



Trajectory of urban sustainability concepts: A 35-year bibliometric analysis



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ARTICLE INFO

Article history:

Received 23 March 2016

Received in revised form 24 July 2016

Accepted 2 August 2016

Available online xxxx

Keywords:

Urban sustainability

Sustainable city

Smart city

Co-word matrix

Clustering analysis

ABSTRACT

In recent decades, our cities are increasingly expected to become more sustainable urban forms, with many added determinants. A multitude of city concepts has therefore been contrived. The most time-honored and prominent concept is the “sustainable city,” which is depicted as a model urban form and thereafter more city concepts have come into being. However, it is not clear for all the concepts, for instance, “eco-cities,” “smart city,” “sustainable city,” and “resilient city,” what are the underpinning building blocks within each concept and how these concepts correlate with each other. This bibliometric study organizes this in conducting a descriptive summary, a clustering analysis, and multidimensional scaling of major city concepts, by establishing a co-word matrix of high-frequency keywords occurring in the Science Citations Index (SCI) and Social Science Citations Index (SSCI) databases. In addition to summarizing the evolution of these concepts, it analyzes the composition of each city concept and the core issues addressed by each city type. Also investigated are the correlations between the city concepts with a statistical analysis of the clusters of literature in one concept that overlap or connect to other clusters in another. From this, it is shown that, under the two umbrella terms of “sustainable city” and “smart city,” the “? -city” literature has developed in a variety of distinctive ways.

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1. Introduction

It has become common practice to contrive a city concept for transforming our cities into a more sustainable urban form. The salience of these terms has been mutually reinforced whenever it is advocated in the policy discourse or seriously elaborated in the academic field. To date, a multitude of city concepts intending to depict a more sustainable and prosperous urban future have been contrived and debated. Of these concepts, the “smart city” and “sustainable city” are the most outstanding and persistent. However, other, comparatively less, prominent city types have also received much attention, although some have lost momentum with the vicissitudes of urban discourse. “Eco-city,” “low-carbon city,” “green city,” and “digital city,” for example, are all representatives as their prime might be in the past. There are also less popular terms, such as “livable city” and “information city” as well as other concepts, whose day may yet come but are overwhelmed by competing new terms. Yet, as their names indicate, they are still endowed with grand expectations for a more sustainable future. In general, these

concepts focus on at least one aspect of the social–eco–economic urban discourse.

It is true that all these city types have a different, although sometimes overlapping, genesis. For instance, the “sustainable city” concentrates more on the tripartite relationship of social–eco–economic realms (Jabareen, 2006), while “smart city” has a more technological genesis and deals more with the social–economic realms of cities. However, they can all be considered as potential sustainable urban forms in a broad sense and focus on one particular aspect of urban development. These concepts form a complex web with each having its own distinctive characteristics. As Kamalski and Kirby (2012) argue, bibliometrics is a useful tool to examine how concepts are connected (or unconnected) within one research field. As a result, bibliometrics (clustering analysis) will be adopted in this study to identify the underpinning clusters under each city concept and how they correlate with each other across each city concept (the overlapping of different concepts), clarifying the relationship between all the concepts.

Section 1.1 provides an introduction of the genesis and evolutionary trajectory of some of the major concepts. Section 2 outlines the method adopted in analyzing the popularity and intensiveness of subthemes of all the concepts that promote urban sustainability in some way. As most current literature does, a thesaurus of terms is established before moving to the clustering analysis of the major city concepts (Liu, 2005; Wang et al., 2012; Kamalski & Kirby, 2012). As to the clustering analysis, a co-word matrix is established based on the keywords of

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“sustainable city,” “eco-city,” “low-carbon city,” “green city,” and “smart city,” to reveal how each cluster connects with each other under the same concept and how different clusters receive different weights of research attention. That is to say, to identify the core research themes and their relationship with other themes in the myriad of articles associated with one concept. In this section, we also build a multidimensional scaling (MDS) diagram to show the inner relationships between the keywords in a city type and the possible trends for the future development of the city concepts that promote a more sustainable urban form. The findings in this section provide an unprecedented perspective for dissecting the vast volume of research in the model cities we have promoted, illuminating the real trends and focus of the research area. The results are also analyzed across different concepts to see how these concepts overlap with, or differ from, each other, drawing a clear map of the composition and trends of the whole literature. The final section draws the conclusions of this study and further explains the implications of the findings for future research.

1.1. Evolutionary trajectory of major city concepts

In recent decades, promoting a more sustainable urban future has become the focus of urban studies and, as a result, a multitude of city concepts have been contrived to promote urban sustainability in some way. The concept of sustainable urbanization is not new and recent decades have witnessed a proliferation of innovations by municipalities and city authorities in its promotion worldwide. As early as the 1980s and 1990s, the research on sustainability in urban areas gradually gained momentum in both academic and policy discourses. Van der Ryn and Calthorpe (1986) were the first in bringing the issue of pollution control to the process of economic development, depicting a prospect of more livable cities that depend less on fossil fuels. Meanwhile a string of conferences and international initiatives focusing on the problem of unsustainability has also highlighted the salience of sustainable urbanization, generating many concept ramifications. The Brundtland Commission (World Commission on Environment and Development, 1987) provided an early definition of urban sustainability, which was consistently improved and completed at international forums. Since then, research on sustainable urbanization has been evolving into a more detailed and complicated form, suggesting the need for a systematic compendium for moving toward sustainability. A comprehensive set of principles of urban planning concepts and strategies was introduced by urban planners to keep traditional planning and designing practice in alignment with the renewed and updated notion of sustainability (Walter, Arkin & Crenshaw, 1992).

