CSIC Emerging Connections: Tomorrow's Cities and their Infrastructure

Workshop Summary

The Emerging Connections: Tomorrow's Cities and their Infrastructure Workshop comprised the second day of AUM2017, a planned series of annual symposia on applied urban simulation models. This year's focus was on major modelling applications. The Emerging Connections Workshop, hosted by Cambridge Centre for Smart Infrastructure and Construction (CSIC), is part of CSIC's 'Transitioning Cities' programme sponsored by the Ove Arup Foundation.

In a world where big data is becoming ubiquitous, our traditional professional and academic silos are not appropriate to address the challenges of designing interventions that meet the needs of diverse urban citizens. The event approached these challenges through a number of focused workshop sessions, each including three presentations, discussion and participation.

Attracting delegates from academia, industry, government and policy-making organisations, Emerging Connections opened with a welcome from Dr Jennifer Schooling, Director of CSIC, who acknowledged the value of collaboration across sectors and disciplines to transform the future of cities and their infrastructure. Supporting this agenda, the event provided an opportunity for individuals and organisations with an interest in future cities to come together to share their visions, successes, and also challenges, with other delegates.

Emerging Connections featured three focused workshop sessions and presentations including:

Session 1. An integrated approach to infrastructure and cities

Assessing the performance of infrastructure across space: Andrea Silberman, National Infrastructure Commission

Smart infrastructure for a smart future city – future-proofing cities: Navil Shetty, Atkins

A geospatial framework for integrated urban and infrastructure systems modelling: Stuart Barr, Newcastle University

Session 2. The role of digital technologies in experiencing and managing the city

Moving from productivity to social outcomes – the journey from Digital Built Britain Level 3 to Level 4: Mark Bew, Digital Built Britain

Digital visualisations as tools for exploring different kinds of smart: Professor Gillian Rose, Open University and Oxford University (from Oct 2017)

Digital agenda for cities – outcomes delivered by an ecosystem: Volker Buscher, Arup

Session 3. Urban planning and economics of cities

Delivering prosperity and diversity through business improvement district projects: Ruth Duston, Victoria BID

The future of planning: Stephan Webb, Future Cities Catapult

Sensory mapping: Luca Aiello, NOKIA Bell Labs

Each of the three sessions was followed by round table discussions with mixed groups of delegates to secure a variety of views and experience. A set of questions shaped the discussions, which highlighted a number of significant themes, challenges and concerns to help shape a 'next-step road map' in planning tomorrow's cities and their infrastructure. This document is intended to capture the discussion and themes arising from these sessions.

Session 1: questions and discussions

- What are the fundamental barriers in translating infrastructure asset/system performance measures to service/societal/economic outcome measures [and vice versa – turning service/societal/economic requirements to infrastructure asset/system specifications]?
- What needs to be done to overcome these barriers?

A number of barriers and mitigations were identified in discussion. The key barriers identified were:

- Politics and citizen engagement
- Need for collaboration
- Data sharing
- Business models
- Measuring outcomes and creating feedback loops

Politics and citizen engagement

Deployment of infrastructure is often problematic for citizens and communities affected by construction. Conversely there are communities who perceive they are underserved by infrastructure. It is usually politicians who have the final say on which communities are affected, therefore privileging one over another. Politics demands the allocation of scarce resources.

Infrastructure planning is a long-term activity which will reach beyond election cycles, but it is difficult to embed long-term decisions in short-term governance terms. Making the case to electorates and leaders for such long-term projects requires winning over hearts and minds.

Better modelling could help explain the case for infrastructure – models which can evaluate impact of infrastructure on economic and social factors of places as well as on changing land use. Models should also take into account the behavioural impact of infrastructure and the rebound effect where well-intended policies have side effects which work against the original objectives.

In practice, there is a need for a consistent modelling framework within which cities should be allowed to develop infrastructure based on their own circumstances. The role of devolution as a mechanism to allow this local decision-making was noted.

