Guest editorial

Sustainability accounting and control for smart cities

Scope of the special issue

Making a city "smart" is an emerging approach to mitigate sustainability problems caused by rapid urbanization and urban population growth, and, more globally, to facilitate the transition of cities towards sustainable development (economic prosperity as well as environmental quality and social well-being). In this context, new technologies can play an important role as an enabler for sustainable urban development. Smart cities basically, are supposed to cope with problematic trends endangering sustainability and to improve respective quality standards through intelligent initiatives and projects in corresponding key fields of urban development: smart economy, smart people, smart governance, smart mobility, smart environment, and smart living (Giffinger *et al.*, 2007).

An increasing number of publications have discussed the smart city approach for the last recent years (Kummitha and Crutzen, 2017). However, the smart city concept itself is still emerging and the work of defining and conceptualizing is in progress. In addition, the vast majority of these publications focuses on urban and regional planning, governance and behavioral aspects or technology innovation while, from a sustainable development perspective, scholars need to move beyond urban and economic research to embrace management and interdisciplinary perspectives to better understand how these complex systems integrate social, economic, ecological and political subsystems (Ben Letaifa, 2015).

The urge for smart city developments as solutions to future urban challenges is accompanied with the need to verify whether these developments have the intended effect. This can be done through the process of accounting, control, performance measurement, monitoring, etc. (Greiling, 2005; Albino *et al.*, 2015; Dameri, 2017).

The lack of maturity of smart city research, especially in the field of sustainability accounting, performance measurement, control or strategic management for smart city development (Crutzen *et al.*, 2013; Ricciardi and Za, 2015; Ojo *et al.*, 2016; Mora *et al.*, 2018a, 2018b), resulted in the establishment of this Special Issue as an attempt to motivate research in this field.

The scope was quite broad welcoming conceptual and empirical submissions on performance measurement and comparison of smart cities focusing on different levels of analysis (e.g. territorial or organizational-level), different stakeholders (governments, companies, citizens) and on different smart city topics (e.g. energy, mobility). As a result, the four selected articles are diverse in topic and focus, not necessarily covering the whole scope, but rather paving the way for more research in this field.

Smart city

The term "smart city" was first introduced by the corporate sector around the mid-1990s as a solution for the increasing global population, urbanization and the resulting infrastructural societal and environmental problems (Carayannis and Rakhmatullin, 2014; Cocchia, 2014; Dameri *et al.*, 2016). Originally, smart cities focused on technology-driven urban development (Hollands, 2008). Over the course of time, the smart city concept has diverged from a purely technological concept towards a socio-technological solution to the many challenges cities worldwide are facing (Caragliu *et al.*, 2011; Vanolo, 2014; Hollands, 2015; Meijer and Bolívar, 2016).

Sustainability Accounting, Management and Policy Journal
Vol. 10 No. 4, 2019
pp. 646-653

2040-8021
DOI 10.1108/SAMPJ-12-2018-0354

The result is a combination of smart city models and definitions, each emphasizing different aspects according to their economic, urban, demographic and geographical specificities (Carayannis and Rakhmatullin, 2014; Cocchia, 2014; Neirotti *et al.*, 2014; Albino *et al.*, 2015; Dameri *et al.*, 2016; Dameri, 2017; Kummitha and Crutzen, 2017; Mora *et al.*, 2017). In addition, the development of smart cities and smart city research is relatively new also resulting in a lot of variation in the maturity levels of different smart cities (Lee *et al.*, 2014; Afonso *et al.*, 2015).

Most smart city publications also seem to agree that a multi-stakeholder process is at the base of a smart city and the most commonly mentioned stakeholders are society, governments, industry and research institutes/universities (Lombardi, 2011; Afonso *et al.*, 2012; Kummitha and Crutzen, 2017; Desdemoustier *et al.*, 2018). Monitoring and accounting is a way to involve these stakeholders in smart city developments (Halachmi and Holzer, 2010; Woolum, 2011) and support broad citizenship participation. Performance measurement and communicating the progress a city is making with all stakeholders is an effective way to build a relationship of trust between citizens and city governments (Yang and Holzer, 2006; Costa and Pesci, 2016; Christensen, 2018). An ambitious approach to stakeholder participation is to involve different societal groups in the development of goals and indicators, which are then communicated.

