Cities are complex adaptive systems

Our futures will in some way be determined by the cities in which we live. Cities produce most of our wealth while consuming most of our resources, including energy. How we think about cities affects their form and function.

Traditionally, cities have been defined by some combination of population size/density, territorial scale, economic activity, and administrative function. Currently, there are diverse definitions that vary between countries, with no universal definition.

The Sustainable Development Goal 11 acknowledges the critical role that cities play in meeting the SDGs. Attaining this goal requires a common set of indicators that can be collected and monitored. Over a period of two years, UN agencies and international development agencies have sought to agree a standardised method of measurement of city level data.

Following a review of tens of concepts, together with extensive consultations with experts, UN-Habitat has developed two city definitions. The first was developed by New York University and has two components, urban extent, and urbanised open space. Urban extent represents the total built-up area, defined as the contiguous area occupied by buildings and other impervious surfaces. Urbanised open space includes unbuilt up areas that are contained in built up areas. Urbanised open space is classified into 3 levels. These include, fringe open space, captured open space and rural open space. Urban and sub-urban pixels make up the “built up” part of the city, while the fringe and captured open spaces make up the “urbanised open space”. Together they constitute the urban extent.

The European Commission’s definition of a city aggregates/disaggregates population density on a 1 km^2 grid. This enables grid cells to be classified into high-density, urban cluster and rural grid cell areas. This is then used to classify local administrative units into densely populated areas, intermediate density areas and thinly populated areas. Together densely populated and intermediate density areas collectively form the city boundary.

This series of city related policy and information briefs draws on lessons learned from cities and infrastructure work carried out by Triple Line over the past five years. It is intended to contribute to more sustainable, inclusive and climate-resilient cities that generate equitable economic growth opportunities for all by identifying market-driven solutions to urbanisation challenges and strengthening democracy and decentralisation processes through capacity building of government agencies at national, regional and city levels.

The city as a complex adaptive system

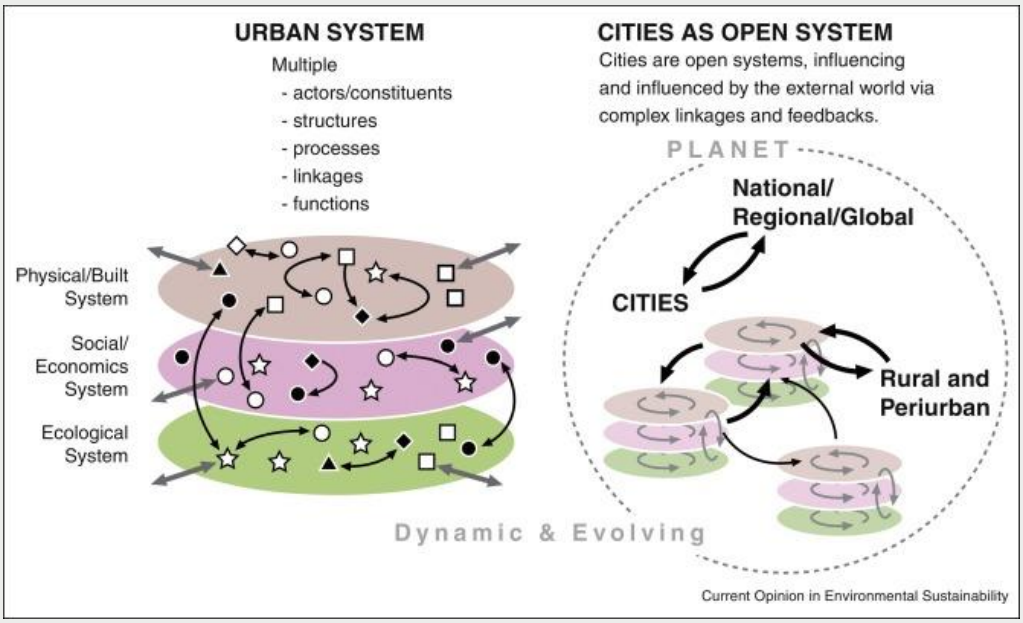
While these two definitions make sense spatially and administratively, they don't provide much help in identifying areas of engagement with cities. Cities are the economic, environmental, and social centres of many societies because they are mainly where people live and work. People have complex interactions with their urban surroundings.

Increasingly, practitioners are understanding cities as complex adaptive systems that are constantly changing. For example, when deciding upon land use and an urban grid, planners need to consider the delivery of urban services that include electricity, water, ICT services, waste collection, treatment, and sanitation. Any development with respect to one of these services affects all the others. Planning, architecture, engineering, transport, water, power, commercial and retail development, urban design, community services and more are all need to be considered rather than being dealt with in isolation or in silos. Treated in isolation, cities become legacies of incremental, disconnected solutions with fragmented decision making amongst competing interests and priorities.

Complex adaptive systems comprise a myriad of subsystems that interact in often non-linear and unpredictable ways. Cities involve numerous layers, agents, material flows, and people driven activities. As a multiplicity of systems, cities become highly complex systems, constantly changing, and adapting to new impulses.

Designing within this context accepts that outcomes are unpredictable, open ended, sometimes surprising, and difficult to attribute direct causal explanations.

A systems approach for sustainable cities advanced by Bai et al. (2016) considers subsystems, different scales and the flows, linkages and feedbacks between them.



What needs to change?

Accepting that cities are complex systems, it is important that the practice of urban planning reflects this. This means changes to conventional practice. It all starts from systems thinking and embedding this into urban design and development culture.

So, what is systems thinking? In essence, systems thinking is about recognition that there are multiple factors and interactions that affect and contribute to possible outcomes. It helps decision makers see a bigger picture and provides greater clarity of all the factors that affect urban development. It also forces planners to think about the people that will be impacted by their decisions as well as the stakeholders that should be consulted or informed of planning decisions. Wide consultation tends to ensure better decision making. This ensures that designs are based on what people actually want and need rather than on what planners believe people want. In the end this saves time, energy and ultimately money.

Systems thinking also acknowledges that cities are fluid and constantly changing and adapting to new conditions. This implies that there is no fixed end point of the impact of an urban design. Systems and subsystems need constant monitoring to determine if new interventions are required to ensure that the projects continue to meet its objectives and provides positive benefits to urban citizens. This is in everyone's interest.

What should cities do?

- **Create multi-disciplinary teams across professions concerned with planning and infrastructure development**
- **Develop an understanding of the dynamics of subsystems**
- **Develop an understanding of how subsystems inter-relate and how they form complex systems**
- **Use this understanding to make urban interventions**
- **Regularly update an understanding of subsystems and complex systems**
- **Regularly update teams with new system dynamics**
- **Regularly monitor the changes that occur after investments in infrastructure have been made**

TRIPLELINE

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