SEARCHING FOR A SMART CITY: A BIBLIOGRAPHIC ANALYSIS OF 'PUBLIC FACING' EU SMART CITY PROJECTS

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ABSTRACT

The narrative used to describe smart cities, including the experimentation on them, affects the perception of the smart city. This study systematically assembles and analyses 'public facing' smart city project data from across the EU. Using a bibliographic analysis, including word frequency analyses across time and countries of project descriptions, we identify the dominant themes and constructs in the smart city narratives used by teams advancing smart city projects. The study highlights spatial and intertemporal variations in locational density, differing project content and the range of conceptual emphases. Results show that the main concern of smart city narratives in the EU is firmly centred on energy. We argue that policy-makers should aim for better alignment of smart cities' narrative with citizens' perception or, at least, a wider description of the very nature of implemented projects to include those rather neglected aspects might attract more interest and citizens' involvement.

Key words: smart cities; EU projects; text analysis; energy

INTRODUCTION

Smart city policies have been claimed to improve energy efficiency (Yu & Zhang 2019). However, despite the vast body of literature contributing to its conceptualisation (Portugali 2012; Li *et al.* 2019) as Smith (2017) cogently notes, '… the current reality of smart cities is that there aren't any. At the end of the day, most so-called smart cities are just cities with a few or several standout smart projects'.

Smart city projects[1] in the European Union (EU) seek by demonstration effect to encourage 'smart urbanism'. Smart urbanism is emerging as a complex process involving the interaction between new technologies, infrastructures and political perspectives on urban development. This multifaceted process has an important expected impact in terms of governance, efficiency, development and sustainability. Despite the long tradition of studies analysing the link between space and digital technologies at a city level (e.g. Galloway 2004; Forlano 2009; Foth 2009; Middleton & Bryne 2011), '… narratives and practices around notions of "smartness" have been largely absent' (Luque-Ayala & Marvin 2015, p. 2107). Furthermore, the development of an analysis of how smart urbanism is conceptualised has been recently set as one of three key points in an articulated research agenda along with social and political implications of smart specialisation and international comparative analysis about its forms, dynamics and consequences (Luque-Ayala & Marvin 2015).

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Notwithstanding a lack of a generally accepted definition of what comprises a smart city, a reasonably well-rounded and comprehensive definition is contained within Caragliu *et al.* (2011). This definition embraces the various dimensions (social, institutional, economic, communication technology, infrastructure and environmental management) impinging on practical smart city thinking. Such complexity in the phenomenon leads to many people not fully understanding the meaning of the smart city concept (Lima 2016).

Perusal of popular media and much 'grey' literature also suggests that that many cities seem to claim to be 'smarter' even though the evidence suggests that strictly speaking (particularly in the light of our preferred definition) they are not. In some of these cases, the status of being 'wired' is sufficient to indicate smartness. Yet simply being wired with high availability and quality of Information and Communication Technology (ICT) infrastructure is arguably not a sufficient or adequate definition of a smart city. That said, in a symmetrical line of thinking, it has also been argued that simply being endowed with genuine smart facilities (e.g. New Songo City in South Korea) does not necessarily translate into a smart city and that there are cases when smart cities are stupid (Keeton 2015).

The concept of the smart city in itself has attracted some criticism in terms of potentially negative effects on urban identity and democracy (Söderström *et al.* 2014). Despite 'being constructed as the solution to many urban problems […] promising prosperity and healthy lifestyles for all' (Hollands 2015, p. 61), the critiques of smart cities have developed to the point that they (rather than the smart technologies at their deep root) are now argued to be '… ill-suited to solving the problems that lie at the heart of improving the quality of urban life' and they have been deemed unable to address poverty issues (Glasmeier & Christopherson 2015, p. 6). For example, it has been argued that smart cities might be able to 'solve traffic problems, but it is not clear how they will regenerate failing schools or find ways to include neighbourhoods facing disinvestments' (Glasmeier & Christopherson 2015, p. 6). More generally, it has been concluded that the smart city reflects some of the negative effects on cities related to the development of new technological and networked infrastructures (Graham & Marvin 2001).

More generally, preliminary studies tentatively argue that the perception of smart cities develops mainly around the key concepts of transportation and ICT and, to a lesser extent, involves environment and sustainability, infrastructure and space utilisation and e-government (Přibyl & Horák 2015). Furthermore, a strong trend emerges with increasing interest in trusted news related to the city, high-quality healthcare smart services, innovation and enhanced education and Training, e-democracy platforms and services, promotion of trusted business and innovation and entrepreneurship through research collaboration (Lytras *et al.* 2019)

Undoubtedly, however, the narrative used to describe smart cities, including the experimentation on them, affects the perception of the smart city per se by the involved actors (Bandura 2002). Perceptions, in turn, are not neutral with respect to the effectiveness, sustainability and persistence of smart city initiatives. In this regard, it has been argued that 'there is a possibility for end-users to reject some of the smart city principles and, consequently, to jeopardize its perenniality' (Schelings 2017, p. 1). Hence, if narrative, perception and perenniality of the smart city are inextricably connected then it is crucial to analyse the immediate mean of knowledge about smart cities' dimensions. Put differently, although we acknowledge that citizens' perceptions about smart cities show a significant degree of heterogeneity contributing to the creation of the so-called 'normative bias'[2] (Lytras *et al.* 2019), in our analysis we aim to adopt a different focus. This focus being one that points towards the importance of publicly available narrative – as a direct source of knowledge – in shaping perceptions. We do not model or analyse perception directly but focus on the only real source of narrative available to the public (as well as most time constrained policy-makers and practitioners), which is via web search.

