Chapter 27
Does Activity Fulfil Aspiration? A Contextual Comparison of Smart City Applications in Practice

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Abstract Research on smart city projects and applications has been increasing in recent years (Meijer and Bolivar 2015). The smart city concept is mostly considered from a technology-oriented perspective that stresses the use of data technologies, big data and ICT to 'smarten up' cities. In contrast, attention to soft aspects of the smart city—namely smart governance, people and social learning—seems to be limited in both academia and practice. Moreover, what seems to be largely missing from the literature is empirical insight into the extent to which different smart city aspects are factually known of and applied in different geographical contexts. This contribution presents a contextual comparison of smart city applications based on a mainly quantitative empirical analysis. Particular emphasis is put on the knowledge that government practitioners in the Netherlands have of smart aspects and the extent to which they are willing and able to implement smart aspects in their specific local and regional contexts. The results of the analysis show that both in the Netherlands and worldwide there are great aspirations to develop and implement smart city applications, but that to some extent factual activities are lagging behind. The reasons for this are mostly related to a lack of awareness of the possibilities and

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a lack of financial and political priority. This especially applies to smaller cities in the Netherlands. When this is resolved, actual activities are more likely to live up to the great aspirations regarding the smart city concept.

Keywords Smart city · Smart governance · Policy · Implementation · Contextualization

1 Introduction

Smart city initiatives continue to be implemented worldwide. In recent years, a wide variety of smart city aspirations have been realized and projects accomplished, either in the form of complete smart cities or by means of individual smart projects. Examples of the first form can be found in, for instance, China, where firms like IBM and Siemens have been involved in setting up several hundred complete smart cities, such as Yinchuan. Examples of the second form can be found in many places, such as Barcelona (Barcelona Digital City 2016), which has its own overall smart city framework composed of smaller projects, and Amsterdam (Amsterdam Smart City 2016), whose smart city platform is made up of a variety of smaller smart city projects and initiatives.

However, even though in practice there seems to be a lot happening in terms of smart city projects and applications, academic research into smart city projects, applications and the concept itself has been relatively scarce, although there has been more in recent years (see e.g., Meijer and Bolivar 2015). Furthermore, research into smart city developments has been mainly limited to conceptual research or to the empirical investigation of individual projects. What is lacking is empirical research that provides a more state-of-the-art overview of smart city developments. One of the very few examples of such research is provided by Neirotti et al. (2014), who present an empirically based worldwide overview of the geographic distribution of smart city developments. To complement this worldwide overview, we provide a more detailed but still empirically based overview of smart city developments in the Netherlands. We also provide some additional background insights. As such, in comparison to the Neirotti et al. (2014) paper, this chapter provides both a more detailed overview of a specific area (the Netherlands) and a more detailed insight into the background to differences with respect to smart city developments.

The chapter is structured as follows. The following section gives an extensive overview of existing literature on the smart city and its applications. First, special consideration is given to the smart city domains as identified by Giffinger et al. (2007) to be able to differentiate the smart city concept. Thereafter, based on Neirotti et al. (2014) we shed light on the outcomes of a worldwide comparison of smart city initiatives to see how the concept is geographically differentiated.

In addition, we elaborate on our own empirical research in the Netherlands related to smart city aspects. Subsequently, our results are contrasted with the outcomes of Neirotti et al. (2014). This contrast is used as a basis for an overall discussion and conclusion based on both the literature and the empirical results.

2 Smart City: Making Sense of a Fuzzy Concept

Smart city is a very timely and contemporary concept that seems to be becoming increasingly important for various stakeholder groups, such as businesses, governments and the wider public or civil society. There are many different descriptions and definitions of the smart city concept (e.g., Stimson and Pettit 2016). There is no universal consensus on its meaning and therefore it can be regarded as a fuzzy concept (see e.g., Batty et al. 2012; Caragliu et al. 2011; Lombardi et al. 2012; Papa et al. 2013). However, for the sake of clarity, and despite its fuzziness, in this chapter we adhere to the smart city definition given by Caragliu et al. (2011, p. 50) *"… when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance."*

2.1 Smart City Domains: The Conceptual Picture

To shed more light on this fuzzy concept we turn to Giffinger et al. (2007), who in a report for the European Union conceptualized smart city into six domains, namely governance, economy, living, environment, people and mobility (see Fig. 1). Here, we briefly explain the main characteristics of each domain based on Giffinger et al. (2007) and associated literature.

