Ecological Indicators 90 (2018) 38–46

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Original Articles

Defining and measuring urban sustainability in Europe: A Delphi study on identifying its most relevant components

Jurian V. Meijering[a,*], Hilde Tobi[a], Kristine Kern[b,c]

[a] Biometris, Wageningen University & Research, Droevendaalsesteeg 1, P.O. Box 16, 6700 AA, Wageningen, The Netherlands
[b] Leibniz Institute for Research on Society and Space, Flakenstraße 29-31, 15537 Erkner, Germany
[c] Åbo Akademi University, Finland

ARTICLE INFO

Keywords:
Delphi method
Operationalization
Dimensions
Categories
Themes
Indicators

ABSTRACT

Urban sustainability rankings may be useful for urban planning. How urban sustainability is defined influences the results of urban sustainability rankings. Various efforts have been made to define the concept and to operationalize it into specific components (e.g. air quality, inequality, employment). Consequently, numerous different components are currently being used without agreement on which components are most relevant for defining and measuring urban sustainability. This study identified which components experts find most relevant for defining and measuring urban sustainability in a European context. The study thereby provides insight into what the concept actually entails. This may facilitate the development of future urban sustainability rankings. A European sample of 419 urban sustainability experts was invited to participate in a three-round Delphi study. In each round experts were asked to evaluate and comment on the relevance of various components of urban sustainability. The following seven components were identified as most relevant: air quality, governance, energy consumption, non-car transportation infrastructure, green spaces, inequality, and CO_2 emissions. Five of these components are part of the environmental dimension of urban sustainability, which suggests that urban sustainability is still perceived as mainly an environmental concept. Based on experts' evaluations of the components, weights could be established that reflect the relative relevance of each component for measuring urban sustainability. This study provides an expert-based framework in which urban sustainability is operationalized into several weighted components. This framework may be used by future developers of urban sustainability rankings to properly define the concept and to select appropriate indicators.

1. Introduction

With almost three-quarters of Europeans living in urban areas, Europe is among the most urbanized continents in the world (UN-Habitat, 2016). European cities are the engines of the European economy (European Commission, 2011) and in various ways they have been front-runners in the field of sustainable urban development (Newman and Kenworthy, 1999). However, European cities are also home to many problems such as unemployment, poverty, and environmental pollution to name only a few (European Commission, 2011). The European Union is therefore committed to making its cities more sustainable (European Commission, 2010). In 2008 the European Commission initiated the European Green Capital Award: a competition in which European cities are evaluated and ranked according to their environmental standards and commitment to future environmental improvement and sustainable development (European Commission, 2015). Since then, other institutions have also developed and published some form of urban sustainability ranking. Examples are the European Green City Index (Siemens, 2009) and the Sustainable Cities Index (Arcadis, 2015).

City rankings may be useful for urban governance, in particular urban planning and development (Besecke and Herkommer, 2007), but should also be used with caution because of methodological issues (Meijering et al., 2014). City rankings are often based on an indicator system. This means that the ranking attribute on which cities were finally ranked (e.g. urban sustainability) is operationalized into various indicators that each measure a specific aspect of the ranking attribute. For each city, data were collected on the indicators and then aggregated into a composite index value and corresponding rank number. Although rankings thus developed ought to reflect the performance of cities on the ranking attribute, they may be very sensitive to various methodological choices made, such as the techniques used to normalize and weigh indicators (Floridi et al., 2011; Jacobs et al., 2005; Lun et al., 2006).

* Corresponding author.
E-mail address: jurian.meijering@wur.nl (J.V. Meijering).

https://doi.org/10.1016/j.ecolind.2018.02.055
Received 6 June 2017; Received in revised form 24 January 2018; Accepted 26 February 2018

A fundamental choice concerns the definition of the ranking attribute. How urban sustainability is defined influences the selection of indicators and thereby ranking results (McManus, 2012). In this regard it is problematic that many different definitions of urban sustainability exist (for an overview see Huang et al. (2015)). Additionally, various concepts related to urban sustainability have been developed during the last couple of years. Bibliometric analyses of the trajectory of urban sustainability concepts revealed that the various concepts can be categorized into two clusters: one with an emphasis on eco-economic issues and one focusing more on socio-economic issues. Other concepts, such as low-carbon city or eco-city, seem to be hybrid forms which enrich the traditional sustainable city concept (de Jong et al., 2015; Fu and Zhang, 2017).

Since the report of the Brundtland Commission (World Commission on Environment and Development, 1987), it is widely accepted that sustainability in general and urban sustainability in particular consists of three pillars or dimensions: environmental, economic, and social sustainability (Hassan and Lee, 2015; Huang et al., 2015; Tanguay et al., 2010). Still, these three dimensions are very abstract and open to a wide range of interpretations. To help define and measure urban sustainability, various efforts have been made to divide the three traditional dimensions of urban sustainability into more specific components, also referred to as themes or categories (see for example Huang et al., 1998; Michael et al., 2014; Tanguay et al., 2010). So far, these efforts all ended up with a different mix of components. As a result, many different components of urban sustainability are currently being used without agreement on which components are most relevant for defining and measuring the concept.

