Journal of Urban Management xxx (xxxx) xxx

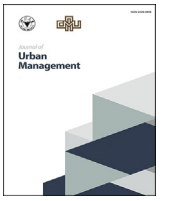
HOSTED BY

ELSEVIER

Contents lists available at ScienceDirect

Journal of Urban Management

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



Research Article

Smart cities and citizen engagement: Evidence from Twitter data analysis on Italian municipalities

S. Blasi [a], E. Gobbo [b], S.R. Sedita [b,*]

[a] Department of Business Administration, University of Verona, via Cantarane, 24, 37129, Verona, Italy
[b] Department of Economics and Management, University of Padova, Via del Santo 33, 35123, Padova, Italy

ARTICLE INFO

Keywords:
Smart cities
e-Government
Twitter
Web scraping
Social media listening
We-government

ABSTRACT

Smart cities are increasingly keen to establish a fruitful conversation with their citizens, to better capture their needs, and create virtual platforms for stimulating co-creation processes between government and users, with the final objective of increasing the quality of life and well-being. Social media applications provide an opportunity for dialogic communication, where, for a relatively low cost, a large amount of information reaching a wide audience can be published and exchanged in real time, fueling opportunities for citizens' engagement. This study is based on a social media listening method, through Twitter data mining, which enabled disentangling different components of citizen engagement (popularity, commitment, and virality) for a sample of Italian municipalities. In addition, we executed a deep analysis of the types of communication artifacts exchanged and, through a content analysis of the tweets published by followers of the municipalities' accounts, we identified the main areas of interest in the social media conversations. Our results are based on the analysis of online conversations engaged by followers of Twitter accounts of a sample of 28 Italian municipalities, chosen among the most active and densely populated. We show that municipalities tend to use the Twitter account as a channel of communication to inform the population about a variety of topics, such as transport and public works, among the others. The volume of activity and number of followers (audience) vary from one municipality to the other. There is generally a negative relationship between the density of the population of a municipality and citizens' engagement: smaller municipalities show a higher citizens' engagement; the biggest ones, like Roma, Milan, Turin, Naples, are laggards. We finally conducted a city profiling process, which provides a representation of key citizens' segments in terms of engagement. Policymakers could find in our work useful tools to increase citizens' listening capacity.

1. Introduction

Since the beginning of this millennium, the concept of smart cities has gained traction amongst businesses, governments, media, and academia (Kitchin, 2015; Zheng et al., 2020). This term has been mainly used to refer, on the one hand, to the use of ICTs (Information and Communication Technologies) to stimulate economic development and, on the other hand, to the extensive embedding of digital platforms into the fabric of the city to augment urban management towards e-governance (Caragliu et al., 2011; Kitchin, 2014; Nijkamp & Cohen-Blankshtain, 2013; Samuel et al., 2020). This approach finds support in the OECD and EUROSTAT (2005), which highlighted

* Corresponding author.
E-mail addresses: silvia.blasi@univr.it (S. Blasi), edoardogobbo@gmail.com (E. Gobbo), silvia.sedita@unipd.it (S.R. Sedita).

https://doi.org/10.1016/j.jum.2022.04.001
Received 31 December 2021; Received in revised form 11 March 2022; Accepted 5 April 2022
Available online xxxx

the importance of ICT as a driver for urban innovation. Lately, the concept of smart city is morphing toward a more comprehensive understanding of city planning and development, which is inclusive of social and environmental concerns (Zheng et al., 2020). However, the concept of smart city is still anchored on a 'one-size-fits-all' and efficient view of technology. In particular, the development of new technologies and new ways of communication, alongside the increasing population density in urban centers, represents a unique opportunity for new technologies, and specifically the Big Data, in developing smart cities. Through Big Data, city management and citizens are given access to a wealth of real-time information about the urban environment upon which to base decisions, actions, and future planning in a collaborative atmosphere, reducing inequalities and social polarization (Engin et al., 2020). The wide usage of Big Data technologies helps achieve new frameworks and paths for planning smart cities, enabling the creation and supporting the development of social and relational capital (Coe et al., 2001).

Smart cities initiatives are not limited to optimizing traffic patterns, parking management, efficient lighting, improvements of public works, etc., rather are oriented to fuel citizen engagement as critical to accomplish a smart and inclusive growth trajectory (Lee, 2019). Smart cities picture themselves as creating technologies, techniques, and visions that are scientifically grounded, objective, pragmatic and apolitical (Kitchin, 2015; Vanolo, 2014). However, this technologically grounded model of city development is generating several social and environmental concerns, whose impact and meaning are often overlooked (Hollands, 2008).

On the one hand, smart cities using big data can generate benefits in transport, health and safety, and pollution management (Belanche et al., 2016; Söderström et al., 2014). Through digital mapping it is possible to identify areas and times of maximum congestion, or evaluate the safety of places, and, finally, create optimization processes aimed at reducing emissions, saving people liters of water, and reducing solid waste production (Cheela et al., 2021). On the other hand, leaving aside issues such as privacy and social control, which are often covered, albeit with little results, in the columns of national and international newspapers, there are more and more scholars, policymakers and city managers voicing their concern for the negative effect of this model (Kummitha & Crutzen, 2017). Even Florida (2017), who is one of the main proponents and admirers of this hi-tech model of cities, urges policymakers and city managers to take corrective actions. This is because smart city strategies are producing inequalities, gentrification, segregation, and progressive worsening of both natural and man-made environments. The dream of a smart city and a smart development has translated into a fragmented patchwork: a large part of the wealth generated has spatially concentrated into a few small residential areas sporadically lived by a global creative class constantly moving from one place to the other; on the contrary, a large part of the poverty has been localized in vast areas, surrounding the firsts, of social, cultural, and environmental degradation. It is for this reason, according to Florida (2017), that political situation, such as Brexit, has come to place.

