



# The TOSCA Case: How Open-Source Spatial and Digital Decision Support Tools Help Urban Agglomerations to Leapfrog Towards Smart Sustainable Cities

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## ABSTRACT

Considering the rapid pace of global urbanization especially in emerging economies of the global South, this article addresses governance approaches for the sustainable development of cities which seek to transform into smart cities. It focuses on leapfrogging as a governance concept for cities thriving towards sustainable development and describes the role of open source digital tools as accelerators for this transition. On such premises, the Toolkit for Open and Sustainable City Planning and Analysis (TOSCA) will be presented as a case study. The paper provides an overview of its conceptualization and implementation in two pilots regions. An overview of the gains and difficulties from the empirical process is discussed, concluding with learnings and challenges for further implementation in other regions, and for the sustainable incorporation of open-source digital tools in urban and regional governance.

## KEYWORDS

Decision-Making, Digital Tools, GIS, Global South, Governance, Leapfrogging, Planning, Spatial Data

## 1. INTRODUCTION

To understand the complexities to be faced in the coming years in the realms of urban and regional governance - especially in developing nations of the Global South - the challenging pace of the world's population growth needs to be acknowledged. According to the UN, an unprecedented and exponential shift of the world population from rural to urban dwellers has taken place since the 1950s. This tendency is expected to accelerate. Estimates hold that by 2050 approximately 90% of this dramatic increase of the world's urban population will be accounted for in the regions of Asia and Africa (UN, 2018). Effective measures are required to mitigate the effects of the imminent urban sprawls that occur especially in rapidly developing regions and emerging economies across the globe.

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These key facts shed light on the urgent need to revise the processes adopted by policy makers to address sustainable urbanization, while recognizing the need to maintain a connection between rural and urban development. The Sustainable Development Goals (SDGs) are an example of globalized means of mitigation for the long-term impacts of rapid urban growth. For example, SDG 16, related to Peace, Justice and Strong Institutions, targets transparency in governance in order to establish security and consolidated development in society (UN, 2022). The achievement of such goals will depend on how effectively these measures can be implemented across the different scales of regulators and institutions, and whether they can reach the most local levels of governance.

To have a deeper view into ground-breaking societal developments, the concept of leapfrogging is a highly relevant approach. Coined almost four decades back (Fudenberg et al., 1983), the term was framed within the scope of industrial organization, addressing the potential streamlining of market and economic growth. However, over recent years, ‘Leapfrogging’ has been further adopted to other realms of development e.g., technological progress, with remarkable examples in developing regions. In Africa, for example, the rapid take-up of mobile technology allowed the population to have a broader access to information, far surpassing the pace expected by the development of conventional landline infrastructure (World Bank Group; China Development Bank, 2017). Understanding this concept of leapfrogging and its adaptation to a wider spectrum of society and development, its application to, and impact on, the realm of governance is a worthy discussion.

This article will contribute to the understanding of future challenges in the evolution of cities from the Global South which seek their path of transformation towards smart cities, especially through the adoption of digital tools and data infrastructures. The paper thus revolves around the following questions: Can the concept of leapfrogging be transferred to the scope of governance to help cities thrive towards sustainable development? And: How can open source tools accelerate this transition? To address these questions, this paper will introduce the Toolkit for Open and Sustainable City Planning and Analysis (TOSCA) as a case study, providing an overview of its conceptualization and development process as well as its implementation in two pilot locations. The objective is to give empirical evidence of the gains and difficulties from the pilot applications, in order to better address the potential challenges coming ahead for the successful future implementation in other developing regions. Further, the article aims to outline how the sustainable incorporation of open-source digital tools may reduce the gap between local authorities and its population, in the face of procedure constraints on the side of governments.

## **2. BACKGROUND**

Several concepts need to be defined to put the proposed questions into context. The following notions form the cornerstones of a theoretical framework that not only supports the targeted application of digital solutions in the urban context but also enables a reflection of their capacity as enablers for swift (“leapfrogging”) urban development.

### **2.1 Urbanization**

There is a broad spectrum of definitions aiming to qualify urbanized areas. As explained by Ritchie & Roser (2018) it is not possible to present one universally agreed concept of what defines an urban area; it varies per country according to population density in some cases, or by level of infrastructure development, to name a few parameters. The European Commission, for example, seeks for a more generalized definition, and breaks down this differentiation according to the number of inhabitants and the population density per km<sup>2</sup> (Pesaresi et al., 2016). When comparing different parameters and indexes, the exact worldwide population in urban contexts varies considerably among entities such as the UN and the EC. Nevertheless, the trend of growth is indisputable, having its largest share among Asia, Africa and Latin America, in other words: the developing regions of the global South (Figure 1).

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