- *Smart governance* is related to the policy aspect of the city, such as participation, e-governance and transparency of governments (Giffinger et al. 2007). Hollands (2008) stated that social integration with e-governance is the main characteristic of a smart city. A bottom-up approach plays an important role in smart governance. Governments can have a facilitating role or actively seek input from citizens and businesses and in that way be communicative towards the public (Chourabi et al. 2012). E-governance is also used internally, to improve existing public administrative processes (Tranos and Gertner 2012). Smart governance can bring about a change in norms and values towards smart city applications (Chourabi et al. 2012). Working more digitally and with increased transparency could require a change in the mind-set on the part of public administration.

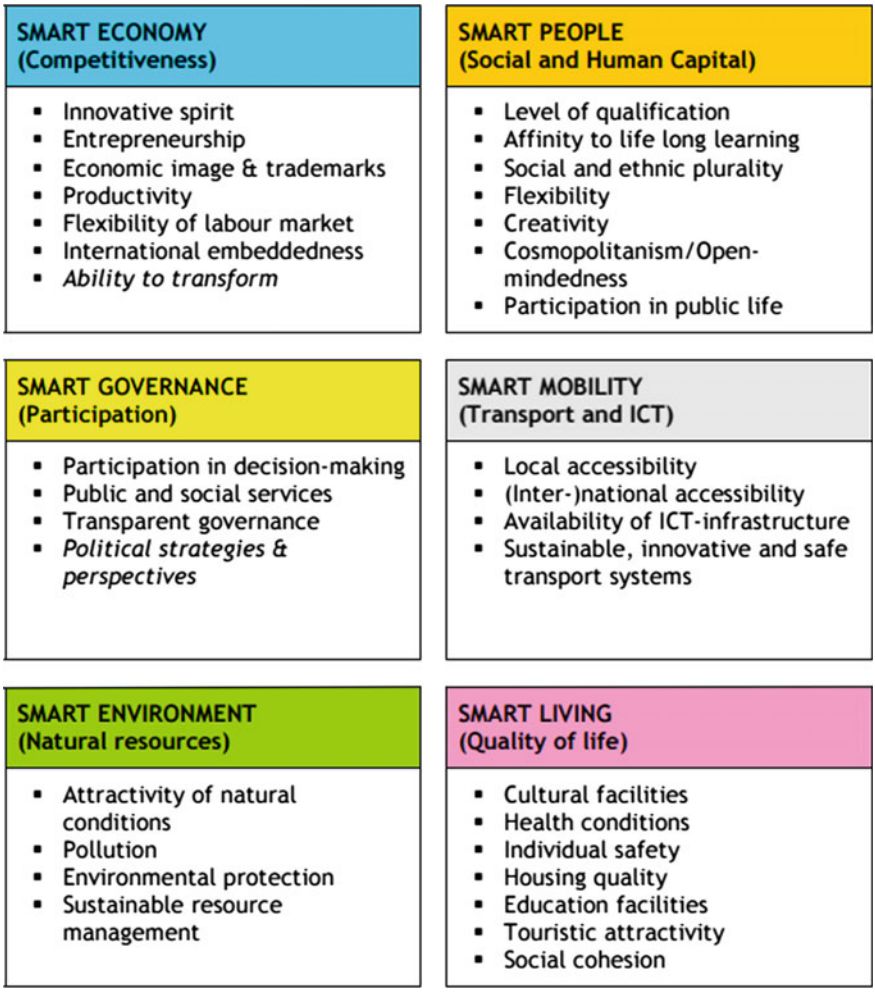

Fig. 1 Characteristics and factors of smart city (Giffinger et al. 2007)

- *Smart economy* asks for urban development that is mostly led by businesses, rather than by governments (Giffinger et al. 2007) Additionally, the availability of creative and innovative entrepreneurship is important. The general urge to be innovative is important, because innovation can improve a city's competitiveness (Tranos and Gertner 2012). Information networks and social and financial capital are important for a smart economy. Tranos and Gertner (2012) emphasized the importance of creative and innovative people in the city in stimulating urban economic growth.