In the light of this debate, existing academic contributions have devoted great attention to the technological development of smart cities, with the introduction of the Web 2.0 and the implementation of crucial technologies in our daily lives, nevertheless, just a few studies have been conducted in understanding how local governments effectively interact with their citizens through the usage of such technologies. However, we believe that the relationship between municipalities and citizens is a crucial point in this scenario. The administration must have a clear understanding of the smart city model that is most capable of transforming the community in a positive sense, through digital technology: an economically sustainable model, i.e. based on the ability of territory to activate collaboration between public, private and civil society, from the socio-cultural point of view, i.e. focused on the daily needs of citizens. The smart city must first and foremost be "human" and for this to be the case informed administrators and active citizens must share a common vision. One of the most used tools to keep in touch with citizens is being active, as municipalities, on Twitter, an American microblogging and social networking service on which users post and interact with messages known as "tweets" (Haro-de-Rosario et al., 2018). We focus our analysis on Twitter conversations, since this is the preferred social media for the interaction city-citizens.

Driven by this scientific curiosity, we aim to answer the following research questions: Are there any specific behaviors of municipalities on Twitter that are more likely to stimulate citizen engagement? Which are the structural characteristics and the cultural ground of cities that more greatly stimulate interaction via Twitter with municipality managers?

In this paper, we contribute to the existing literature by providing a general overview of the use of social media networks for transferring and exchanging information at the city level among Italian citizens and municipalities. In addition, we explore which factors influence citizen engagement considering municipalities' size, Twitter activity, audience, content, and media types. Finally, we conducted a city profiling process, which provides a representation of key citizens' characteristics in terms of engagement. The results show that municipalities use their Twitter account as a channel of communication to inform the population about transport, public works, etc. The volume of activity and number of followers (audience) change from one municipality to the other. Surprisingly, smaller municipalities have a higher citizen engagement than larger ones (like Roma, Milano, Torino, Napoli). If we look at the cultural ground of cities, three clusters of cities, with different levels of engagement emerge: Melting pot, Lagging, and Changemakers.

The structure of the paper is as follows. Section 2 presents the theoretical framework and the hypotheses, Section 3 introduces the data, Section 4 explains the methodology used, and Section 5 presents the results. Finally, Section 6 offers the discussion and some conclusive remarks.

2. Theoretical framework and hypotheses

Within a context where municipalities struggle to involve citizens, the spread of social media and the use of technologies have certainly favored the massive dissemination of information and generated new modes of interaction and collaboration that allow the involvement of citizens and organizations in the production of public services (co-production of public services or citizen coproduction) (Skoric et al., 2016; Verma et al., 2017). Social media have become in a short time more and more pervasive in public administrations, becoming a central element of the e-government process (Bryer, 2013; Marino & Lo Presti, 2018). The use of social media in the public sector has also attracted the attention of the academic world, which has seen in the new modes of communication and interaction via the

Internet the possibility of rethinking the traditional boundaries between individuals, organizations, communities, and the different levels of public administration (Bertot et al., 2010, 2012; Jaeger & Bertot, 2010). We are seeing, in fact, a significant evolution of the relationship between the different actors in the public sector in which citizens are no longer customers, but partners of the administration for the definition of policies, and the production of public services (Criado et al., 2013; Warren et al., 2014). This involvement is justified by the possibility of increasing the quality of public services not only through greater citizen participation in decision-making but also through greater control over resources and outcomes (Karakiza, 2015; Loeffler & Martin, 2015).

In the social media world, participation can be realized by both user-content interactivity and user-user interactivity (Ksiazek et al., 2016). User-content interactivity takes place when a user interacts with content and its producers, while user-user interactivity refers to the interaction between two or more users. Active citizen participation depends on both the modalities and the topics addressed by the municipalities in their interaction with citizens on social media channels (Bonsón et al., 2017). Furthermore, it is particularly important for municipalities to understand what the "hot topics" are and to encourage interaction and discussion (Bryer & Zavattaro, 2011; Zavattaro & Sementelli, 2014). Municipalities need to increase citizen engagement in public issues by stimulating participative decision-making processes to identify appropriate codesign ideas to more efficiently address government matters (Bonsón et al., 2017; Mergel, 2013; L.; Zheng & Zheng, 2014; Zafiropoulos et al., 2014). Still, some municipalities are more focused on providing one-way information, rather than allowing for two-way communication on social media to increase citizen engagement (Hofmann et al., 2013; Mergel, 2013).

Several studies showed a correlation between the type of topics posted by the municipality and the level of citizen engagement (Graham & Avery, 2013; Grover & Kar, 2020; Halpern & Katz, 2012; Khan et al., 2014). However, it is not clear in which direction municipalities should go to better capture citizens' attention and active participation. Bonsón et al. (2015, 2019), taking into account Twitter data, state that cultural activities, sports, public transportation, or promotional publications for the city, region, or country are the topics that can generate a higher level of citizen engagement. Ellison and Hardey (2013) state that open conversations about local political issues can generate interest in citizens because they feel directly involved. Hofmann et al. (2013) conclude that there is no specific topic that can determine superior citizen engagement. However, their results seem to support that leisure activity and news about administration events better work. Therefore, we put forward our first hypothesis.

Hyp. 1. The specific topics posted by municipalities on Twitter influence citizen engagement.