Building on the importance of the narrative (the form) used to describe smart city projects, this study aims to contribute to systematically unveil the public facing narrative used by practitioners and policy-makers in describing smart

city projects. Methodologically, the task is performed by means of a bibliographic analysis on text harvested from the webpages of EU-funded smart city projects. Projects are identified via a systematic key word search using a popular Internet search engine and then, limited to the project for which the information is available, cross-checked against the EU CORDIS database. This approach is used to mimic the search method used by the general public and therefore more closely reflect the narrative that is likely to be received by EU citizens.

The analysis shows that the key word in the narrative is 'energy' and is manly associated with issues such as measurement and consumption. This testifies that, among the multiple dimensions of a smart city highlighted in the extant literature (Giffinger *et al.* 2007a, 2007b; EC 2016) including – but not limited to – economy and environment, those two dimensions have somewhat monopolised the discourse. Conversely, little attention has been paid to other crucial themes such as 'people', 'citizens(hip)' and 'governance' that might appear at least as important to citizens who represent the main beneficiaries of smart city projects.

We conjecture this observation is driven by three factors: The selection decisions of the funder; the type of project bids that the funding call attracts and the public facing visibility of the project information. Thus, to more fully engage a positive public perception of the smart city narrative, our findings suggest that the EU could shape its funding policy towards underrepresented dimensions of the smart city narrative and support the projects to align the public facing information with the smart narrative. Put differently, we conjecture that the way the smart city projects are communicated conveys a message on the extent to which the development of smart cities represents a shared goal and, eventually, along with which dimensions. The nature of initiatives, therefore, will potentially signal and nurture the prevalence of only some among the many dimensions of the smart city concept over those less frequently covered. Nonetheless, to fully exploit the potential benefits of a balanced development along all the dimensions of the smart city concept a similarly balanced policy mix and narrative would be required.

This systemic collection of evidence concerning the narrative used to describe smart city projects represents a preliminary, yet necessary, step towards a more comprehensive critical analysis. We identify the need for further research that explicitly contrasts project descriptions with post-implementation outcomes. Such an exercise would be potentially able to unravel the narratives in terms of similarity or dissimilarity and eventually highlight very florid or heroic stretching of reality.

This study begins by introducing the evolving rationale for smart city thinking buttressed by critical consideration of the concepts that are proffered in the extant literature. Smart (city) projects implemented in the EU are mapped with reference to the results of a systematic Boolean web search exercise. This provides a source of reference for examining Smart city projects across the EU. The results of the Boolean web search exercise helped empirically uncover and disentangle dominant or key themes in the narrative used by actual practitioners and policy-makers in shaping the perception of Smart city policies and projects across the EU. The dominant themes in the EU smart city project data are visualised through time and space dimensions, accompanied by some evaluative commentary. The final section concludes and presents policy implications.

SMART CITY THOUGHT: A BRIEF RETROSPECT

Across nations and particularly in the aftermath of the 2008 financial crisis, central and local governments have faced increasingly tight budgets – particularly as urban population growth adds to pressure on basic services such as drinking water, electricity, waste management, street and highway maintenance. Accordingly, there is a growing consensus that greater and wider use of new technologies can make cities more efficient by offering more outputs (goods/services) with lower resource inputs. This efficiency may also be married to better use of human capital and technology to improve the well-being of city residents and

workers in a tangible way. Securing such well-being could solicit further popular support for continuous development of urban community and infrastructure capacity.

In the context of strategic national and international policy imperatives, for example, the then UK Department for Business, Innovation and Skills (2013) also highlighted other motivations for smart city policies relating to three key concerns:

1. Concerns about climate change, and the fact that 80% of the UK population live in cities, inevitably mean that cities have a key role in improving energy efficiency and reducing carbon emissions, while promoting energy resilience in terms of security of supply and price.
2. The paradigm shift towards online entertainment and online retail/consumer services is beginning to change the nature of the High Street.
3. An ageing population is placing an increasing burden on adult social care, to the point where it is absorbing an ever-increasing proportion of local authority budgets.

There is some consensus that the key prefacing concepts to smart city thinking comprise the notion of utopianism (Choay 1997 [in translation, but originally 1980]), the development of systems thinking (Buchanan 1992; Chadwick 2014),the articulation of policies around smart growth (Filion 2003; Downs 2005; Handy 2005) and intelligent cities specifically (Deakin & Al Waer 2014).

Arguably since Thomas More's Utopia (1516), there can be identified a utopian tradition in urban planning. For Choay (1997), this manifests itself as a 'therapeutic discourse' featuring a diagnosis of urban problems and pursuing these with a set of 'universally valid' solutions. She defines the utopian genre as '… a single voice proposing – through a narrative distinguishing between a corrupted past and a perfect and immutable future – an ideal and universally valid model of society constituted by a rational spatial form'. Many smart city projects in the EU dwell significantly on not only their contribution to amenity, environmental and quality of life (wellbeing) improvements from physical capital developments but also the scope for participative collective decision-making opportunities allowing individuals to be empowered in their living space.

Very specifically, urban sprawl, a key feature of North American urban growth in the post-war era since Second World War that is highlighted as an outcome to avoid by proponents of the smart growth movement. 'The smart growth concept calls for forms of urbanization that are more compact, transit- and walking-friendly, conducive to high-quality urban life and less environmentally damaging and infrastructure hungry than present urbanization patterns'. (Filion 2003, p. 49) (See also Downs 2005; Handy 2005). Smart city projects tend to eschew the manifestation of such sprawl.