The smart city concept itself is still in its infancy and the work of defining and conceptualizing is in progress (Ricciardi and Za, 2015; Kummitha and Crutzen, 2017). As a result, different types of smart cities have emerged, each with a different scope and definition, but what they have in common is that smart cities are focused on outcomes and results (Dameri, 2017; Kummitha and Crutzen, 2017; Ramaprasad *et al.*, 2017). Over recent years, the question arises whether the time and effort that cities invest in smart city developments are really resulting in the promised solutions to future challenges of cities worldwide. To answer this question on expected impacts, there is a need to design a more integrative conceptual model which allows to consider governance and stakeholder, to integrate relevant dimensions of urban development and to connect these elements with city specific challenges. Corresponding methodologies are discussed providing qualitative valuation based on text analysis of documents and interviews (Fernandez-Anez *et al.*, 2018). However, this approach is still lacking a more precise implementation of monitoring and performance management processes which are recognized as one of the solutions to assess and improve the impact of smart city developments.

Public performance measurement and monitoring

Performance measurement or monitoring contains the process of gathering performance information by looking into the inputs, outputs and outcomes of an organization and is, in theory at least, widely accepted in (smart) cities (Yang and Holzer, 2006; Hollands, 2008; Van Dooren *et al.*, 2015).

Since the 1900s, several types of public performance measurement have emerged but the idea always remained the same (Van Dooren *et al.*, 2015). Even though the idea of performance measurement in cities is popular, it is not widely implemented, because of psychological, cultural and institutional barriers and/or a lack of information (Bouckaert and Van Dooren, 2009; Hvidman and Andersen, 2014; Van Dooren *et al.*, 2015). For instance, cities are complex organizations (Heinrich, 2002; Sanger, 2008a), have objectives that are not always clearly defined or measurable (Verbeeten, 2008) and the shift from a bureaucratic to a result-driven organization takes time and effort (Sanger, 2008b; Folz *et al.*, 2009). Not monitoring usually has negative effects on the performance of an organization. Recent calls for improved decision-making, more efficient services, and clear accountability and

technological advances (ICT, data etc.) have boosted the attention for performance management in cities in an attempt to increase the impact of governance on the city and society (Kloot and Martin, 2000; Bouckaert and Peters, 2002; Newcomer and Caudle, 2011; Holzer *et al.*, 2017).

Monitoring smart cities

Recent systematic literature reviews on smart city research highlight that the evolving field of smart city research focusses more on technological advances rather than looking into factors that facilitate/impede their implementation in real-life (Ricciardi and Za, 2015; Ojo *et al.*, 2016; Visvizi *et al.*, 2018). Especially the monitoring and performance management of smart cities remains under the radar (Ricciardi and Za, 2015; Mora *et al.*, 2017; Ingwersen and Serrano-López, 2018; Mora *et al.*, 2018a, 2018b).

The evolution of the smart city concept greatly influences how the success of smart city development is defined and monitored for several reasons. First, the divergence of smart city definitions and models requires adequate performance management processes (Albino *et al.*, 2015; Meijer *et al.*, 2016; Dameri, 2017). Second, the higher amount of stakeholders, especially citizens, make smart cities increasingly more complex to manage (Crisostomi *et al.*, 2016; Meijer *et al.*, 2016). Finally, the smart city concept is accompanied with an increase in topics and domains that before were not (always) considered a priority for cities (e.g. social inclusion, pollution, well-being etc.) (Crisostomi *et al.*, 2016; Meijer *et al.*, 2016; Dameri, 2017).

In the relatively limited scientific body of work on the topic of smart city monitoring, there seems to be a focus on the development of new methods whereas empirical research based on case-studies appears less popular, which is a trend that can be observed in the whole smart city research domain (Ojo *et al.*, 2016). It is therefore difficult to get a good overview of how smart cities are being monitored which leads to an urgent need for more empirical case-studies on smart city monitoring and performance measurement. However, six publications, all European, analyze existing performance measurement methods in smart cities, based on either case studies or analysis of scientific literature (Table VI), giving rise to different findings.

First, implementing performance measurement methods seems to be something for more mature smart cities. In general, developing smart cities do not start with city-wide performance measurement to avoid overburdening the local governments (Merli and Bonollo, 2014; Caird, 2017; Caird and Hallett, 2018). Second, it seems that several performance measurement frameworks focus more on results and not enough on impact (Merli and Bonollo, 2014; Castelnovo *et al.*, 2016; Ahvenniemi *et al.*, 2017).