Within social media, municipalities can use different forms of media types including text, images, and video to attract the attention of citizens and to improve the operational efficiency and accessibility of their services (Daft et al., 1987). Municipalities could use tweets as eye-catchers to draw users' attention to the information they publish. Hofmann et al. (2013) analyzing the Facebook posts of German local governments, showed that posts with images and videos can generate four to five times more engagement than posts without. In this vein, Rahim et al. (2019) conclude that videos can generate higher engagement compared to other media types. The same result was also found by Kite et al. (2016), who attempted to identify the characteristics of Facebook posts that are associated with higher user engagement on the Facebook pages of Australian public health organizations. Therefore, the following hypothesis was proposed.

Hyp. 2. The specific media type used to post content by municipalities on Twitter influences citizen engagement.

The role of communities has long been considered crucial in economic development and growth (North, 1990). Scholars have addressed this topic from different angles but converge on the identification of social capital (Coleman, 1990; Fukuyama & Sevig, 1999; Putnam, 2000; Putnam et al., 1994) and civil society (Douglass et al., 1998; Perez-Diaz, 1993) as two fundamental concepts. "*Communities* refers variously to features of group life, such as norms, traditions and social conventions, interpersonal contacts, relationships, and informal networks" (Rodríguez-Pose & Storper, 2009). Local communities help generate trust, shared social norms, and the sedimentation of social capital. Cities are the preferential locus for community generation, and the smaller the scale of the city, the higher the probability to have more cohesive and participating communities. As highlighted by Skoric et al. (2016: 1820), "social media platforms mainly tap onto existing offline networks of social ties". Therefore, we expect the following.

Hyp. 3. Citizen engagement is stronger in smaller cities.

Bonsón et al. (2015, 2017, 2019) analyzing the impact of media and content types on stakeholder engagement on local government Facebook pages in Western Europe conclude that larger audiences do not necessarily translate into higher levels of engagement. Specifically, they show that followers of German municipalities, who had on average a higher number of followers, are also the ones showing lower engagement. Ma (2013) empirically investigates the spread of police microblogging in Chinese municipal police departments, confirming a non-linear relationship between audience and citizen engagement. This can be explained by the fact that in smaller social media communities, followers feel a greater closeness to the municipality as they perceive that their opinion matters and can be heard. This perception encourages citizens to interact proactively on the municipality's social media. Therefore, the following hypothesis is proposed.

Hyp. 4. There is a non-linear relationship between the number of followers on Twitter (audience) and citizen engagement.

Some authors are critical of the hyper-connectivity offered by smart cities to their citizens (Calzada & Cobo, 2015). Early in 1985, Hiltz and Turoff (1985: 680) forecasted that "users will be overloaded with information", emphasizing the need for novel strategies to help users filter information and reduce overload. More recently, Edmunds and Morris (2000) stated that rapid advances in information and communication technology have exacerbated the effects of information overload, and they highlighted the need to adopt strategies to overcome this situation. We, therefore, postulate that municipalities that are too active on Twitter might provide redundant information not considered relevant by users, who might tend to take distance from the Twitter account reducing their active participation.

Hyp. 5. There is a non-linear relationship between the number of tweets (activity) from municipalities and citizen engagement.

Even before the rise of the smart city as unit of analysis, Florida (2002a) showed that new knowledge and ideas are responsible for urban economic development. According to this study, people belonging to creative class represent the main source of these new ideas and are attracted by areas in which the quality of life is sufficiently high. In the same spirit, Lee et al. (2004) emphasize the existence of a positive relationship between the share of employment in creative occupations and the growth rate of new firms. Moreover, he also demonstrated that the concentration of bohemians in an area attracts and generates innovative technology-based industries (Florida, 2002b). The 3T (Talent, Technology, Tolerance) model, proposed by Florida (2000), has the merit of shifting the attention from technology to creativity as the main driver of economic development. Florida et al. (2008) estimate a system of simultaneous equations in which the creative class affects the level of tolerance in the economy as well as the stock of talents. They conclude that the cultural economy boosts urban development. Accordingly, we expect to find differences in citizen engagement depending on the cultural ground of cities.

Hyp. 6. The cultural ground of cities affects citizen engagement.

3. Data

Our research is based on Twitter data mining. Twitter uses an algorithm that pushes content into the user timeline (Asadi & Agah, 2017). The algorithm evaluates the relevance of each tweet based on how much recent the tweet is or whether it contains media, the eventual past interactions with the author of the tweet, and tweets the user found engaging in the past. The sample for this study is taken from the Istituto Nazionale di Statistica (ISTAT) which includes data for the 28 largest Italian municipalities ranked by the number of citizens. These municipalities include those with a population exceeding 99,000 inhabitants and had an official website. The Twitter account of each municipality was collected by following the icon link on the municipality's official website or by searching. As the last step before the web scraping activity, we evaluated the activity of each Twitter account. We selected only those accounts that posted at least one tweet in the previous 6 months (the threshold limit was then set in April 2019, given that the data collection started in October 2019). Moreover, we included an additional threshold: each account needed to have issued at least 1000 tweets since joining Twitter. We set these thresholds to avoid biases due to inactive accounts or fake accounts that could have affected our analysis. We then obtained our sample, composed of 28 municipalities among the largest Italian cities with an active Twitter account.

The data collection took place between October and November 2019 using Twint.In,[1] a Python library that allows performing Twitter scraping. Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. It is extremely attractive in the field of Rapid Application Development because it offers dynamic typing and dynamic binding options. To assess the citizen engagement per municipality, we utilized a framework developed by Bonsón et al. (2019). As can be detected from Table 1, for assessing the citizen engagement the authors introduced three different metrics, such as “Popularity” which is based on the number of “likes” received by each municipality, “Commitment” which is based on the number of “replies” and “Virality” which refers to the number of retweets obtained. Once obtained the three different metrics per 1000 followers the “Engagement” can be easily achieved by summing the components up.