An early schematic contribution is presented in Harrison and Donelly (2011), depicted as an 'Urban Information Model' formed of a number of layers. Leydesdorff and Deakin (2011) stress the dynamic interplay of network densities among three 'dynamics' namely intellectual capital of universities, the wealth creation of industries and the democratic government of civil society (the triple helix model). Extant economic literature is somewhat partial and focuses on the contributions from human capital externalities (i.e. the spillovers to city growth/development from smarter, better-educated populations (e.g. Shapiro *et al.* 2006, Fu 2007). In general, there is currently an enormous gap in the state of the contribution of economic theory. However, there is enormous scope for employing economic theory to build a more holistic model of smart cities building on key microeconomic concepts such as economies of scale and scope, user economies of scale and scope, network externalities and network economies. The beginnings of such work are discernible in Bettencourt (2013).

The smart city discourse developed around these foundations ranges from positions of positive constructive engagement (hoping to improve functionality and promote better diffusion of the concept) to fundamental objections (viewing the concept as vector of dystopian harm that will ultimately alienate individuals and destroy democracy. This spectrum is considered in part as a labelling problem and due to a lack of definitional specificity (Hollands 2008). For some commentators '… [Smart city] discourse promotes an informational and technocratic conception of urban

management where data and software seem to suffice and where, as a consequence, knowledge, interpretation and specific thematic expertise appear as superfluous' (Söderström *et al.* 2014). They also observe that '… [city] problems cannot be reduced to data problems but need to be interpreted in the light of long-standing political and scientific debates. Furthermore, we have been there before: municipalities in the 1960s and 1970s have already experienced the deleterious consequences of taking such stories about large-scale simulations being the ultimate planning solution at face value' (Söderström *et al.* 2014).

As a practical construct to serve urban planners and regional policy the notion of smart cities potentially serves a number of purposes. For Giffinger and Gudrun (2010) it offers a strategic instrumental lens to explicitly rank the competitiveness of cities in multiple and often mutually supportive dimensions. In their accompanying empirical assessment of smart city thinking in European cities, statistically implemented via multiple correspondence analysis they *conclude,* '*… the positioning of a city within the urban system is the result of a complex interplay of economic, geographic and socio-cultural conditions, which are partly locally determined. But at the same time, a city's position is strongly influenced by its strategic efforts as a specific aspect of urban governance.*' [p. 23] and that in their opinion '*… the comparison and ranking of cities can be one important instrument in order to identify a city's comparative advantages and to enhance its territorial capital*' [p. 23].

For Hollands (2008, 2015) the construct is largely a self-proclaimed labelling device to serve promotional activity and attract private capital. He finds that while the emphasis in the smart city literature is clearly on the 'utilization of networked infrastructures' to improve economic and governance efficiency, in practice he sees its underlying purpose as helping to drive a more limited political agenda in support of 'high-tech urban entrepreneurialism' [p. 314]. Such labelling may also play a role in place leadership discourse (see e.g. Nicholds *et al.* 2017) where smart city characteristics may offer a means to achieve commercial and social gain.

More recently, the volume of academic literature concerned with smart cities has expanded exponentially (Caragliu & Del Bo 2018), including discussion on the how to define a smart city. There are a variety of alternative definitions of a smart city, driven in part by the bottom-up nature of smart city initiatives, applying technology to help solve city-level social problems. Dameri (2013), Bibri and Krogstie (2017) and Ismagilova *et al.* (2019) among others, provide insightful overviews of these definitions and ultimately conclude that there is no agreed on single definition.

We leave drawing comparison to differences and similarities between definitions to such related research. Instead, we take a single definition for use in our following analysis, chosen by its popular use in other empirical studies on smart cities. While this is a fairly pragmatic approach to resolving the differences in definitions, we note at this point that the results and conclusions within this research do not differ by substituting the definition. We make use of Caragliu *et al.* (2011, p. 70), which provides a definition that embraces the majority of the dimensions impinging on practical smart city thinking, including social, institutional, economic, communication technology, infrastructure and environmental management factors. As such, this offers a reasonably well-rounded and comprehensive definition of a smart city '… investments in human and societal capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance'.

Common across the majority of definitions is the requirement that smart cities should improve the lives of end users and the city's citizens, and there is undoubtedly a rising call to place citizens at the very heart of smart cities, from governance, policy, funding, through to implementation of projects. For example, in review of smart city governance literature, Pereira *et al.* (2018) identifies the need for a new governance approach that can overcome societal challenges, key to that approach is the need for citizen engagement. Cardullo and Kitchin (2019, p. 825) propose a range of measures that include moving token citizen engagement practices towards '… extensive public consultation, collaboration and co-production and roles such as

creators, members and leaders, as well as initiatives gaining more input and oversight by elected officials'.

Yet the intended benefits of smart city projects and the perceptions of citizens do not always align. By surveying citizens, Macke *et al.* (2019) provide evidence of a disconnect between the planners focus (usually on technological advances) and the benefit to citizens (quality of life). In this view, a move to focusing more intently on the factors that contribute to citizens' quality of life at the planning stage could path the way towards a more successful smart city. Similarly, Lytras *et al.* (2019, p. 1669) concludes that '… most of the users of smart cities services seem [to not] care for the sophistication of smart cities infrastructures and services … This is a direct indication that sets design guidelines to Industry providers of smart cities services that the "human" factor matters more than the technology component'.

With such complexity of the definition and multifaceted nature of the phenomenon, it is possible that people not fully understanding the meaning of the smart city concept (Lima 2016). The narrative used to describe smart cities, including the experimentation on them, affects the perception of the smart city per se by the involved actors. Perceptions, in turn, are not neutral with respect to the effectiveness, sustainability and persistence of smart city initiatives. In this regard, it has been argued that 'there is a possibility for end-users to reject some of the smart city principles and, consequently, to jeopardize its perenniality' (Schelings 2017, p. 1) and that 'studying how citizens perceive some of the smart city concepts is a prerequisite for the assessment of the smart city sustainability scheme' (Schelings 2017, p. 1).