As well as this top-down modelling, there is also a need for bottom-up models of engagement with citizens in order for their needs can be identified and fed into the decision making process. Citizen engagement will involve working with people to understand needs, and telling the story in ways people can engage with. There may be traction in translating issues to the affective domain ('populist'/feelings/emotions) through story telling that personalises issues to the scale of an individual or a family.

Collaboration

Planning, financing, construction and operation of an infrastructure project always involves multiple bodies, each with their specific missions and objectives. In this sense, the translation between different evaluation measures is crucial in ensuring the goals of different bodies (public and private investors, constructors, asset managers, users, researchers, etc.) operating at different levels (local, regional, national) are achieved. Specifically, the translation is to create alignment between high-level qualitative objectives and small quantifiable questions. Currently this process mainly works top-down, but feedback from bottom-up should be encouraged.

Data intelligence and sharing

Collaboration can be hindered by lack of data sharing. Participants in the supply chain are not always contractually obliged to share data and may not wish to share data in order to maintain perceived commercial advantage.

Beyond ownership, data format compatibility often poses a problem as well. To solve this, a transferable protocol is essential. A protocol differs from a standard in a sense that the former is less restrictive, which grants flexibility while facilitating data sharing. A working example is the INSPIRE specifications for sharing GIS or spatial data in Europe.

Data security is a shared concern and could inhibit citizen participation if it cannot be shown that citizen data can be kept safe and secure.

Business models

The business model and structures of financing programmes can impact how infrastructure is developed. There have been different models used in recent infrastructure development projects, including build-transfer (Crossrail), and build-operation (HS2). When a company is involved in the operation phase, it has more incentives to care about the life-cycle performance. Funding sources – government or private – are also a factor. Private funders need more assurance about investment recovery and are less likely to support risky or very large-scale projects. Crossrail is 80 per cent privately funded and that source plays a significant role in shaping the project, including the extension of the line to Canary Wharf. More research into how social outcomes could relate to economic outcomes may be needed here.

Measuring outcomes and creating feedback loops

Currently a linear approach to measuring outcomes from assets is taken. However, there is a need to set goals and benchmarks, then measure, then return to the benchmark and evaluate what has been achieved, or, if not, ask why and make an intervention and return to the loop again. The current challenge here is the lack of a feedback concept. HS2 provides a useful example of how a decision framework has been developed to better align key decisions with the business case. More work needs to be done to align the Treasury's Green Book approach with these types of decision frameworks.

Session 2: questions and discussion

- How will the evolution of digital technologies transform the experience of the 'citizen' living and working in the Smart City? What are the potential positive and negative outcomes?
- How are big data and machine learning going to transform the field?

Discussing smart cities

The term 'smart city' needs to be defined. One suggestion is: in future cities the technology environment is no longer something exogenous, it is part of the citizen's life. This definition is already visible in the growing dependency on smartphones to navigate, communicate and transact in the city.

Industry visualisations of 'smart cities' tend to focus on efficiency and often present a sanitised view of cities, which does not accord with the messy reality of cities, where citizen behaviour interacts with infrastructure in complex ways. One example of this is the implications of self-driving cars. Self-driving technology invites behaviour changes by making driving easier and safer, allowing people to travel longer distances at lower cost. From a cities' point of view, this would possibly lead to an increased travel demand. To counter this increased demand, car sharing could be encouraged: for those concerned about safety, this could mean sharing the ownership of the car, not necessarily carpooling. Furthermore, autonomous vehicles might not achieve their full potential in the cities due to complexities in the urban environment, but on motorways, self-driving cars may be more useful.

Discussion should be mindful not to fixate on 'smart cities' and purely push development of technology, but also think about how cities can improve social interactions. Studying people's behaviour in urban settings could help designers to offer insightful support to the design of future cities.

Designing cities

The complexity of cities is hard to grasp, involving multiple viewpoints and perceptions. This is evident when considering citizen experience of the city. There is a broad discourse around smart cities which puts the citizen experience at the heart of city design. This is a good approach but there is not just one citizen, and their experiences do not necessarily support each other. Careful user research and design work is needed here, with an awareness of political context.