We collected 316,801 tweets coming from 28 different municipalities. We used the Python software (Van Rossum & Drake, 1995) to scrape every tweet from each account (Zacharias & Poldi, 2018), and the R software to analyze them. Subsequently, we performed qualitative and quantitative data analysis. The qualitative analysis, thought a content analysis, is aimed to identify the content of the tweet and the media type. The quantitative analysis, through statistical tools, investigates the metrics related to the followers (retweets, replies, likes) to understand the level of citizens' engagement.

4. Methodology

The proliferation of social networks, such as Twitter, offers new and alternative measurement approaches (Schwartz & Ungar, 2015). In this paper, through content and text mining analysis we examined all the tweets coming from different municipalities for understanding the rate of citizen engagement between the Italian population and their municipalities. The content analysis process is composed of three steps: 1) sampling and data collection, 2) coding; 3) content analysis. Fig. 1 provides a graphic explanation of the process.

As it is possible to see in Fig. 1, the first part of the content analysis (the Python one) refers to the data collection process (described above in Section 3); the second part (the RStudio one) describes the coding process and the analysis of the tweets. Before starting to code the tweets, we need to pinpoint the tweets' content type. The identification of the content type is based on an existing list created by Torres and Pina (2001)and subsequently modified by several authors (Bonsón et al., 2015, 2019; Martí et al., 2012). We also revised and adapted our list according to the most frequent words that appeared in the tweets after the analysis was accomplished. Following Bonsón et al. (2019) we set automatic vocabularies to assess the different content types of words. Setting automatic vocabularies represents a crucial phase of the content and text mining analysis. This technique guarantees more transparency and captures more connections between words (Schwartz & Ungar, 2015). The content type list was further refined according to the most frequent words published in

[1] Twint.In is an advanced Twitter scraping tool written in Python language that does not use Twitter's API, allowing you to scrape a user's followers, following, tweets and much more while evading most API limitations (Bonsón et al., 2019). Twint.In utilizes Twitter's search operators to let scraping tweets from specific users. The tweets then were automatically scraped in a csv format and stored in different folders.

Table 1
Metrics for citizen engagement.

Metrics	Code	Calculation
Popularity	P1	Number of tweets favorited/total tweets
	P2	Total number of times favorite/total tweets
	P3	(P2/total number of followers)*1000
Commitment	C1	Number of tweets commented/total tweets
	C2	Total number of comments/total tweets
	C3	(C2/number of followers)*1000
Virality	V1	Number of tweets retweeted/total tweets
	V2	Total number of retweets/total tweets
	V3	(V2/number of followers)*1000
Engagement		P3+C3+V3

Source: Bonsón et al., 2019, p. 484.

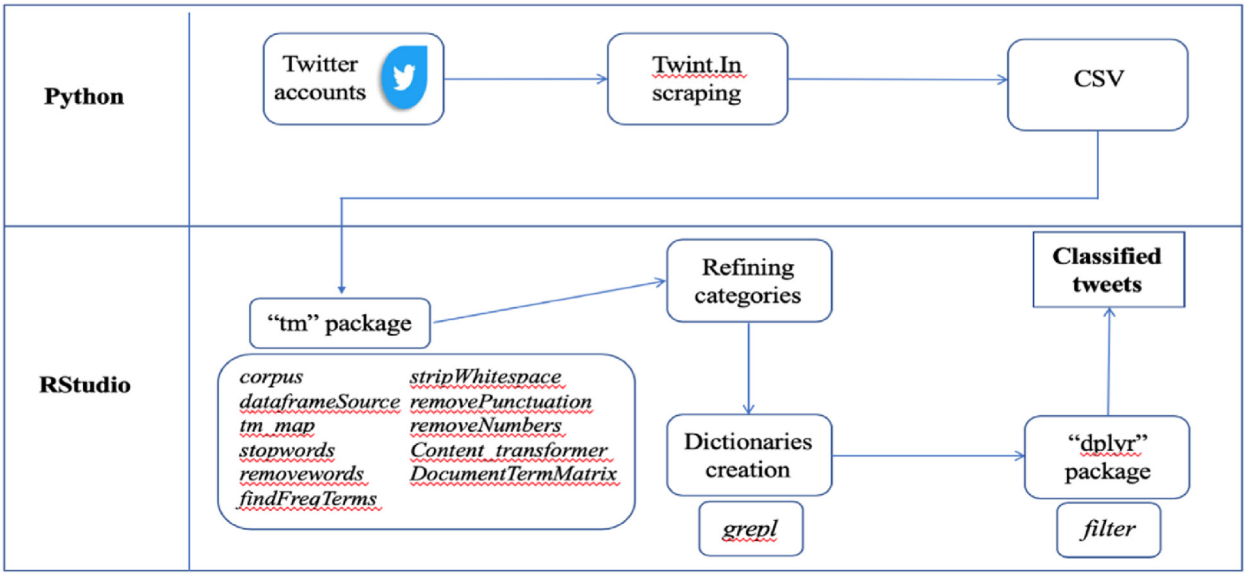


Fig. 1. Flowchart of the content analysis process.
Source: adaptation of Bonsón et al., 2019, p. 484.

the tweets provided by local governments, using the RStudio package "tm".[2] As it emerges in Fig. 1, the "tm" package is composed of several functions. *Corpus* is composed of a set of text documents and it represents the building block of this analysis. The *Data Frame Source* function analyzes a great number of tweets at the same time, considering each tweet as an independent document. *Tm_map* function cleans the Corpus of all "useless" information (e.g. remove punctuation, strip white space, identify and delete all the most common words (articles, verbs, etc.). The corpus was then transformed in a *DocumentTermMatrix* which employs sparse matrices for the Corpus. Thanks to this process we were able to identify the content type (Table 2

Thanks "grepl", we created a dictionary for each category, characterized by the words that composed each content type. This stage, on one hand, reduces subjectivity, on the other hand, gives an overlap error, since there are tweets that span more than one category (Bonsón et al., 2019). After the coding phase, using the RStudio library "dplyr", we automatically examined and categorized all the tweets.