The narrative used to describe smart city projects, rather than having a somewhat subtle and marginal role in the construction and evolution of the smart city itself, represents a substantial element of the smart city both in its conceptual and practical grounds. One is able to convey a given perception and, therefore, substantially contributing to shape the future development trajectories including cases of success or failure. The relationship between narrative, perception, expectation and effects of smart city projects is a circular one where the above main pillars influence each other. The [mis]alignment between expectations about a given idea of smart city, on the one side, and used narrative, on the other side, represents a crucial aspect for the achievement of aimed effects of the implementation of smart city projects. In Aristotelian words it can, therefore, argued that in this sense 'the form is that which is most truly substance' (Lesher 1971, p. 169).

Understanding citizens' perception of smart cities, the narratives that are placed in the public domain for citizen consumption and citizens' role within smart cities are less developed research areas. Building on the importance of the narrative (the form) used to describe smart city projects, this study aims to contribute by systematically unveiling the public facing narrative used by practitioners and policy-makers in describing smart city projects.

DATA AND METHOD

Although the academic literature shows some conceptual development over time, it increasingly features commentary based on a number of empirical studies exploring the practice, performance and review of smart city policies and demonstrator projects at various scales of geographical resolution (district, city, area) and in different locations across the globe. This study begins by systematically exploring the geographical range and scale of smart city projects. Project details were then harvested to support subsequent text analysis implemented on 'R' software.

In this analysis, we are concerned only with public facing smart city projects in the EU. Thus, we define our data as EU funded projects that report a smart city narrative and are limited to those that are amenable to access via an Internet search engine. We follow the European Commission's approach to describing a 'project', in line with the Community Research and Development Information Service (CORDIS), as projects funded by the EU's framework programmes for research and innovation (FP1 to Horizon 2020).

Data on smart city projects were collected through various web sources via a systematic

search using and Internet search engine was conducted using Boolean phrases 'Smart Cit*' AND 'project*'. From the list of results obtained, we have only included those projects that are self-proclaimed as smart city projects and that are taking, or took, place in the EU area. The data were cross-checked against information in CORDIS (https://cordis.europa.eu/), European Innovation Partnership on Smart Cities and Communities (https://eu-smartcities.eu/), Smart Cities Information Systems (http://smartcities-infosystem.eu/sites-projects/projects) and NOMINET (http://www.nominet.uk/list-smart-city-projects/). We acknowledge that the list of the projects harvested is not an exhaustive list of smart city projects; it is the intention of this analysis to focus solely on the projects we define as providing a public facing narrative. Project descriptions are presented in English within the EU CORDIS database, which minimises the possibility of projects being overlooked due to the chosen language of the search terms.

The data comprise 117 smart city projects operating during the period 2005–2016,[3] presented in online Appendix A. The data include the project aim, project description, country of implementation, start and end date, total cost, funding (where acknowledged) and other eventual acknowledged funding.[4] Combined, the projects in this data set cost a total of €1,266,788,798. On average, 65% of the total project costs were funded by the EU. The most expensive project cost €68,732,990 (the FiWare project for infrastructure and innovative delivery of service) and located across the entirety of the Europe. The median project took 4 years to be completed and cost € 9.935 M. Table 1 reports the descriptive statistics of the considered projects.

Moreover, assuming that the total cost is a proxy for the value created by each project, the higher the cost is, the higher the benefit for the involved stakeholders is. Hence, the cost somewhat represents a measure of the benefits delivered to taxpayers in every dimension involved by any single smart city project. It is reasonable to assume that both the cost and the number of active projects shape the public interest in smart cities.

Figure 1 shows the interest of European citizens in the concept of smart city compared to the rest of the world, captured by Internet search trends.[5] EU citizens appear to be more interested in general and the more recent increase in interest started earlier, after 2010, compared to non-EU citizens. Nevertheless, the peak of interest comes sooner for the rest of the world (mid-2015 in contrast to late-2016 for the EU). This observation may well be driven by the number of projects (both in absolute numbers and in the number of active projects), thus producing more public communications.

Table 2 shows the number of public-facing smart EU city projects by country, including the number of single-country projects. With the exception of the United Kingdom, which has 17[6] single projects (out of its 33 overall), the majority of the countries seem to have zero or a few single projects. The number of collaborative projects, those that run across more than one EU country, provides a sense of to what extent the discourse on 'smart cities' has developed into a shared strategy within the EU. As opposed to a project that has been implemented with narrower, national view. In other words, the number of collaborative projects is correlated to the extent to which the development of smart cities represents a shared goal. The nature of

Table 1. *Overall descriptive statistics.*

Overall descriptive statistics

	Average	Median	Min	Max	Std. dev
Period	–	4	0.5	20	–
Total cost	€ 15,838,949	€ 9,935,996	€ 289,153	€ 68,732,990	€ 14,474,858

Note:: All countries' amounts are expressed in €, converted through yearly PPP.
Source: Authors' calculations.

