Delivering new concepts for urban citizens

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Engineers, data scientists and architects will have to work more closely together in the cities of the future. Credit: Swinburne University of Technology

The city could be thought of as a living organism that requires inputs of energy, nutrients, and water and exudes wastes. Traditionally, engineers designed and managed the systems that bought energy and water into the city and removed solid and liquid waste. Food is distributed in a less centralized fashion, but still organized by large corporations.

This model is now being subverted. The subversion is most notable with the trend to ad-hoc generation of power by individual households, which is already causing headaches for the engineers responsible for stabilizing the power grid. In the future, however, the organic and dynamic evolution of urban infrastructure, enabled by new technologies, will need to be anticipated and planned for, with the human at the center. Engineers will need to work more closely than ever with architects and urban planners. One profession will not always be in charge, leaving the other professions to fill in the blanks. The close and rigorous integration of engineering, data science and architecture will become mandatory.

The Smart Cities Research Institute's (SCRI's) Future Urban Infrastructure program is organized around the following three intersecting streams: Integrated Infrastructure Systems (IIS), Urban Information Modelling (UIM) and Digital Fabrication and Procurement (DFP). Each draws from the knowledge and insights of the other two streams, and inherently cuts across disciplines.

1. Integrated infrastructure systems

The IIS stream represents the flows of energy and materials to cities and urban precincts—and also the flows within them. Cities, their precincts and extra-urban communities traditionally drew in electricity, water and food from beyond their boundaries, and expelled waste heat, water and solids. Now, power is generated and stored in buildings, water is collected and re-used, and food is grown locally.

How do we encourage this anarchic and organic process while regulating to preclude disasters in health, safety and energy? If people are convinced to install battery storage, why are they not convinced to drink recycled water? How can we use the big data of the UIM stream to co-ordinate a myriad of individual producers and consumers? How can we use the novel construction techniques of the DFP stream to respond

flexibly to citizens' needs?

2. Urban information modeling

UIM embraces the world of big data with the application of new algorithms and artificial intelligence to vast data sets. Whether at the scale of individual buildings, urban precincts, or the whole city, real-time information modeling and diverse scenario-testing can lead to rapid decision-making and highly-informed planning.

Data on the flows of power, food, water and materials of the IIS stream—as well as on mobility—must be tapped. Then, it must be distilled to yield unexpected relationships and implications. This empowers stakeholders and end-users alike to take courses of action that might not have otherwise occurred to them until it was too late.

How can we put big data into citizens' hands so that they can be active yet responsible designers of their own cities? Through information modeling and management, all the aspects of designing, building, managing and demolishing the built environment in the DFP stream can be linked. This can radically increase efficiency and reduce waste of time, effort, and resources across the construction sector.

3. Digital fabrication and procurement

The DFP stream actively engages with the rapidly changing processes behind the procurement and making of cities, precincts and buildings. Automation is changing the way we are thinking about building, requiring completely new and innovative procurement strategies and building processes.

How can we utilize robotic and adaptive technologies, long established

on the factory floor, to both fabricate and disassemble urban environments to suit changing needs? There are significant crossovers between each of the streams as pairs. Together, the IIS and UIM research communities can engage in the quest for novel environmental systems modeling. UIM and DFP can come together over building systems integration. The alliance between DFP and IIS researchers offers new technologies for building systems integration.

Serving the needs of urban citizens

Trans-disciplinary research always was and always will be a challenge. That is why, at Swinburne, we choose areas where we have published, internationally-recognized expertise, and we match researchers who can work together to deliver on projects where only the combination of disciplines will succeed.

I am happy to confess I am a complete newbie in the urban design world. My own area of research is fluid dynamics—the study of fluid flows. It is a branch of mathematical physics studied by engineers and scientists. So, when it comes to architecture I am definitely a fish out of water.

However, I have had some experience in bringing teams of researchers from entirely different disciplines together, and my SCRI colleagues who are architecture and design experts have been wonderful at educating me. I am tasked with bridging the culture gap between my world of engineers—the designers of technology—and the world of human-centered design. Together, we can come up with new ideas for future infrastructure. Our concepts will have novel yet rigorous, research-based footings and will serve the human needs of the urban citizen.

Provided by Swinburne University of Technology