5. Results

5.1. Descriptive analysis

The Twitter accounts of the municipalities under analysis have a different number of followers: the account with the largest audience has 468,600 followers, while the account with the lowest audience has just 1316 followers. This also implies a huge difference in the total number of tweets published. The average activity (number of tweets for a single municipality) amounts to 11,314 whilst the

[2] The "tm" package is a text- mining tool which offers some powerful functions which aids in text processing steps.

Table 2
Content categories.

Content type	Tweet content	Code
Cultural	Cultural activities and events.	1
Employment and Education	Employment and training schemes. Public education.	2
Environment	Environmental concerns.	3
Security and Health	Citizen Protection and security. Health service.	4
Sport	Sport activities and events	5
Transport and Public Works	Public and private transport. Public works in the city. Town Planning.	6
Others		7

Source: Bonsón et al., 2019, p. 484.

average amount of followers per municipality is 56,795 (Table 3). The average amount of audience is biased by the number of followers belonging to the largest cities in Italy (Roma, Milano, Torino, and Napoli).

From the analysis of the content type categories emerge that municipalities tend to adopt Twitter accounts as a channel of communication to inform the population about transport, public works, and new town planning ideas, given that the 26% of the tweets falls under this category. The second content category type, represented under the name “others” (25%), covers a diversity of topics that had not been included in our category selection. Cultural (19%) and Sport (13%) appear as crucial topics used by the municipalities for engaging with the population (Table 4).

The preferred media type adopted by the Italian municipalities is the website link (40%), which nowadays is roughly included in one out of two tweets produced. Although there is a massive presence on the social network of photos and videos, plain text still seems to be one of the most preferred ways of communication adopted by municipalities (28%). Photos and videos or the combination of web links, photos, and videos appear with the percentage of 18% and 12%, respectively (Table 5).

To assess the citizen engagement in Italian municipalities, we used the metrics proposed by Bonsón et al. (2019, 2015). Table 6 shows the main results.

On average roughly 42% of the tweets are liked as represented by P1, 11% of the tweets are replied to (C1) and 46% of the tweets are retweeted (V1) by citizens. Moreover, as can be noticed looking at P2, C2, and V2, the average number of likes and retweets per tweetise high, 2.17 (P2) and 1.52 (V2) respectively, while the average number of replies per tweet is low (0.17; C2). According to the methodology proposed by Bonsón et al. (2015), dividing P2, C2, and V2 by the number of followers and multiplying it by 1,000, we obtained the average number of likes, replies, and retweets per tweet per 1000 followers. The results show that citizens prefer to interact with municipalities through "likes" rather than answers and retweets. Finally, it is possible to see that the average citizen engagement Italian index is about 27.83%.

By applying the methodology proposed by Bonsón et al. (2015) we noticed that smaller municipalities have higher levels of citizen engagement. The municipalities with the highest levels of citizen engagement are Trento, Prato, Bergamo, Ferrara, and Padova. Perhaps, this result is due to the higher level of closeness to the municipality that citizens from smaller cities tend to show, as claimed in our Hyp. 3 (Fig. 2).

5.2. Statistical analysis

For the purpose of our study, we are also interested in identifying the factors associated with citizen engagement. More specifically, we wanted to understand whether the audience (number of followers) and the activity (number of tweets) of municipalities might have an impact on the engagement, and if the municipality size was somehow linked with it. Indeed, smaller municipalities, and, more generally, small villages, tend to care much more about their cities compared to largest ones. Engagement stands for collaborating with the local governments in enhancing old services and providing new ones for reaching common wellness. As can be noticed from Table 7, the analysis shows a significant negative relationship between citizen engagement, activity, and audience. This implies that increasing the level of activity and audience generates a lower level of engagement. Table 7 also shows that there is no relationship between the population, and therefore the size of the municipality, and the level of engagement of citizens. We apply Spearman's coefficient for understanding the relationships among the variables. The Spearman's correlation between two variables is equal to the Pearson's correlation between the rank values of those two variables; while the Pearson's correlation gives linear relationships, the Spearman's correlation assesses monotonic relationships. In other words, the Spearman's correlation between two variables will be higher when the observations have similar rank and lower when observations have a dissimilar rank between two variables.

Results in Table 7 confirm that there is a non-linear relationship between the number of followers on Twitter (audience) and the number of tweets (activity) and citizen engagement, as put forward in Hyp. 4 and 5.

After analyzing the relation between activity, population, audience, and citizen engagement, we investigate the relationships

Table 3
Number of followers and tweets.

	Average	Median	Maximum	Minimum	Std. Deviation
Audience	56,795.57	9169.00	468,600.00	2220.00	111,446.45
Activity	11,314.36	7733.50	48,402.00	1316.00	10,321.33

Table 4
Percentage of content type.

Content Type	Percentage
Transport and Public Works	26%
Others	25%
Cultural	19%
Sport	13%
Security and Health	7%
Environment	5%
Employment and Education	5%

Table 5
Percentage of media type.

Media Type	Percentage
Web link	40%
Text	28%
Photo/Video	18%
Web links Photo/Video	12%
Others	2%

Table 6
Metrics for citizen engagement.