Measuring perception is a challenge. Perception is truth to the human mind. Including psychologists and methodologists to help planners/designers understand human behaviour may be beneficial. The biggest challenge in perception measurement is to design a repeatable methodology and this requires mathematical measures.

Practitioners could deploy a user-centred design process to support the design of citizen experiences. Thinking about the entire network that comprises 'government services', including how people will access services, marks a cultural shift. This requires a nuanced view of how people will access services using digital technology to ensure citizen agency is not removed, e.g. the elderly population may not want or be able to use an app to book a hospital appointment because they prefer to speak to someone or aren't able to use the technology.

The Australian example of facilitated consultation to planning may provide useful reference. This model enabled planners and residents to work together and shows how educating people about the planning process engaged residents who were able to provide specific feedback on how to improve their area.

Game-changing technologies

One of the technologies put forward with a view to transforming the experience of the 'citizen' living and working in the 'smart city' is augmented reality (AR). However, there are a number of barriers to success to truly immerse the citizen in the city through this technology. Creating a 'natural' interactive technology is difficult: the technology often feels unnatural and causes privacy concerns.

The effectiveness of small interventions in everyday practices was agreed with the recent success of PokemonGO that encouraged physical exercise and impacted movement patterns in places. Over time, however, usage has dropped off as PokemonGO is no longer novel. Another example given was using a virtual reality interface to replace a course lecturer which offered trainees the addition of entertainment as part of the technology.

The example of the e-government in Singapore was discussed. There are around 900 e-government stations in Singapore which are akin to big 'vending machines' where people can go to complete a number of tasks online, including buying tickets and paying university fees. The stations are designed for ease of use and therefore widely accessible.

Satellite technology is used to track cars and charge people for road use. Data can be used to support planning. Jobs in different geographical areas can be tracked and this data could be used to inform the location of new employment centres where the job-to-residence ratio is low. Data can be used for master planning and to identify both negative and positive areas of impact and introduce social support where it is needed.

The management of data used to track people's movement is significant: how should this data be managed? How should the data be stored and what metrics should be kept from the data?

While there are analytical models – urban models and business models – used for designing cities, more experienced designers are needed. Often the planners and architects of cities do not have sufficient comprehension of how new technology actually works so cannot build it into their own designs. Furthermore, clients are often not informed to ask for the right outcomes.

Session 3: questions and discussion

- What is missing in our current education to prepare students and professionals to tackle urban challenges?
- What are the specific outcomes that you would love to see, but are not achieved yet, from the joining effort in tackling cities' challenges?

Transdisciplinary communication

From the previous discussions, it is clear that the complexity of smart cities/technology/data demands a cross-disciplinary understanding of issues. Different university disciplines and departments should be brought together around identified 'hubs' in order to encourage better transdisciplinary communication and collaboration.

There are numerous disciplines and diverse approaches within, for example, social sciences tackling 'urban challenges' and the 'urban' including urban anthropology, urban geography and urban sociology. Creating conversations even between academic groups can be challenging – each subject

uses its own vocabulary so developing a common language would be useful. If knowledge is scattered across disciplines – in silos – that fail to cross over with each other then a common discourse needs to be shared to efficiently deliver solutions.

The social science domain is very good at understanding what citizens want and what good outcomes might look like, but lacks the mechanism and interest in how to deliver this. Engineers and architects are good at delivering solutions but don't have the fuller social science understanding of good outcomes. Better communication between these disciplines would support securing more integrated and considered solutions for people.

Questions to consider include: What type of backgrounds and types of degrees do people who are currently involved in meetings that discuss smart cities and infrastructure have? Are the majority of them from or study engineering or architecture? Is it necessary to know about technology? Is it compulsory to understand how technology is designed to work or is part of the work understanding its intention, reception and benefit to the citizen?

Skills and knowledge gaps for planning professionals

The workshop participants considered the areas that planners and architects, as key influencers of the built environment, now need to understand. Challenges of planning are increasingly more complex. Planning involves ecologies, engineering, design and economics. Solutions are not found in one discipline. A vital skill that should be taught is to challenge the discipline itself and to have enough intellectual capacity to ask questions and learn the language of different disciplines to be able to join a wider conversation.