Furthermore, existing performance measurement methods and frameworks are often designed as one-size-fits-all solutions supposedly valid for a wide variety of cities. Adopting a more comprehensive and inclusive approach is assumed to result in monitoring methods that are more adapted to the cities' specificities and interests of the local stakeholders, thus improving the likelihood of being implemented in practice (Kitchin *et al.*, 2015; Castelnovo *et al.*, 2016; Ahvenniemi *et al.*, 2017).

Finally, the inclusion of all urban stakeholders is, in theory at least, closely intertwined with smart city developments and is even thought to improve the impact of smart city projects. In reality, however, this is not always the case and it seems that more efforts are necessary to get all stakeholders sufficiently involved in smart city developments (Merli and Bonollo, 2014; Kitchin *et al.*, 2015; Castelnovo *et al.*, 2016).

Papers in the special issue

In total four different articles are selected for this Special Issue, one presenting a new smart city maturity assessment and benchmarking tool and three focusing on performance measurement in the field of greenhouse gas emission.

The first article by Daniela Warnecke shows the conception and implementation of a smart city maturity assessment and benchmarking tool that allows practitioners to evaluate their initiatives, track progress and determine their competitive position. The tool has been tested with data of five cities and expert interviews and has been validated in the field of smart mobility, but future development iterations are to integrate additional smart city action fields.

The second article by Mia Parvez looks into the difficulties that arise when cities are trying to quantify their greenhouse gas emissions. By analyzing the greenhouse gas emission data of 42 cities participating in the Carbon Disclosure Project (CDP), the author found that the emission data at the city level is outdated, incomplete, inconsistent, inaccurate and incomparable which leads to a gap between how much greenhouse gasses are emitted by cities in reality and on paper. To close this so-called expectation gap thus allowing for correct greenhouse gas emission data by cities, more work is necessary by policymakers and urban stakeholders.

Thirdly, Delphine Gibassier provides an empirical in-depth case study of a small city that implemented climate change policies over the past 13 years to mitigate and adapt to climate change. The governmentality lens is used to critically deconstruct the mechanisms in place and what they achieve- or fail to achieve towards environmental sustainability. The efforts of the studied city can be attributed to two different approaches, that of the "good citizen", responsible to lower his impact on climate change, and the "model city" – a laboratory that would serve as a guide for future policies to tackle climate change at the city level. The "model city"-approach proved to be more successful than the "good citizen" approach in this city which demonstrates that local strategies and governmentality mechanisms have more effect than getting individual citizens engaged in fighting climate change at the local level. Even though larger cities are well represented in climate change research, the role of smaller cities and villages is less clear and this manuscript shows how a small city adapts its local strategies and their own governmentality mechanisms to face a changing climate.

The final article by Jo-Ting Huang Lachmann investigates synergies of smart city applications in urban climate change adaptation literature by using the theory of coproduction. A systematic literature review and content analysis are carried out to answer the research questions and a theoretically based smart cities concept matrix with synergetic coproduction theory is used to assess the empirical studies. This analysis shows that there are substantial co-existing benefits in smart city development and urban climate change adaptation. The successful cases serve as example to exploit opportunities in smart city applications and climate change adaptation and identify win-win adaptations.

Conclusions

The papers in this issue provide a valuable contribution to our current understanding of smart city monitoring and performance measurement. Even though the small number of papers are very diverse in scope and do not give an exhaustive view of smart city monitoring, some conclusions can be drawn.

First, all the submitted papers are European, confirming earlier bibliographic analyses of smart city research (Ojo *et al.*, 2016; Mora *et al.*, 2017). Given the divergence of smart city definitions and models (Mora *et al.*, 2018a, 2018b), these four selected papers will likely give

a biased view on smart city monitoring that is not necessarily representative for the rest of the world.

Furthermore, there is a very strong focus on climate change monitoring and adaptation. A recent study shows that in Europe, the smart city concept is often linked to the establishment of a low-carbon economy (Mora *et al.*, 2018a, 2018b).

Finally, only one in-depth case study has been submitted, even though the call-for-paper specifically requested empirical case studies of smart city monitoring. Together with the diverse scope of the selected papers, this indicates a lingering lack of maturity in the field of smart city performance measurement. This shows that there is a need for more empirical studies that focus on one or a few cities by using multiple research methods and data sources (qualitative and quantitative) to get a better understanding of how smart cities are monitored in reality.

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Further reading

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