	Code	Max	Average	Min	Std.deviation
Popularity	P1	0.86943824	0.42809801	0.14086629	0.188947599
	P2	11.8008553	2.16548154	0.16705465	2.568666337
	P3	0.75714314	0.14798961	0.013935	0.165891054
Commitment	C1	0.49788214	0.11194724	0.01363485	0.111304662
	C2	0.91118785	0.17493106	0.01407826	0.232629249
	C3	0.03635865	0.00988196	0.00181481	0.007941579
Virality	V1	0.93790275	0.46104294	0.0287071	0.214761821
	V2	5.9154787	1.52004359	0.1354617	1.435520691
	V3	0.45039497	0.12046044	0.01233172	0.118683037
ENGAGEMENT	(P3+C3+V3)	1.24389676	0.27833201	0.02808153	0.292515669

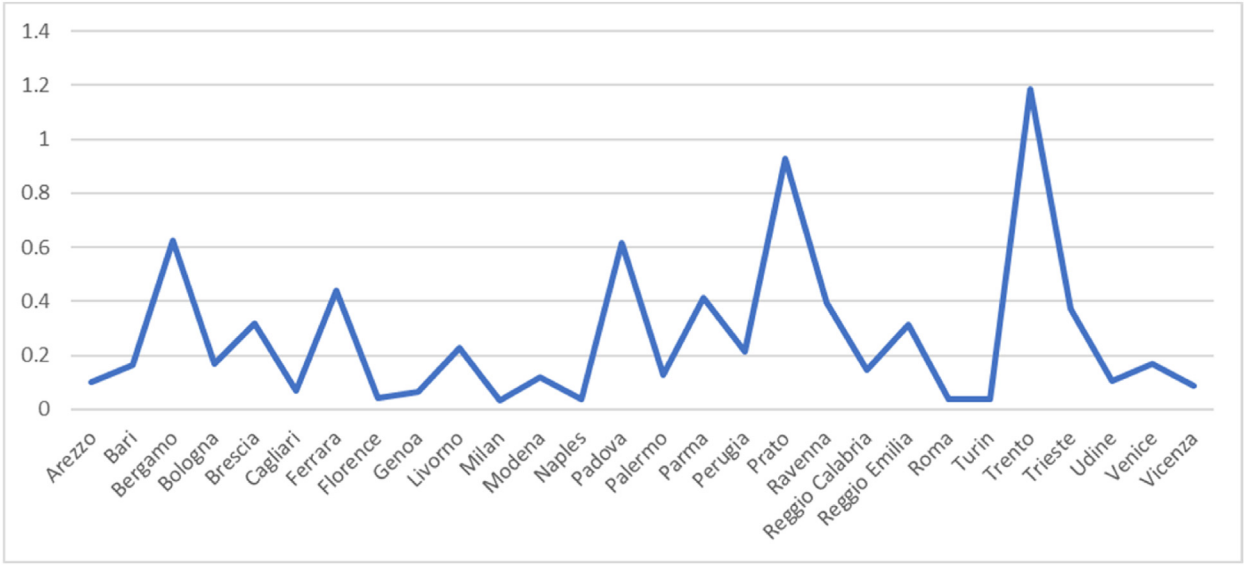


Fig. 2. Citizen engagement per municipality (ranked by population).

Table 7
Relationship between activity, population, audience, and citizen engagement.

Dependent variable	Independent variable	Spearman's coefficient	Significance
Engagement	Activity	−0.6551724**	0.0002183
	Population	−0.4499179	0.01716
	Audience	−0.7192118**	0.000002701

** Significant at $p < 0.01$ (2-tailed).

between media types and citizens' reactions on Twitter (likes, replies, and retweets). Table 8 summarizes the descriptive statistics that shall light on how citizens interact with municipalities on Twitter.

Looking at Table 8, it emerges that all those tweets that contain photos or videos generate much more likes (4.09) and retweets (4.12) compared to the other media types. This outlines a common global trend, indeed due to the massive usage of smartphones and other devices, photos and videos seem to be a more direct way of interacting with the others: social networks widely used, such as Instagram and Snapchat are based on sharing photos and videos represent two of the greatest examples of that trend. While, when dealing with plain text tweets citizens tend to reply with a higher frequency compared to other media types (0.78): this can be explained by the fact that this media type helps in starting open directl dialogues more easily with municipalities and thus increases the engagement rate. However, the frequency appears low and thus, once again, suggests that Twitter users do not use the reply button as much as they do with the like one and the retweet one, probably due to its feature of not being as "immediate" as likes and retweets. Our results support Hyp. 2, which claims differences in the efficacy of different media types used by municipalities in their tweets.

Finally, we analyze how citizen engagement varies according to different content types, defined in Table 2. Table 9 presents the main results. We can see that each tweet generates on average 14.21 likes, 1.71 replies, and 12.41 retweets. In Italy, citizens interact with municipalities by pushing the like button while scrolling Twitter, rather than using the reply button and the retweet one, even if the average number of retweets per tweet is considerably high (12.41). From our evidence, the *Sport* category is the content that generates more likes (3.78) and retweets (2.87), *Environment* is the content that obtains more replies. In summarizing, looking at Table 9, we can see that different content types generate different levels of engagement among citizens. Therefore, since the specific topics posted by municipalities on Twitter influence differently citizen engagement, Hyp. 1 is confirmed.

5.3. City profiling

To profile cities, and to investigate how citizen engagement varies across cities, we conducted a cluster analysis, which is oriented to separate cities according to some specific features. The cluster analysis is a set of statistical techniques designed to identify groups of units similar to one another in relation to a set of characteristics taken into consideration according to a specific condition. The objective is to combine heterogeneous units in several subsets that tend to be homogeneous and mutually exhaustive. The statistical units are, in other words, subdivided into a certain number of groups according to the level of "similarity" evaluated, starting from the values that a series of chosen variables assume in each unit (Fabbris, 1990).