Meijering et al. (2014) suggested that agreement on the definition and operationalization of urban environmental sustainability may be achieved by using the Delphi method: a structured data-collection method that aims to facilitate a group of experts in achieving agreement on a topic. The method has indeed been frequently used to develop definitions and operationalizations of various concepts such as 'team effectiveness' (Lohuis et al., 2013) and 'acute respiratory distress syndrome' (Ferguson et al., 2005). Therefore, the objective of the current study was to identify which components experts find most relevant for defining and measuring urban sustainability in a European context by means of the Delphi method. In doing so, the study provides insight into what the concept actually entails. This may help developers of future urban sustainability rankings to properly define the concept, select appropriate components, and in turn, find or develop corresponding indicators. The study was restricted to the European context as urban sustainability is a place-dependent concept (Hassan and Lee, 2015) and may thus be defined and measured differently in different parts of the world. Within this context an area may be defined as urban when at least 50% of the inhabitants live in high-density clusters (i.e. contiguous grid cells of 1 km^2 with a density of at least 1500 inhabitants per km^2 and a minimum population of 50.000; see Dijkstra and Poelman (2014) for full details).

2. Methods

2.1. The Delphi method

The Delphi method, developed in the 1950s by Dalkey and Helmer (1963), consists of at least two rounds of data collection. In the first round experts are independently questioned about their opinion on the topic of interest, usually by means of a standardized questionnaire. To prevent group pressure and inadvertent influence of dominant individuals, experts participate anonymously and do not directly communicate with each other. Instead, the study moderator provides experts with so called controlled opinion feedback: a summary of the findings from the previous round. Based on this feedback experts are allowed to reconsider and change their opinion in the second round. This process continues until a pre-specified number of rounds has been completed, a certain level of agreement has been achieved, or experts' opinions have stabilized (Diamond et al., 2014; Hasson and Keeney, 2011; Linstone and Turoff, 1975). In the current Delphi study a sample of urban sustainability experts was questioned about which components are most relevant for defining and measuring urban sustainability in a European context. The number of Delphi rounds was pre-specified at three as it was expected, based on a previous comparable Delphi study (Meijering et al., 2015), that this would be sufficient to obtain the required data.

2.2. Expert sample

Urban sustainability experts were considered to be people whose work is related to urban sustainability as inferred from the institution they work for, their position within that institution, their job description, or work related activities (i.e. participating in urban sustainability conferences or projects). With regard to Delphi studies it is recommended to compile a heterogeneous panel of experts to assure the inclusion of a diverse range of views (Hussler et al., 2011; Powell, 2003). For the current study it was therefore decided to search for urban sustainability experts from four different types of institutions: academia, business, civil society (i.e. NGOs, non-profit, and community-based organisations that pursue charitable or member-oriented goals), and government. These four types of institutions have all been involved in the development of urban sustainability rankings. To illustrate, the European Smart Cities Ranking was developed by a team of researchers from the Vienna University of Technology, the Networked Society Index by Ericsson, the Sustainable Cities Index by the Forum for the Future, and The European Green Capital Award by the European Commission. In addition to searching for experts from four different types of institutions, it was decided to search for experts from various European countries.

A convenience sample was assembled from various sources. Several conferences on urban sustainability that took place in different European countries in 2013 or 2014 formed a first major source of experts. Initially, contributors (i.e. presenters and authors of accepted abstracts as mentioned in the conference program or proceedings) to the following three conferences were regarded as potentially suitable experts: The Sustainable City Conference 2014 (Siena, Italy), The Urban Sustainability and Resilience Conference 2014 (London, United Kingdom), and The PLEA Conference 2013 (on sustainable architecture and urban design, Munich, Germany). Because the three conferences mainly yielded experts from academia, additional experts were acquired from two conferences targeted at a more diverse audience: The Future Cities Forum 2014 (Munich, Germany) and The Reference Framework for European Sustainable Cities Conference 2013 (Brussels, Belgium). Names of potentially suitable experts were researched online to acquire additional background information (i.e. the institution they work for, their position within that institution, their e-mail address) and to verify whether they held a position in an institution located in a European country.

The Joint Programming Initiative Urban Europe formed another major source of experts. This program was established in 2010 by the European Commission and aims to "Enhance the capacities and knowledge on transition towards more sustainable, resilient and liveable urban developments" (Robinson et al., 2015). By means of two calls for proposals the program selected and funded 20 projects. The coordinators of these projects and their project partners as listed on the website were regarded as potentially suitable experts. Their names were researched online to acquire additional background information and to verify whether they held a position in an institution located in a European country.

Finally, by searching on the internet and talking to experts, many institutions were found that are active in the field of urban sustainability. For example, developers of urban sustainability rankings (e.g. Arcadis), partners of sustainable and smart city conferences (e.g.