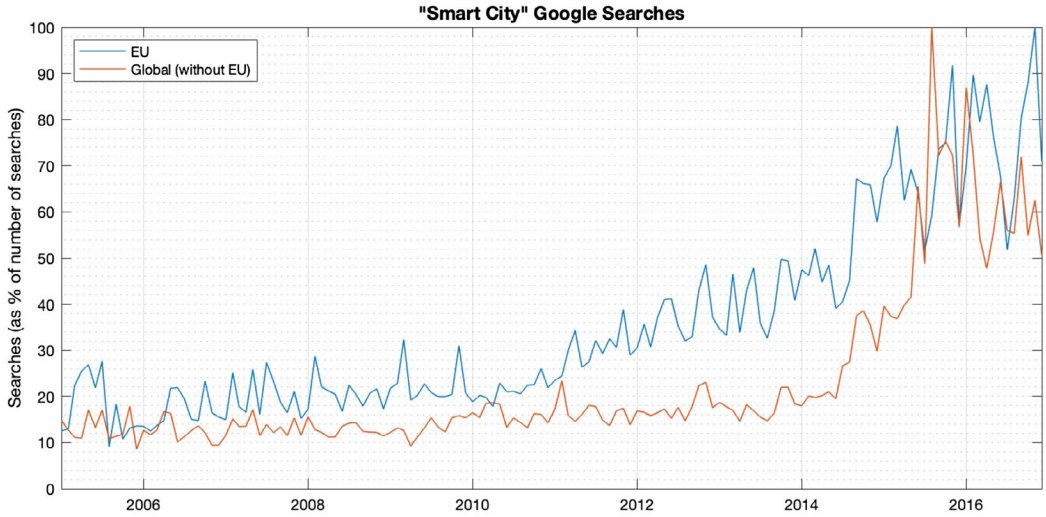

Figure 1. *Interest in the 'smart city' concept. Comparison between EU countries and the rest of the world. Source: Google Trends, keyword used 'smart city'.*

Table 2. *Number of smart city projects in the time period 2005–2016.*

Countries	# of single country projects	# Total projects (single + collaborative)
Austria	1	13
Belgium	0	5
Bulgaria	0	4
Croatia	0	4
Czech	0	3
Denmark	2	15
Estonia	0	3
Finland	4	8
France	2	19
Germany	6	22
Greece	0	3
Hungary	0	5
Italy	2	25
Latvia	0	3
Lithuania	0	2
Luxembourg	0	2
Monaco	1	1
The Netherlands	1	19
Norway	1	7
Poland	0	3
Portugal	0	2
Romania	0	1
Serbia	1	1
Slovakia	0	2
Slovenia	1	3
Spain	8	42
Sweden	1	17
Switzerland	0	4
Turkey	0	6
The United Kingdom	17	33

Source: Authors' assembled data.

initiatives and especially for the widespread collaborative projects, in turn, will convey a sense of priority/prevalence of some of the multifaceted aspects of the smart city concept over the remaining ones.

Using the text information from each project, common words were excluded (e.g. 'the', 'a', 'such' etc.),[7] along with exclusion of words, which were not associated with any meaningful point. Text stemming was applied, cutting the words to account for differences between the US and UK dictionaries (e.g. 'organise' and 'organize' etc.) and account for all variations of a word's meaning in a different context (e.g. 'energy' and 'energy-related' would result in counting 'energy' once prior to the stemming and twice afterwards).

To analyse the key narratives that public-facing smart city projects communicate to their benefitting citizens, the bibliographic method identifies the precise key words and volume of their use within project summary and objective text. This allows for comparison across country and year.

RESULTS

In what follows the main results of the text analysis are summarised. Figure 2 shows the ten most frequent words used to describe smart city projects to EU citizens, whereas Figure 3 shows which key words are most associated with most frequently used terms, 'energy', 'build', 'city' and 'develop'. This association translates into the correlation between these words (most frequent[8]) and other words appearing in the same sentence. For instance, the most common words encountered in the same sentence with the word 'energy' are 'measuring', 'consumption' and 'action'.

The results of the analysis considering the cross-country dimension are set out in Table 3, which reports the ten most frequent words by country. A third stage of analysis takes account of the time dimension. The related results are set out in Table 4 repeating the same exercise (the most frequent words) by year.

From the first stage of the analysis, it is possible to distil the following three main findings:

1. The word that most frequently appeared in most smart city projects' summaries is 'energy'. This is clearly reflected in the visualisation of the analysis outputs found in Figure 2. Moreover, the eminence of that word in comparison with the rest is considerable. It features more than 170 times, in contrast to be less than 100 times for the second most frequent word and slightly above 50 for the third one. Indeed, words that have a common root to the

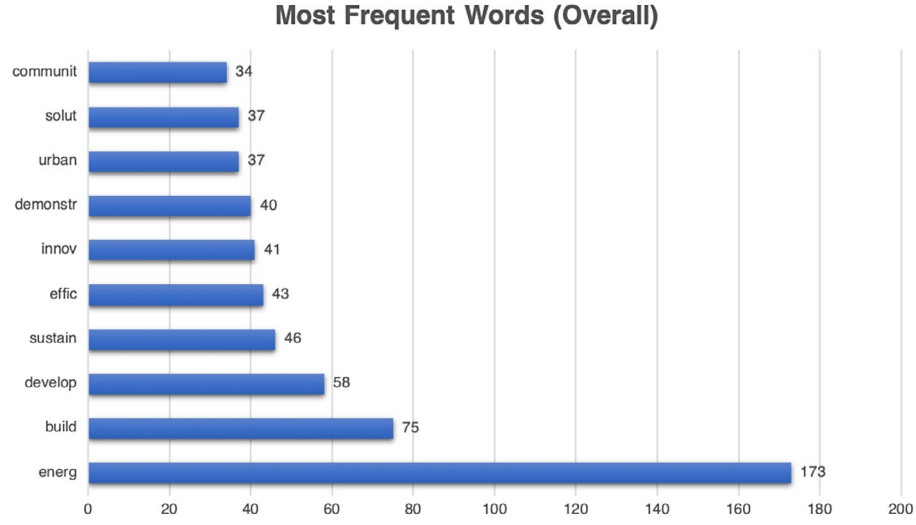

Figure 2. *Top ten most frequent words (roots) cross-country. Source: Authors' elaboration on collected data.*