Given the theoretical attention to the 3T's approach launched by Florida (2002a) in identifying common development patterns across places, we decided to isolate specific features of cities considering three indicators: Tolerance (as the percentage of immigrants in the overall population), Creative class (as the percentage of people employed in the creative industries), Technology (as a percentage of people employed in high-tech industries). We then performed a hierarchical cluster analysis based on Ward distance (Everitt, 1979; Johnson, 1967). This made it possible to visualize the data structure through a dendrogram (or tree diagram) – See Fig. 3, which facilitated the authors' choice regarding the number of groups to select (3).

Fig. 3 shows that the first cluster (in the red frame) groups 12 municipalities, the second (in the green frame) 5 municipalities, and the third (in the yellow frame) 11 municipalities.

Table 10 summarizes the values of the clustering variables (Tolerance, Creative Class, and Technology) for the three clusters, and Fig. 4 represents graphically the distribution of the three indicators by cluster, through a box-plot analysis.

Table 8
Descriptive statistics of media types and citizen engagement.

Media Type		Likes	Replies	Retweets
Web links	Mean	0.63	0.09	2.01
	Std.Deviation	3.07	0.61	4.01
Text	Mean	0.68	0.78	0.61
	Std.Deviation	2.90	0.19	3.53
Photo/Video	Mean	4.09	0.28	4.12
	Std.Deviation	13.34	0.90	8.69
Web links - Photo/Video	Mean	3.01	0.25	2.39
	Std.Deviation	4.46	0.98	8.92
Others	Mean	3.90	0.59	2.49
	Std.Deviation	16.11	1.45	11.16
Total	**Mean**	**12.31**	**1.99**	**11.62**
	Std. Deviation	**39.88**	**4.13**	**36.31**
	N	**936,713**	**77,342**	**732,192**

Table 9
Descriptive statistics of content types and citizen engagement.

Content Type		Likes	Replies	Retweets
Transport and Public Works	Mean	2.03	0.24	1.23
	Std.Deviation	10.89	0.61	2.07
Others	Mean	2.01	0.32	2.22
	Std.Deviation	5.79	0.54	6.98
Cultural	Mean	2.33	0.14	2.79
	Std.Deviation	6.65	1.78	6.72
Sport	Mean	3.78	0.21	2.87
	Std.Deviation	11.48	0.43	8.42
Security and Health	Mean	0.75	0.24	0.21
	Std.Deviation	5.63	0.56	4.89
Employment and Education	Mean	1.22	0.11	1.06
	Std.Deviation	6.78	0.66	4.98
Environment	Mean	2.09	0.51	2.03
	Std.Deviation	6.32	0.71	5.95
Total	**Mean**	**14.21**	**1.71**	**12.41**
	Std. Deviation	**53.54**	**5.29**	**40.01**
	N	**1,180,445**	**97,092**	**774,69**

The box-plot analysis reveals interesting features of each cluster. Cluster 1 is formed by municipalities where Tolerance has a dominant role, creating the pre-conditions of city governance oriented to cope with diversity as a potential for future development. We could label these municipalities as “Melting pot cities”. Cluster 2 is formed by municipalities that show low levels of all the three indicators, we could label these municipalities as “Lagging cities” in terms of potential for future development. Cluster 3 is formed of municipalities that show high levels of both Tolerance and Technology indicators, we could label these municipalities as “Changemakers”, because of the great potential in terms of use of the technologies and ability to cope with diversity issues.

We are now able to measure the mean values of citizen engagement in each cluster, which is summarized in Table 11.

Not surprisingly, Table 11 reveals that the “changemakers” cities present the highest level of citizen engagement, followed by the “melting pot” and the “lagging”. The cultural ground of the cities impacts the willingness of citizens to be active participants in the city planning, thus offering interesting insights on the possibility to activate, in these municipalities, bottom-up governance platforms, which could help municipalities to become inclusive and intelligent cities. This important result gives support to our Hyp. 6.

6. Discussion and conclusions

Our research has attempted to deepen the present understanding of how social media data analysis can be applied to smart cities development. We provided an overview on how governments and local municipalities are implementing such technologies for enabling citizens to actively participate in a two-way relationship with city government. E-government, through Internet of Things technologies, represents a unique opportunity for helping citizens to improve societies' engagement with governments. We then tried to explain how Twitter data mining process can be used to improve and shape citizen engagement in a sample of 28 Italian municipalities. To perform our studies, we executed a content analysis on 316,801 tweets retrieved from the official Twitter accounts of our sample of Italian municipalities. The content analysis allowed us to move beyond classical statistical analyses on social media, mapping the reaction of citizens to a variety of thematic areas proposed by the municipalities where they live. We built on Bonsón et al. (2015, 2019), which performed studies on citizen engagement on Western European municipalities (through Facebook) and Andalusian municipalities (through Twitter) and extended their results by offering a city profiling analysis. By doing so, we were not only able to retrieve information on types and intensity of engagement, but also to observe city features related to citizen engagement.

The results show an heterogenous situation of the local governments in Italian municipalities, regarding population, audience (total followers) and activity (total tweets). This evidence supports the idea that it is not possible to apply a one-size-fits-all approach to smart city development. Regarding citizen engagement, likes are the most frequent way for Italian citizens to interact with their local city council account, on the other hand, the percentage of replies per tweet appears low, outlining how nowadays citizens tend not to spend much time in giving feedbacks to municipalities on different contents and topics. Our findings show that the media type category that generates more engagement (in terms of likes and retweets) is Photos/Videos. Transport and Public Works and Cultural are the content categories most frequently re-tweeted, whereas the content type category with the highest levels of engagement is Sports.

