Cities are complex systems – let's start looking at them that way

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The way we design our cities needs a serious rethink. After thousands of

years of progress in urban development, we plateaued some 60 years ago. Cities are not safer, healthier, more efficient, or more equitable. They are getting worse on these measures.

The statistics on [chronic disease](link), [rising road tolls](link) and [congestion](link) in our urban environments paint a bleak future. The clues to why lie in how we think about and [design](link) our cities.

Cities are highly complex, yet we are not thinking about them that way. We argue cities are complex and sociotechnical in nature. This means that, stripped back, they comprise people and communities interacting with one another and with objects (such as roads, buildings and parks) within a range of urban settings or contexts.

Complex sociotechnical systems (urban, transportation or warfare) are difficult to analyse. However, ergonomics and [human factors](link) methods such as [cognitive work analysis](link) allow an understanding of the whole system rather than the parts.

Cognitive work analysis was originally developed to support the analysis and design of [complex engineered systems](link). We are using it to analyse and design cities.

The quest for better cities

Theoretical and practical efforts to create better cities have a long history. Before Walter Christaller's ["central place theory"](link) and Charles Lindblom's exploration of the ["science of muddling through"](link), there was Ebenezer Howard's utopian ["garden city movement"](link), the enduring ["concentric zone model"](link) of Ernest Burgess, and the ["multiple nuclei model"](link) of Chauncy Harris and Edward Ullman.

More recent approaches provide guidance on good city structures

relating to quality of life, infrastructure efficiency and city futures. The [Congress for the New Urbanism](#) advocates for quality of life through "walkable" urban neighbourhoods. [Transit-orientated developments](#) seek to have commercial, residential and community facilities close to public transport.

In the 21st century we recognise and conceive ["creative"](#), ["smart"](#) and ["knowledge"](#) cities. These focus on the use of human resources, social capital, education, innovation, communication and digital technologies.

We argue that the limitation of these approaches is their reliance on sets of standards and guidelines. They provide reductionist principles for how cities "should" be designed and developed.

While useful for articulating the goals and values we would like for cities, their consequences within the broader city system are not well considered.

Cities as complex sociotechnical systems

The priority of sociological and technological systems is to optimise the interactions between people, technology and environments.

Cognitive work analysis is concerned with constraints rather than goals. It is based on the notion that by making constraints explicit, and exploiting them, we enhance system performance. It comprises interrelated phases including [work domain analysis](#).

This approach allows us to model the city system across five hierarchical levels. This detailed model describes and links the purposes, values and priorities, the activities that are performed, right through to the physical objects that make up the city and the functions they serve.

The findings are compelling. For example, we can show that public art on a footpath has the function of both a landmark and a form of communication, in the same way signage does. This is then linked to improved way-finding, legibility and social interaction in the street. And that, in turn, results in greater levels of perceived and actual safety, user comfort and a sense of community.

Ultimately, this supports both the technical intention of a footpath, as a pedestrian right of way, and its urban design contribution, as an important social place. As it is now possible to understand the system-wide implications of including or excluding key elements, we can start to design better cities.

Additional analyses have [focused on](): the design of active transport corridors; public space; main streets; school zones; playgrounds; and urban design and CCTV. The findings demonstrate the complexity in these environments and show how existing design approaches may not be fit for purpose.

Exploring a new approach

In a rapidly changing world in which smart cities are desired and urban [megacities]() are a reality, we need to explore new knowledge and new approaches. Current descriptive and disparate approaches to the review, analysis and design of our cities need to be challenged.

The profession and politics of the built environment continue to operate within discipline silos. Planning, architecture, engineering, transport, water, power, commercial and retail development, [urban design](), community services and more are all dealt with in relative isolation. The links between them are only examined as necessary, or as legislatively required.

As a result, our cities are a legacy of incremental solutions, fragmented decision-making and competing urban priorities.

Managing complexity in [city] design is challenging. There are very few ways to examine all of the parts of [urban development]. We contend that [ergonomics, human factors] and [sociotechnical systems methods] offer a way forward.

While it may seem far-reaching to apply the methods used to design work, transportation and warfare systems to urban development, it has been shown to have significant [value].

Our approach allows decision-makers, designers and the community to understand the complex nature of humans, technology and their environments. It is possible to create cities that cope with complexity rather than collapse under the weight of it.

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