal. This situation is unlikely to alter much in the mid-to-long term without a major change in the data regimes of city administrations.

Institutional and Political Challenges

When proposing an intelligence approach to planning, Melvin Webber was also mindful of the institutional and political aspects of planning and that cities and regions are complex entities that cannot be simply reduced into data and rules and run via computational, technocratic procedures. Planning is inherently political. Cities and regions are full of competing vested interests, and decision-making is the art of making compromises. Webber's proposal was to improve the quality of decisions and actions through the creation of intelligence centres, while being mindful of the politics of information and the politics of planning itself. As our own work testifies, there is significant internal and inter-institutional politics and negotiation involved in creating and operating urban dashboards, which inevitably shape the systems developed and what they convey (Kitchin, Maalsen, & McArdle, 2016). Planning technologies and their operation are never neutral, value-free enterprises.

A significant challenge in creating an intelligent planning system is to harness the power of data and computation while ensuring the treatment of cities as places, not merely systems. This requires being open to public opinion, debate, and contestation rather than enacting an autonomous technocratic approach. It also requires a methodological approach that is open and transparent, qualities that systems employing artificial intelligence struggle with, as analysis of the ethics of smart city technologies highlight (Kitchin, 2016). Moreover, the professional planning community has long held concerns with regards to technocratic and computational approaches to planning (see Flood, 2011), and has sought to pursue other forms of planning practice that use different epistemological and methodological approaches, promoting a different planning ethos and values (see Gunder, Madanipour, & Watson, 2016). In interviews with senior planners in Ireland about the potential use of CIMs in planning, our interviewees, while noting the potential benefits of such technology, expressed a number of doubts and concerns with respect to its utility in aiding planning praxes. All held the view that they would be supporting aids rather than a vital component of decision-making. A major shift in planning theory, ideology and practice will need to occur for an intelligent planning system approach to become common-place. There is little evidence that such a shift is likely in the short-to-mid term.

Conclusion

There is little doubt that much more data is becoming available that might aid planners in the formulation and assessment of plans. There are also a growing range of technical systems that provide ever more sophisticated supports for data-driven analysis. However, the prospects of creating and mainstreaming a holistic, intelligent planning system seem remote, due to challenges of a technical, institutional and political nature. That is not to say, however, that digital technologies utilising big data and artificial intelligence will remain on the sidelines of planning practice. As technologies mature and become more sophisticated their utility will be exploited to aid design and assessment. Such use raises questions about the nature of planning and the extent to which an already technocratic profession should become computationally codified and automated. These questions will become more pressing as the political pressure intensifies to adopt such technologies as part of a move towards the creation of smart cities (Kitchin 2014). It is necessary then for planners to proactively formulate how such technologies should fit within the planning system, how the planning system fits within smart cities, and how their own processes might change to accommodate these shifts, rather than letting external forces and the technologies dictate future vision, habitus and practices.

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