- *Smart living* looks explicitly at the social aspect of smart cities in terms of quality of life. Themes within this domain include culture, health, safety, tourism, education and social cohesion (Giffinger et al. 2007). ICT could help improve the quality of life in a city by means of sensors that analyse certain aspects of quality of life. Smart living can be seen as a domain of contemporary urban issues, such as safety in the city, caring for a growing group of elderly, and so on.
- *Smart environment* is a domain that occurs in different processes and projects and mostly looks at ecological or physical sustainability that might be dependent on the existing conditions of a city (Tranos and Gertner 2012; Giffinger et al. 2007). Smart city policies seem to have a sustainable component and cities are focusing on decreasing negative environmental impacts such as pollution (Tranos and Gertner 2012). ICT and data could help resolve environmental issues, for example, through the use of sensors or sustainable technologies in the city, such as energy-saving streetlights.
- *Smart people* bears similarities with the domain of smart living, but smart people looks more at the individual in the city, rather than at society as a whole. Smart city also has a 'softer' side that focuses on knowledge and people's abilities (Hollands 2008). Smart people relates to human and social capital and looks at characteristics of society such as age, education, creativity and open-mindedness (Giffinger et al. 2007).
- *Smart mobility* is related to the combination of ICT and mobility. Smart mobility distinguishes between physical and digital infrastructure: the physical infrastructure consists of roads, train tracks, station areas, et cetera, and the digital infrastructure includes technologies and data (Frost and Sullivan, White Paper, n.d.). The intelligence of transport could be measured with the help of ICT infrastructure that is related directly to transport (Debnath et al. 2014). An example is traffic data gathered from sensors that are then used to adjust the maximum speed on a certain route.

2.2 Smart City Domains: Empirical Evidence at the Global Scale

Looking from an empirical perspective at these six smart city domains, it appears that there is hardly any empirical data that provide insight into their application. Neirotti et al. (2014), however, empirically researched current trends in smart city initiatives worldwide, which closely resemble the domains of Giffinger et al. (2007). They conducted an empirical analysis on a sample of 70 cities worldwide that claim to have developed projects and best practices in one or more of the smart city domains (see Fig. 2).

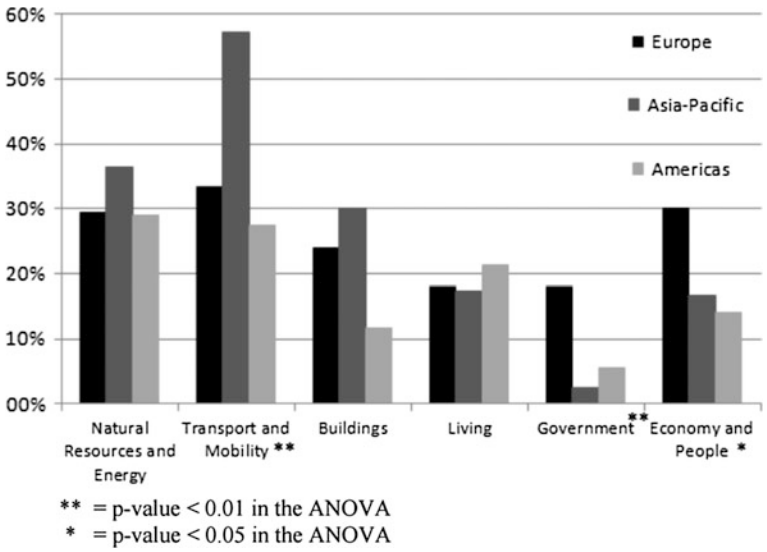

Fig. 2 Smart city development trends in three major world regions (Neirotti et al. 2014)

Although the categories in the research by Neirotti et al. (2014) only partly overlap the domains of Giffinger et al. (2007), a clear general picture can be distilled from this. First, it shows in general some similarity in focus on natural resources and energy, transport and mobility, and buildings. The other categories (living, government and economy and people) have received less attention. Besides this general picture, there are some significant differences across continents, in particular for transport and mobility, government, and economy and people. Asian cities have paid particular attention to the transport and mobility domain, and less to the government and economy and people domains. European cities have paid much more attention to the government domain than the other continents. Both North and South American cities have fewer smart city initiatives than their European and Asian counterparts.