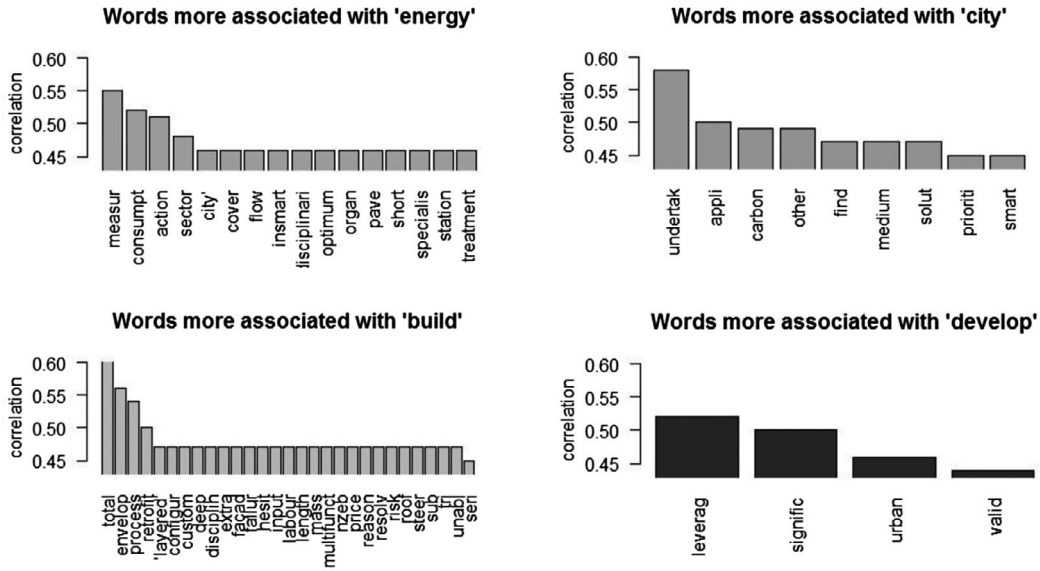

Figure 3. *Association between frequent terms (roots) associated with smart cities. Source: Authors' elaboration on collected data.*

word 'energy' are the most frequently encountered in the data set, highlighting the importance of energy-related projects overall, and of course, the focus of the smart city projects towards this area. We acknowledge this evidence is consistent with the fact that in the past programming period the EU defined smart cities mainly in terms of their potential, increasing energy efficiency[9] and other energy-related benefits.[10] The smart cities and communities – European Innovation Partnership (EIP-SCC) aims at

'… accelerating the deployment of innovative technologies, organisational and economic solutions to significantly increase resource and energy efficiency, improve the sustainability of urban transport and drastically reduce greenhouse gas emissions in urban areas.' (European Commission 2012, p. 11)

Moreover, the EIP-SCC has oriented the Seventh Framework Programme (FP7) to reflect the integrated nature of the urban energy, transport and ICT topics (Russo *et al.* 2014). Within the framework of the EU model developed around energy and transportation, it aligns with the EC's environmental initiatives in general, and more specifically with its 7th Environment Action Programme.[11] This evidence is an extension into an international context of the case-study evidence about the UK Future Cities Demonstrator Competition. In this competition, the 'city system integration' themes of 'Energy and Transport' and 'Energy and Local Economy' registered the first and the second rank, respectively, based on the number of bids placed. Respectively, they comprised 12 and 10 out of a total of 59 bids and where the theme 'energy' was present in four out of the eight highlighted themes (Buck & White 2017). More generally, this evidence reflects the EU model (compared with the US one) where a quasi-governmental body provides funds for technology implementation around energy and transportation (Glasmeier & Christopherson 2015).

2. It does not come as a surprise that one of the most common words encountered in the text analysis is the word 'city', and, therefore, this is the main reason the term has been excluded in Figure 2. In other words, because all these projects address this very topic, of 'converting' (metaphorically speaking) a city from its conventional

Table 3. *Top ten most frequent words (roots) in national projects*.*

Top ten frequent words	Austria	Denmark	Finland	France	Germany	Italy	Monaco	The Netherlands	Norway	Serbia	Slovenia	Spain	Sweden	UK
#1	mobil	energ	data	build	plan	energ	inform	light	light	experi-ment	energ	public	activ	data
#2	platform	build	servic	energ	user	platform	provid	adjust	move-ment	facil	build	park	hous	park
#3	app	demonstr	develop	technolog	inform	servic	user	energ	detect	univers	electr	servic	electr	street
#4	avail	solut	urban	connect	data	support	app	save	electr	applic	system	system	urban	peopl
#5	book	suppli	creat	commu-nit	public	applic	condit	sensor	emiss	deploy	technolog	network	balanc	technolog
#6	creat	system	open	manag	platform	build	feedback	air	lamp	develop	air	open	effici	local
#7	custom	balanc	area	busi	connect	data	public	brighter	pollut	european	applianc	car	energ	air
#8	develop	develop	activ	district	access	develop	servic	collabor	reduc	uniqu	assess	technolog	increas	energ
#9	futur	heat	busi	home	develop	hetero-gen	work	colour	sensor	user	demonstr	deploy	power	system
#10	inform	integr	decis	network	space	integr	activ	complet	adapt	accept	eco	urban	renew	inform

