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# In Search of Indicators for Assessing Smart and Sustainable Cities and Communities' Performance

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## ABSTRACT

The goal of the paper is to elaborate on sustainability aspects of smart sustainable urban environments. More specifically, at a first step the paper aims at critically reviewing globally initiated state-of-the-art approaches for assessing smart cities' performance as to sustainability objectives. The scope of this effort is to identify sets of indicators used in different approaches as well as convergence/divergence among them. Secondly, an attempt to integrate different indicator sets into a more enriched and coherent indicator system is carried out which, by effectively embedding smart and sustainable city development into sustainability indicators' sets, can be used by various types of cities' examples. Finally, the rationale of the indicators' selection process is depicted, in order to support policy makers and planners' guidance towards choosing an appropriate, city-specific set of sustainability indicators for carrying out relevant assessments.

### KEYWORDS

Key Indicators, Key Issues, Planning, Policy, Selection Process, Smart and Sustainable City (SSC), Sustainability Assessment

## INTRODUCTION

Continuously escalating urbanization trends at the European continent result in the overpopulation of urban centers. More than the two thirds of the European citizens are nowadays residing in urban environments, with urbanization being a "… defining feature of the 21st century" (Suzuki et al., 2010, pp. xv). The outcome of such a trend can be perceived both: positively, with urban areas being considered as the backbone of the European economy and development (85% of Europe's GDP is produced in urban areas – European Commission Website), and as places that can provide solutions to current environmental, social and economic challenges by boosting creativity and innovation; and negatively, with overcrowded urban areas being conceived as the source of contemporary challenges and risks, due to the excessive use of resources (e.g. energy, water, land), pollution, congestion, irrational consumption patterns, overproduction of waste, unemployment, migration, segregation and poverty, etc.

In order to cope with the negative impacts but also strengthen the positive outcomes of the current urbanization trends, EU has placed the goal of sustainable urban development at the core of its policy agenda for urban regions. More specifically, it has created a vision for future European cities (European Union, 2011), where urban environments represent a promise for the future, built on

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concepts such as freedom, innovation, creativity, opportunity and prosperity (Schaffers et al., 2012; Stratigea et al., 2015); while fulfilling urban sustainability objectives. At the heart of this policy lies, among others, the concept of Smart Cities and Communities (SCC) that is recently evolving as a result of the radical technological advances and their applications; and constitutes a new force for effectively managing various urban functions in a highly connected, knowledge- and information-intensive era. Promoting smartness seems nowadays to be an effective and favorable, to many cities, strategy for steering economic competitiveness, environmental sustainability, and livability (Stratigea, 2012; Lövehagen & Bondesson, 2013; Stratigea & Panagiotopoulou, 2014 & 2015); and mitigating the impacts of urbanization trends and the consequent overpopulation of cities (Chourabi et al., 2012).

But how can we assess urban sustainability performance especially in the smart city context? Can this be perceived independently or should it be part of a more integrated approach, assessing the impact of both smart and sustainable policies, since the former, in many cases, can add value to the latter? What is the current practice at the global scale in respect of this intriguing problem?

During the last decades, a wide variety of indicator lists have been produced by numerous organizations and studies in support of planners and policy makers for planning sustainable urban futures and assessing urban sustainability achievements (Shen et al., 2011). The selection of the most proper set of indicators has always been considered as an intriguing issue, but also as an issue that has provoked confusion and has obstructed planners and decision makers' effort towards monitoring urban sustainability projects. It has also been a source of mistrust, due to the lack of transparency as to specific indicators' choices that doubts their soundness and somehow implies deliberately selected indicators to support pre-defined policy directions and decisions. Taking into consideration the recent smart city developments and the type of interventions they introduce to pursuing sustainability objectives, assessment tasks have become even more complicated (Deakin, 2009). The question is: are there already developed sets of indicators effectively dealing with the new challenges faced by cities in a rapidly evolving information era? Are existing sets of indicators sufficient to assess smart city performance as to sustainability objectives, or should they be further enriched in order smart city sustainability achievements to be properly embedded in these sets?

While the smart city concept has been largely conceived as a new ICT-enabled approach for sustainable urban development and is constantly gaining popularity among various cities around the globe (Komninos, 2002), the way that smart city performance, with respect to sustainability, can be assessed and monitored still remains a not fully grasped issue. As pointed out in the EERA JPSC Symposium on Smart City KPIs, although there are many satisfactory indicator systems put in place, there is not a broadly-accepted indicator system that reflects the 'smart city' dimension. This is, among others, the outcome of the lack of an unambiguous operational definition of the term, whose conceptual exploration is still in progress. An analysis of several smart city examples from the global scene reveals that there is not a clear definition and underlying semantics, indicators and measures, as well as standardization of the concept's critical aspects (ITU-T Report, 2014a). Moreover, city-specific smart development does not follow a certain pattern and as Bhattacharya & Rathi (2015, pp. 17) state, there is not only "one size that fits all smart city models". In fact, current smart city examples exhibit substantial variations in terms of technological maturity, level of ICT infrastructures and type of smart applications deployed to serve the needs of cities of varying spatial scales, sustainability objectives and current state of achievements; geographical and geo-political context in which smart applications are developed, etc. This renders the assessment of sustainability performance much trickier and case-specific, while it implies the need for: setting up a coherent, comprehensive and well-structured indicator system, drawn from the international experience; and providing a certain guidance to navigate in this system and select the most relevant, to each city example, set of indicators for evaluating the impact of ICT-enabled and non ICT-enabled policies on sustainability achievements of cities.

The goal of the present paper is to elaborate on the above issues, with a particular focus on urban sustainability, constituting the main planning goal behind smart city developments. Towards this

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