Furthermore, Neirotti et al. (2014) stressed that the number of domains covered by smart city initiatives seems not to be correlated with the size of the city. This implies that both large and small cities are capable of showing innovation with regard to smart city implementation. This reinforces the need for more empirical scrutiny of the smart city concept in various geographical contexts and at different scale levels. Building on this, we are especially interested in how these results translate to a more detailed context like the one of the Netherlands. In the following section, we elaborate on the methodology applied and the results of this study.

3 Smart City in the Netherlands

Using the conceptual study by Giffinger et al. (2007) and the empirical study by Neirotti et al. (2014) as reference points, we looked in more detail at the spread of smart city developments in one specific country, namely the Netherlands. This is of interest given that the Netherlands is a relatively densely populated country with a variety of different-sized cities and a high degree of internet coverage.

The empirical data used for this chapter are derived from an empirical research project carried out by Utrecht University and Vicrea Solutions, a Dutch geo-IT company. In this explorative empirical research, the focus was on getting an overview of and a deeper insight into the smart city knowledge of government practitioners and the implementation of smart city applications in Dutch municipalities. The research project used a mix of qualitative and quantitative research methods, with a broad approach at the beginning and a more detailed one later on.

The quantitative data collection consisted of a survey to gather empirical data on smart city aspects and their implementation in Dutch municipalities. The survey questions were drawn from an extensive literature review (as summarized briefly in the previous section) and were focused on the six smart city domains of Giffinger et al. (2007). The questions asked were related to the municipalities' current implementations of smart city initiatives and to their future smart city aspirations. The questionnaires were filled in by 131 employees from 94 municipalities, which is about a quarter of all Dutch municipalities. The quantitative data were analysed in detail with the use of SPSS statistics software.

The qualitative part of the research consisted of in-depth interviews with stakeholders at six municipalities and two private companies. These semi-structured interviews focused on the knowledge that municipalities had of the smart city concept and explored whether there were practical examples of smart city applications in that municipality. The smart city domains discussed in the theoretical section were also discussed in-depth with the interviewees, using a topic list. However, the interviews mostly served as an open discussion platform to make sure that the interviewees could communicate their knowledge and ideas about the smart city concept. In the Netherlands, municipalities are seen as important actors that can stimulate and facilitate smart city initiatives. Interviews were conducted with four large municipalities (>50,000 inhabitants), one middle-sized one (20,001–50,000 inhabitants) and one small one (<20,000 inhabitants), according to the sizes that CBS Statistics Netherlands suggests (CBS 2015). In the following section, other categories are also used, because of the response on the quantitative survey and to create a better overview of the results. The interviews were transcribed, summarized and analysed. The analysis was used to support the interpretation of the quantitative data.

Since smart city can be seen as a fuzzy concept, both the interviews and the survey started off with a brief explanation of the smart city concept, based on academic literature. Furthermore, the survey was long and relatively complex because of its specific content, especially for some employees who might not have

worked with the smart city before. As a result, not all respondents were able to complete the entire survey; thus the N-value varies per question. In the next section, we therefore report the N-value for each figure. Still, the results from a quarter of all Dutch municipalities in 2016 represent an interesting and informative overview of the state of the art of smart city applications and intentions in the Netherlands, which is outlined in the following section.

4 Smart City Domains in Dutch Municipalities: Unknown Is Unloved?

This section describes the most important results of the empirical research in the Dutch context. Quantitative data were analysed with the use of graphs. The qualitative data served to support or explain the numerical data.

4.1 Smart City Awareness

With regard to awareness, quite remarkably, almost half of the survey respondents had never heard of the smart city concept before and only a very few respondents had already worked with smart city applications or considered themselves specialists in this field (Fig. 3).

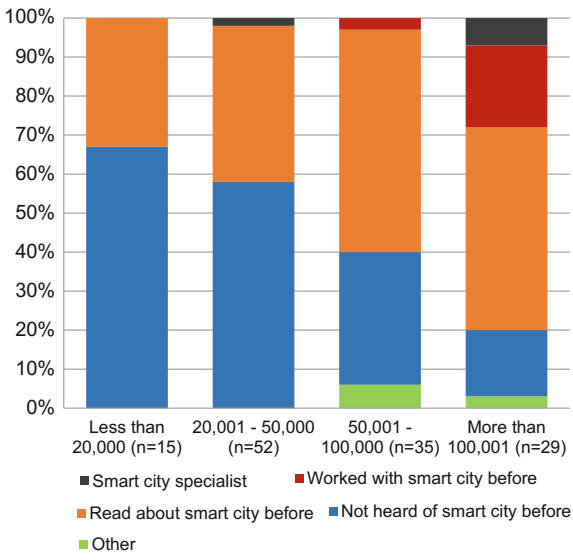

Fig. 3 Smart city awareness, by population size of municipalities (n = 131) (de Wijs 2015)