**Excludes multinational smart city projects.*
Source: Authors' elaboration on collected data.

Table 4. *Top ten most frequent words (roots) per year.*

Top ten frequent words	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009	Year 2010	Year 2011	Year 2012	Year 2013	Year 2014	Year 2015	Year 2016
#1	energ	energ	energ	internet	energ	data	build	build	energ	park	energ	energ
#2	project	act	sustain	compani	area	servic	energ	light	data	build	develop	street
#3	commu-nit	polic	build	connect	develop	research	air	energ	plan	develop	urban	data
#4	aim	acceler	renew	data	commu-nit	develop	monitor	network	develop	energ	innov	effic
#5	renew	advanc	commu-nit	analys	manag	experi-ment	demon-str	trans-port	sustain	project	solut	transport
#6	heat	area	suppli	applianc	design	facil	system	open	system	system	servic	innov
#7	reduc	build	develop	build	tech-nolog	support	reduc	servic	district	cloud	effic	travel
#8	suppli	commu-nit	system	commu-nit	demonstr	urban	platform	deploy	demon-str	innov	heat	solut
#9	increas	demonstr	area	design	storag	energ	climat	system	effic	peopl	sustain	chang
#10	innov	develop	demonstr	devic	control	communit	effic	demon-str	tech-nolog	tech-nolog	network	intellig

Source: Authors' elaborations.

definition, to the 'desired' one of being 'smart'. Thus, 'city', which is the target of those projects, is, of course, one of the most frequently used words. Nonetheless, from Figure 3, where the term 'city' is included to analyse the narrative mostly used to characterise it an interesting element does emerge. Here, the words most associated with the term 'city' are related to transformation (or as above mentioned 'conversion') such as 'undertake' and, again, to energy such as 'carbon'. By contrast, the themes such as citizenship and community seem to be underrepresented in the current narrative directly associated to the term 'city'.

3. Seemingly, the aim of most of the projects for smart city ideas was to be 'diffused' in other cities/countries after they are finished and pilot-tested. The words 'demonstrate' and 'implement', are two words commonly appeared in the scope of the projects. Such as involving the diffusion of those ideas in an exemplar project, or even fully implementing them in other geographical locations.

For the second stage of text analysis, we wanted to explore whether these (most frequent) words change between countries. In other words, whether the focus of smart city projects change from one country to another. Therefore, we filtered the data set to include only those projects that are carried out only in one country (e.g. single projects), and we ran a text analysis for each country for which we have data. The results (most frequent words for each country) are set out in Table 4. What we may draw from these outputs is that:

1. In general, the environmental initiative (as proxied via the word 'energy') holds the first or one of the first places (in the form of most frequent word used) for the majority of the countries examined.
2. Nevertheless, a few countries (Austria, Finland, Germany, Spain and the United Kingdom) exhibit higher interest (according to the most frequent words used) on other initiatives such as 'open data', 'information' and 'applications' of interaction platforms involving the citizens. Going through the objectives of these countries' projects, we discovered that although they still focus on 'energy'-related initiatives, most of the projects found to use data that are used for decision analysis purposes and dissemination of information to the citizens. For example, they use data from traffic, parking places and construction works to platforms with citizens engaging in communications, expressing their views/concerns on a range of issues within the community).

For the third stage of the text analysis, we wanted to pool all the aforementioned projects (in both the multinational and the national settings) and see whether the orientation of the project changes between the years in our sample (2005–2016). Therefore, we ran a third text analysis for each one of the years in our sample (see Table 4). What we may draw from these outputs is that:

1. In general, energy-related projects still dominate, as shown from the most frequent word being 'energy' for most of the years in our sample.
2. Nevertheless, after 3 years of environmentally oriented projects (as shown from the words 'energy', 'build', 'renew',[12] 'heat' for the time period 2005–2007), the orientation changes towards IoT-related projects for the next 3 years, 2008–2010 (as proxied by the words/roots 'Internet', 'data' etc.). This evidence seems to reflect in terms of narrative the empirical evidence that the aftermath of the financial crisis had also an environmental effect. This seemed to consist of a shift towards the use of cheaper energy resources encouraged by both the relaxation of environmental standards and a lesser concern with environmental issues (Turcu, Karadimitriou & Chaytor 2015).
3. Afterwards, there appears to be a reversal of the focus of smart city projects towards energy-related goals, which still holds to date. Again, this evidence is consistent with the policies emerging in response to the 2008 global financial crisis, as a deeper understanding of its effects evolved. Thus, becoming more apparent were policies supporting greener infrastructures to encourage investments into 'energy efficiency' in buildings, transport and urban design (Turcu *et al.* 2015).

Consequently, we can conclude that, apart from the impact effect of the recent crisis, 'energy' is the main focus/objective of the majority of the smart city projects, either on a country level or on a multinational setting. Moreover, this objective is still considered as the principal one when we check the yearly trend of those projects. Put differently, the 2008–2010 drift caused the narrative to focus on IT-related projects, but afterwards, the pre-crisis pattern has recovered its momentum following a sort of (what on the basis of our analysis we can hypothesise to be a) long-run trend in the conceptualisation and narrative of 'smart cities'.

CONCLUSIONS AND POLICY IMPLICATIONS

This study has critically considered and dissected the term smart city taking into account how the term is used in the narrative lexicon that is actually deployed by practitioners and policy-makers across the EU and within individual countries and over time. Harnessing, quantitative and qualitative data visualization approaches, this work reports in detail on the geographical coverage, scale and project content of EU smart city projects.

