Livable cities of 2050: How MBSE will help get us there

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—Chris Bouch, Chartered Civil Engineer

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Chris Bouch, Senior Research Fellow at the University of Birmingham

By 2050, according to the United Nations, two thirds of the world’s population will live in cities. Lucky for us, someone is thinking about how to design these cities of the future. That’s because a helter-skelter, incidental approach to city development will not help us navigate the challenges we’ll face: climate change, waste management, transportation, not to mention spaces for leisure and relaxation.

“Cities are complicated and complex,” says Chris Bouch, senior research fellow in the School of Civil Engineering at the University of Birmingham in the United Kingdom, making a distinction that systems thinkers are happy to explain. “Complicated in the sense that we have many infrastructures creating a web where each infrastructure impacts others. Complex because we have a human population interacting with the infrastructure and also changing it.”

Bouch is working on two projects that are naturally inter-linked. The first one is called “Transforming the Engineering of Cities to Deliver Societal and Planetary Wellbeing,” or “Livable Cities,” for short. This venture is envisioning the livable cities of 2050 and the engineering strategies needed to get us there.

The second one is “Infrastructure BUsiness models, valuation and Innovation for Local Delivery,” or iBUILD; it is developing new business models to facilitate provision of the infrastructure future cities will need. In both cases, Bouch is using a software tool to help with the process, one that aids in modeling all the connectivity and inter-relationships while providing stability and traceability. It is CORE, Vitech Corporation’s flagship systems engineering tool.

“We needed a stable platform that would allow us to create objective and repeatable, integrated models,” he says. “By objective, I mean that we’re going to use standards, policies, and operating procedures to provide the data to build the model, rather than relying solely on the knowledge of domain experts. By repeatable, I mean that if separate teams are working on the project using the same methodologies, they’ll come up with the same model.” In this manner, he says, they can have some faith in the model that’s produced.

“CORE allows us to gather all the data about the system and link it together to provide an integrated model. And the beauty of this model is that we can run a simulation so we can see how our system is working.”

Chris Bouch in his home city of Bristol—rated one of the most livable cities in the UK—with Bristol Harbour and the cathedral in the background.

Bouch has been thinking about engineering and systems for a long time. He's been a Chartered Civil Engineer for over 20 years, and has worked on power stations, bridges, a major highway viaduct in Egypt, and hospitals in Nigeria. But his foremost passion is the railway. In 2003, he was awarded an M.Sc. in Rail Systems Engineering, and in that same year started as a research fellow at the University of Birmingham's Centre for Railway Research and Education. He has studied, among other things, modeling the resilience of rail networks in the face of climate change. Since 2014, his research focus has expanded to look at future cities, and in particular their resilience and sustainability.

But how do you pay for it?

Working on the iBUILD project is especially rewarding, he says. "The need for new infrastructure in cities is well understood, but one of the big problems is how to pay for it. Private sector investment has a big part to play, but will not be forthcoming unless investors can be sure of capturing their fair share of the value generated," he explains. "The new business models are aimed at overcoming this problem. It's great to think that our research will have significant impact in facilitating future infrastructure provision."

The "middle-out" approach

One novel feature of the iBUILD project is the "middle-out" approach the team is taking. This may not be typical, but when you can't cleanly dismantle an existing system, remove it, and then install a new one—as is true for city infrastructure—you can't afford the traditional top-down approach. "It's easy in the top-down approach to forget about everything that's already there, which then causes all sorts of problems later on," Bouch notes.

CORE is especially helpful in this regard. It can map the "as-is" architecture of a system and then model the "to-be" architecture such that it can be validated and verified before significant funds are committed to implementation.

Stakeholders for cities of the future

Stakeholders for the iBUILD project, as befits a city of the future, comprise more than your standard public works officials. A meeting of such vested interest parties in Birmingham in 2017 included an industrial symbiosis consultancy, an electric car rental company, a hydrogen technology company, and an ethical investment bank. The data elicited from these people is being integrated into the model.

But the beauty of systems engineering is that it can handle more than just hard data. "Systems engineering is not just about what we might call 'hard engineering,'" Bouch says. "It's not just about bridges and power systems. It's about considering the system as a whole. So you can deal with soft issues like governance, too."

Bouch hopes that the team's work with iBUILD will uncover solutions that cut across traditional policy silos and help to ensure that the city of the future is a prosperous, healthy, and vibrant place to live.

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