Fig. 4 Word cloud of the words most commonly used to describe smart city (de Wijs 2015, author's own translation)

When looking at municipal sizes, respondents in smaller municipalities were less often aware of the smart city concept in comparison to respondents from larger municipalities. At first sight this seems to contradict the evidence of Neirotti et al. (2014), who found that size or density is not necessarily correlated with the implementation of smart city aspects. The remarkable lack of awareness in the smallest municipalities leads to the suggestion that the size of cities or municipalities still needs to exceed a certain threshold level before awareness starts to increase significantly. In this study it could also have to do with the specific job description of the respondents. This all needs to be further tested.

Because of the fuzziness of the smart city concept, the survey asked respondents to name a maximum of three characteristics of the smart city concept. In Fig. 4, the terms most commonly used to describe the concept are in the largest fonts. The results suggest that most respondents think smart city is mainly about data, digital infrastructure, ICT, the city and, for example, the environment, mobility and efficiency. The qualitative analysis produced a similar result. The associations that respondents expressed concerning the smart city concept were in close accordance with the academic literature on the concept, which also has a predominant orientation towards ICT-related aspects. Still, when looking at the variety of academic literature and the number of smart city projects, we expected more respondents to be familiar with the smart city concept.

4.2 Aspirations for and Factual Application of Smart City Concepts

In a lot of Dutch municipalities, application of the smart city concept is still in its infancy. Respondents mostly rated their current application of the smart city concept as just sufficient or even insufficient. Interviewees mentioned that the application of smart technologies could be improved and that projects were just starting up. The importance of experimenting was addressed in the qualitative research.

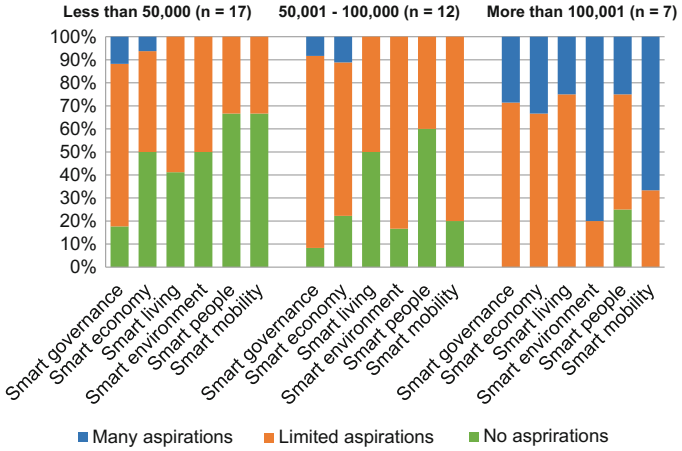

Fig. 5 Level of aspiration related to smart city domains, by population size of cities (n = 36) (de Wijs 2015)

Experimenting through, for instance, urban living labs could help municipalities to find the smart applications that are most suitable for them.

Due to the limited number of factual smart city applications in Dutch municipalities, it was not possible to directly compare the outcomes of the worldwide research by Neirotti et al. (2014) with our own results (de Wijs 2015). Instead, we took the differential aspirations related to the smart city domains identified by the Dutch municipalities to reflect their expected applications of the smart city concept (see Fig. 5).

As stated, in general the larger Dutch cities expressed more explicit smart city aspirations than the smaller towns. When divided along the domains of Giffinger et al. (2007), the smart governance aspects in Dutch municipalities seem to be more advanced than in the worldwide smart city applications described by Neirotti et al. (2014). This could possibly be explained by the relatively open and participatory nature of Dutch planning processes. Respondents emphasized the importance of internal and external efficiency in smart governance. The word cloud (Fig. 4) already showed the importance of efficiency and governance, as well as of social media, which are used by many municipalities for smart governance. Open data also play a crucial role in this.