The project data collected was systematically explored, highlighting spatial and intertemporal variations in locational density, differing project content and conceptual emphases. The analysis leads to the conclusion that the main concern of public-facing smart city narratives in the EU is on energy. We acknowledge that our analysis concerns self-proclaimed smart city projects only. Therefore, in principle, it might be true, on the one hand, that there are smart city projects in their very nature, not labelled as such; on the other hand, there might well be self-proclaimed smart city projects, included in our sample, that are just energy-saving projects. Nonetheless, the former might not be accounted for in citizens' perception, whereas the latter category of projects does contribute to shape the perception of smart city projects, overall.

More specifically, results for the term 'energy' are pivotal whether on a country level or on a multinational setting. The focus on energy consumption persists also in relatively recent and innovative projects such as the GAIA (Green Awareness in Action)[13] project specifically addressing young citizens who belong to the school population. That said, over the time-period 2008–2010 there seems to have been an explicit attempt to reshape the smart policy narrative towards more IT-related projects in partial response to the financial crisis, where the environmental discourse is clearly shown to have been relatively reined in or relaxed. Yet based on the sample of projects considered in this study, this trend was not apparent in the subsequent subsample (post 2010) where energy takes again the lion-share of the body of the smart city narrative. From the evidence derived from smart city project data in the EU, it is seems clear that in practical terms 'smart cities' have overwhelmingly developed into a trope for city project-level energy policies and energy-focussed project developments.

This evidence shows a substantial misalignment with the exploratory evidence reported in preliminary studies on citizens' perceptions and priorities on smart cities involving a variety of aspects ranging from 'people', 'living' and 'environment' (Schelings 2017) to transportation and ICT (Přibyl & Horák 2015), trusted news, healthcare, innovation, education and training, e-democracy, business and innovation and research collaboration (Lytras *et al.* 2019).

Put differently, both the understanding and the expectations of the general public on smart cities encompasses a wide variety of dimensions highlighted by the relevant literature stressing also that 'various factors should be simultaneously present for cities to thrive' (Caragliu & Del Bo 2018, p. 3). However, the actual implementation and narrative on smart cities to which the general public has immediate (e.g. via a Google search) access shows a much narrower view, one being mainly focussed on the 'energy' dimension. In terms of policy implications, a better alignment of smart cities' narrative with the smart city concept or, at least, a wider description of the very nature of implemented projects to include those rather neglected aspects might attract more interest and citizens'

involvement. Results highlight that this issue concerns the policy design, implementation and communication strategies. While we cannot provide direct evidence to the root cause, the observed focus on energy-related project suggests that the key concern is the narrower focus in smart cities' policies implemented by policy-makers.

To what extent this result applies to a larger scale and how does it affect the perception and sustainability of smart cities are themes that are left for the future research agenda. Nonetheless, the evidence reported in the present study represents an interesting highlight of the current discourse about smart cities to be considered both in the future design and implementation of smart city projects.

Notes

[1] Conceptually, the term 'projects' is typically applied to term-limited developments or activities. The development or activity outcomes may well have a design life that last longer than the scheduled 'project' life, which may, in many cases, just cover the period of start-up, early phase operation and some scheduled review of operating performance. Projects (including smart city projects) may even have distinctive legal and fiscal status for varying time periods, in the latter case as 'Special Purpose Vehicles' for the treatment of tax and accounting reporting. The use of the term 'project' thus implies that these developments/activities are not routine or conventional operations. These projects are also financed from a wide variety of sources: direct central government, local/regional government, public/private partnerships, EU, private sector and consortium finance from multiple sources.

[2] The terms broadly refers to the potential misalignment between potential benefits made available by the technological progress, on the one side, and, citizens' perceptions about the value of proposed innovation on the other side.

[3] 2005 was the first year for which data was found. There is no other reason why we choose this particular time period.

[4] Information was last retrieved 15/10/2018.

[5] Data obtained via 'Google Trends' (https://www.google.co.uk/trends/). Google does not provide the raw data (e.g. number of searches monthly), but rather their linear normalisation in the form of: (monthly # of searches/Max # of searches overall).

[6] By the term 'single' we mean those projects that are being developed only within the country (e.g. domestic), whereas the total number of the projects refers to all the projects (including the single ones) for which they (the countries) co-participate. For instance, it could be the case – more like the rule, rather than the exception – that a project is applied/engineered in a number of countries, instead of just one.

[7] Other words excluded are 'demonstrated', 'new', 'will', 'brief', 'summary', 'project', 'one', 'two', 'three', 'four', 'five', 'also', 'within', 'used', 'aimed', 'main', 'overview', 'aim', 'using', 'different', 'around', 'order', 'research', 'can', 'use', 'projects', 'aims', 'across', 'concepts', 'making', 'city/cities', 'citizen'.

[8] Only four out of the overall ten words' associations are presented in this figure. This is mainly to illustrate how our text analysis was executed in more detailed data disaggregated stages after the preliminary text analysis results were obtained.

[9] See, for example, Smart Cities - Smart Living | Shaping Europe's digital future (europa.eu). Retrieved on 28/01/2021.

[10] However, it is worth noting that this is in contrast with the broader focus adopted in the 'European Innovation Partnership on Smart Cities and Communities Operational Implementation Plan' focusing on '*a significant improvement of citizens' quality of life, an increased competitiveness of Europe's industry and innovative SMEs together with a strong contribution to sustainability and the EU's 20/20/20 energy and climate target*' (EC 2013, p. 5).

[11] For more, see: http://ec.europa.eu/environment/action-programme/.

[12] The word 'renew' is the root of (and mostly associated with the word) 'renewable', used solely in the context of energy-related projects (e.g. 'renewable' energy, sources etc.).

[13] http://gaia-project.eu/. Retrieved 25/07/2019.

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