However, in the early 2000s, the notion of urban sustainability gradually varied into a subset of concepts as the result of burgeoning “smart green technological solutions” (Joss, Cowley, & Tomozeiu, 2013). Although the planners were equipped with new technological innovations and policy tools, the way to sustainable urbanization was far from clear after the three-decade endeavor. Rather, the notion of sustainability had multiplied and become dramatically enriched, with the requirements for achieving sustainability becoming much more demanding than hitherto (Joss, 2011; Ni & Jie, 2014; Yigitcanlar, O'Connor, & Westerman, 2008). The notions and concepts of urban sustainability on the one hand are inspired by technological innovations and, on the other, go beyond technological advancements. To date, urban sustainability has become an umbrella concept covering “ecological modernization,” the “green economy,” “regenerative sustainability,” “the ecological city as economic city,” “social justice,” and so on (Barton, 2000; Cole, 2012; Mol, 2003; World Bank, 2010). Technological innovations have significantly enriched the meaning of sustainability, leading to a myriad of discussions over the dynamics of the conflicts among, and priorities of, the social–economic–ecological triangle (Rotmans, van Asselt, & Vellinga, 2000; Berke & Conroy, 2000). The research and practice of urban sustainability, instead of being discarded as hackneyed jargon after decades of intensive attention, flourished and generated a

set of subcategories of new terms. The traditional term “sustainable cities,” which is still in its prime in current theoretical and practical discourses, has been attracting attention over other newly innovated notions such as eco-cities, low-carbon cities, and smart cities (Caragliu, Del Bo, & Nijkamp, 2011; Liu, Dai, Dong, & Qi, 2009; Roy, 2009).

The emergence of these city concepts is the result of the development of sustainable discourse. The emergence and thriving of eco-cities was largely the result of refining the sustainable city as an “ecological healthy city” and the “ecological city as economic city,” promoting a new generation of study of the planning of eco-cities as well as the relevant qualitative and quantitative evaluation measures involved (Register, 1987, 3; World Bank, 2010; Joss, 2011). Neoliberalization in the global context facilitated the knowledge transfer of eco-cities (together with other subcategories of sustainable cities and relevant technologies and policy tools), rendering private companies, research institutes, and governments at all levels competitors and partners in their joint efforts in greening cities worldwide (Harvey, 2005, 2006; Pow & Neo, 2013; Joss, Cowley and Tomozeiu, 2013). This has bred a new focus of research into green standards, green technology, and green knowledge transfer. Also, worth mentioning is the fact that the booming of green standards, such as the American LEED, UK BREAM, and other similar versions throughout the world, is the by-product of the evolving process of sustainability discourse and global knowledge transfer (Joss, Tomozeiu, & Cowley, 2012). This ongoing process of evolution of meanings in urban sustainability has shaped and reshaped contemporary research and taken it to new frontiers.

In parallel, the rising salience of carbon discourse in the 21st century has also left its mark in the theory and practice of urban sustainability. The early literature of Register (1987) and Roseland (1997), although advocating ecological and environmental protection, did not deliberate on the issue of CO₂ emission reduction and solutions to climate change. It was not until the adoption of the Kyoto Protocol (1997) that “low carbon” or “carbon neutral” gradually became accepted as a universal standard by almost all the cities in the world. A string of global summits, including the UN Climate Change Conference in Copenhagen in 2009 and the Paris Conference in 2015, stressed the responsibilities of all cities to reduce their carbon emissions and urged coordinated collective action worldwide. Cities, which are estimated to account for almost 70% of all global carbon emissions and energy consumption, are seen as the key to sustainability (UN HABITAT, 2011). In accordance with this trend, sustainable and eco-city initiatives have integrated the clear and specific goal of carbon emission reduction into their policy statements and future plans. The carbon discourse not only provides the low-carbon city as the new approach to achieving a more sustainable urban form, but also introduces a series of terms such as “low carbon,” “carbon neutral,” “zero carbon,” and “carbon footprint,” further expanding the sustainable urbanization research field with a new dimension (Chen & Zhu, 2009; Gosson, 2011; Liu et al., 2009). Quite distinct from eco-city research, the low-carbon literature concentrates more on technical issues, especially the innovations in technological and policy tools for reducing energy consumption and increasing efficiency (Storch & Downes, 2011; Premalatha, Tauseef, Abbasi, & Abbasi, 2013).

Very recently, the term “smart city” is gaining maturity and becoming more popular, and with the quantity of published papers with the keyword “smart city” even surpassing those containing “sustainable city” (De Jong, Joss, Schraven, Zhan, & Weijnen, 2015). In the literature of “smart city,” the tripartite eco–economic–social relationship deliberates less on ecological sustainability than on economic–social sustainability with the expectation that digital information technologies will upgrade the social and economic performance of cities to create a more prosperous future, with high-tech industries and efficient social services for future generations (Joss, Cowley and Tomozeiu, 2013). This advancement has steered research toward a new direction. The most recent trend on the studies of the “smart city” has articulated

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