When looking at the domains of smart people and smart living, there certainly are aspirations to, for example, improve social cohesion, although these aspirations are still limited, which is what Neirotti et al. (2014) also found. Furthermore, they seem to be not very explicit and the use of data and technology within these domains seems to be rather limited. About two thirds of the respondents indicated that these aspirations to bring about smart living are limited by, for example, a lack of political priority and a lack of finances. Furthermore, the research showed that for this domain, the links with ICT are still unclear. Municipalities are working on

improving cohesion, but are not using technologies for this. In addition, more than half of the respondents said that they feel that privacy issues could have a limiting role when it comes to smart people applications, whereas a small group of respondents stated that privacy issues will probably decrease over time. Because there are only a few smart city applications, it is hard to establish whether and, if so, in what way citizens are open to these technologies and whether they are using them yet.

Smart economy seems to take a middle position in the smart city domains, both in the Dutch aspirations (de Wijs 2015) and in the worldwide smart city applications described by Neirotti et al. (2014). Municipalities stated that there are aspirations to realize a smart economy, especially because there is a demand from citizens and businesses to expand on this and because private actors can get started with this domain. Examples of smart economy are the openness of the municipality to economic innovation and the presence of creative and innovative businesses in the area. When a municipality has relatively little aspiration to realize a smart economy, this is something that businesses could work on.

Smart environment seems to be a domain with a lot of aspirations, which can also be read from the outcomes of the worldwide survey by Neirotti et al. (2014). The respondents stated that sustainability is always incorporated in policy and smart city projects, although according to Dutch respondents the link between this domain and ICT seems limited and we currently cannot speak of 'smart' sustainability everywhere.

Finally, the domain of smart mobility could be seen as a trans-boundary domain that goes beyond municipal jurisdictions. Aspirations to realize smart mobility are quite substantial, as are those concerning the environment. Examples found in the domain of smart mobility are the collection of traffic sensor data and smart parking systems, but these are not in place yet in every municipality.

These conclusions concerning the aspirations per domain seem to be in accordance with those found by Neirotti et al. (2014). The majority of respondents stated that they would like their municipality to become 'smarter' as a whole in the future. It seems that aspirations related to the environment and mobility corresponds to the smart city applications worldwide described by Neirotti et al. (2014).

5 Conclusion

This chapter focused on the current and widespread attention paid to smart city projects and applications. Although a dominant worldwide model for implementing the smart city seems a bridge too far, in this relative early stage of development it is interesting to see in what sense the different domains of smart city are actually realized. Until now, however, comparative empirical research on smart city implementation is very limited. Therefore, we executed empirical research in the Netherlands and compared its outcomes to the only other quantitative empirical study on smart city applications that we are aware of (i.e., Neirotti et al. 2014).

In that, we hope to shed more light on the priorities in the implementation and application of smart city domains and in the geographical commonalities and differences.

One of the most striking findings is that especially in the smaller-sized Dutch cities and municipalities the majority of our respondents (municipal employees) had never heard of the smart city concept, indicating only a limited awareness of the concept in Dutch policy practice. This was somewhat unexpected, given the widespread attention to the smart city concept in academia, business and public administration in many parts of the world (cf. Neirotti et al. 2014). This also seems to contradict the earlier findings of Neirotti et al. (2014) that city size or density is largely uncorrelated with the possibility of implementing smart city innovations. Our data suggest that a certain threshold in terms of the size of a city's population is still needed to significantly increase the awareness and implementation of smart city ideas.

We also found some interesting and important similarities and differences between our data concerning Dutch municipalities and the earlier worldwide empirical work of Neirotti et al. (2014). Similar to their findings, also in the Netherlands we found clear aspirations to develop and implement smart city applications, at least within the bigger cities. However, implementation of in particular the governance-related smart city applications seem to lag behind what we would expect. Reasons for this mostly relate to a lack of awareness, a lack of political and financial prioritization, and data security issues. There seems to be a gap between aspirations and implementation, which respondents suggested could be reduced by means of experiments and pilot projects. In addition, Dutch municipalities do seem to have the same aspirations in the domains of environment and mobility that Neirotti et al. (2014) identified in worldwide smart city applications.

This empirical research adds to the limited research data on smart city applications. It would be desirable to see more extensive comparative empirical smart city overview studies in order to compare countries in their smart city aspirations relative to their factual activities and to help them position themselves in this respect. Furthermore, additional empirical research will help academics to understand the smart city concept and its application and implementation more thoroughly and help countries that lag behind to catch up with these developments.

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