At the moment, much of the knowledge about the impact of technology (e.g. Internet of Things) and how technology can be deployed in the built environment resides with technology companies, who may have a different agenda to that of the planners. Planners need to understand how technology can impact cities both positively and negatively, as well as the issues of deployment, in order to influence the impact of these technologies on our cities.

Education needs to give planning students greater exposure to new technologies and different design approaches. Not all qualified planning and architecture students should learn how to code, but need sufficient understanding of coding language.

Currently planning students largely consider their own situation and needs rather than being adequately exposed to the diversity of experiences. Therefore, urban design does not routinely address the needs of all people. Students often conceptualise the city as an abstract place without following an academically rigorous social engagement as part of the university course. This also needs to be learned from practice. One element key to how people experience the built environment is the support networks of communities, which are often invisible and go unnoticed in planning redevelopment. While the locations people move to can be tracked, it is difficult to capture lost social capital. Would a historical perspective supported by longitudinal data help understand this better?

Funding is another area for further education of students. Current education on local economic development and funding schemes does not include knowledge of and experience of forecasting and other quantitative elements (social planning and local development). While infrastructure projects are increasingly funded through public-private-partnerships (PPP), the specifics of PPP and finance are taught in business schools, rather than planning schools. This leads to planners not always having a

clear idea of finance and potential sources of funding to access. Continuing education is important as the landscape is changing rapidly. Public and semi-public authorities are becoming much more financially adept to secure more financial certainty. However, in practice much of the financial work is outsourced to consultants in the private sector who have the capacity to attract key talent.

The role of the architect is to listen and understand the functional requirement of the organisation and put it within the context of the wider environment within the master plan, and to articulate this complexity in words and pictures that enable people to understand. It is necessary to retrain our architecture engineers to understand the problems first and use the data to evidence solutions, and to convince the users that these solutions are going to provide these outcomes. How do we recreate the role and the value this role brings and to elevate it to a point where we end up with an ability to use data to create new solutions? This role needs a combined set of new skills, including data analysis, listening, interpreting, understanding, articulating and teamwork.

Challenges

One challenge faced by universities is that the technology landscape changes so quickly. Technology around planning and architecture design is accelerating rapidly and is driven by people outside the field. We need to think how we can interpret advanced technology to solve problems in the field. Regional scale modelling analysis planning around infrastructure and major land policies tend to be long-term, and the process is slow. The plan is reviewed every few years and the process to engage public in meaningful discussion about these options is very poor. There are possibilities to use new tools such as visualisation, social media and gaming to connect and engage people in a more effective way.

Sustaining multi-disciplinary work in the long-term remains a challenge to industry. There are opportunities to come together in the short-term, e.g. hackathons, but such events last only a few days. How do we scale this multi-disciplinary collaboration model to the longer term? There are some organisations, such as Cambridge Spark, that provide science training to industry for six months, which could potentially equip people with the skills and experience to better tackle urban-related challenges.

Architectural decisions are currently made late in the process, but they need to be made earlier. Planning is facing a rapidly changing world incorporating changing lifestyles, an ageing population and emerging technologies which will impact employment models and labour markets. Students need to be enabled to reflect and think critically about the spatial, societal and economic impact of these changes.

Universities face the challenge of recruiting highly skilled experts, such as visual artists. Big tech companies can recruit talent by offering high wages, perks and benefits. Are new contractual models required for universities to be able to leverage these people outside the traditional academic route?

At the legal framework level of planning, under which planning operates, the planning inspector may be even less familiar with data technology and revert to old ways of working. While significant efficiency could be delivered within the planning system by better use of data technology, there needs to be deeper education to overcome resistance – not just for students but government, planning inspectors and the Royal Town Planning Institute who all need to update knowledge.

Industry should recognise that education does not stop at university and that industry has an important role in ensuring continued progress.

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