Understanding which media types generate more engagement could be a useful tool in order to stimulate citizens' participation in city government. For instance, if a municipality is willing to receive feedbacks about certain topics, issuing a plain text tweet could generate more replies, on average, than issuing tweets supported by other media types. On the other hand, if a municipality is willing to reach many citizens, it should issue tweets including photo, video, and web links. We therefore observe that there is a tradeoff between reach and richness. Contrary to Bonsón et al. (2019) in Italy citizens interact with municipalities by pushing the like button while scrolling Twitter, rather than using the reply button and the retweet one. Thus, there are some country specificities that are needed to be considered for maximizing the efforts of municipalities in interacting with citizens.

Finally, looking at the results of the city profiling process, it emerges that it is important to detect the cultural ground of the cities, following the Florida's approach, which suggests that the development of places is strictly connected to some not economic indicators

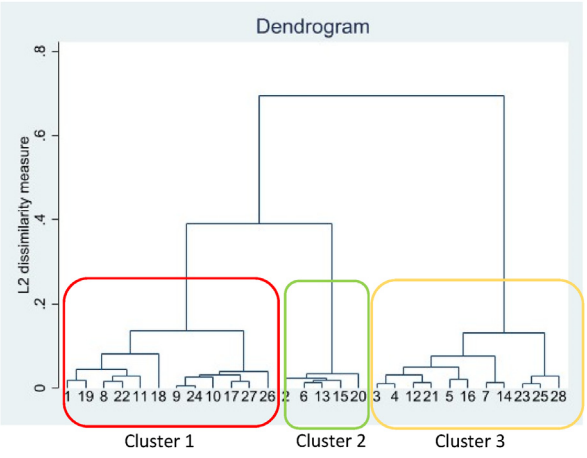


Fig. 3. Dendrogram.

Table 10
Mean values of the clustering variables by cluster.

	Mean	Std. err.	[95% conf. interval]	
Tolerance				
Cluster 1	0.1125	0.007797	0.096502	0.128498
Cluster 2	0.04	0.005477	0.028762	0.051238
Cluster 3	0.11	0.005222	0.099285	0.120715
Creative Class				
Cluster 1	0.011872	0.001373	0.009055	0.014689
Cluster 2	0.014964	0.002541	0.00975	0.020179
Cluster 3	0.007519	0.000433	0.006631	0.008407
Technology				
Cluster 1	0.046643	0.004769	0.036859	0.056427
Cluster 2	0.013757	0.004618	0.004282	0.023232
Cluster 3	0.12251	0.007244	0.107647	0.137372

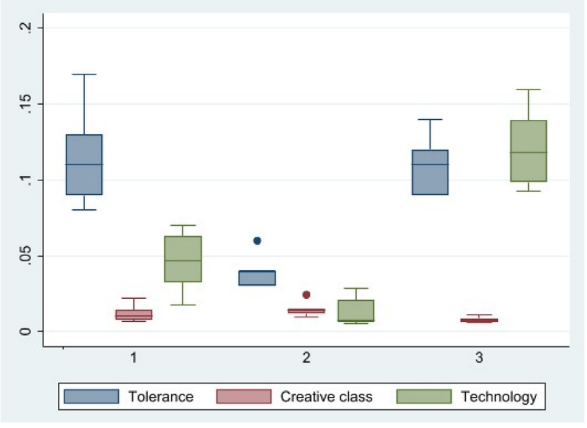


Fig. 4. Box-plot of the clustering variables by cluster.

such as Tolerance, Talent (Creative Class plus Skilled Individuals), and Technology. In our work we decided to monitor three specific aspects of the human capital available in the city, which were the percentage of immigrants (Tolerance), the percentage of creative employees (Creative Class[3]), and the percentage of high-tech employees (Technology). We were able to classify cities into three groups: Melting pot, Lagging, and Changemakers. The three groups present different levels of citizen engagement, where the municipalities with

[3] We decided to measure only the Creative Class, because we observe high correlation between Skilled Individuals and Technology in our sample.

Table 11
Mean value of citizen engagement by cluster.

	Mean	Std. Err.	Number of obs = 28	
			[95% conf. interval]	
Melting pot cities	0.29175	0.108674	0.068769	0.514731
Lagging cities	0.1084	0.024264	0.058614	0.158186
Change makers	0.319182	0.060621	0.194798	0.443566

a high level of Tolerance and Technology are the ones where citizens are more active. Consequently, city planning should take into account the cultural tissue that characterizes citizens, being aware of specific features that enhance the possibility to well introduce mechanisms of bottom-up city governance. The success of smart cities initiatives is linked not only to the ability of policymakers, but also to the city profile, in terms of its citizens, which can be associated to a variety of social ad relational capital.

6.1. Limitation and further research

A series of limitations together with recommendations for future research must be acknowledged before concluding. The first limitation regards the size of the sample: 28 Twitter accounts cannot guarantee the generalization of the results; future research could be oriented to extend the analysis to a larger sample, if not including all the Italian provinces. Moreover, the study could be replicated using data coming from other social media networks, such as Facebook and LinkedIn, even if gathering data from them could be difficult, because of their privacy protection tools. Besides, Twitter posting, and re-twitting is much related to culture, age, generation, occupation, etc.; future research might be addressed to control for those relevant aspects, together with the usage of automated content analysis, classifying tweets through a dictionary of the most frequent words, thus reducing subjectivity issues. Another relevant limitation to be acknowledged is the way in which citizen engagement was assessed. We used likes, replies, and retweets, without accounting for the sentiment, which takes into consideration positive or negative impressions related to specific content. Nevertheless, we were not willing to capture the feelings of citizens, but their level of activity in general. A final note is due to mention the ethic drawbacks of this type of analysis, in case it is used by policymakers and city governments, because of the risk of abusing big data on individual preferences, incurring in what Bauman and Lyon (2015) refers to as the danger of the “surveillance era”.

Acknowledgement

The authors acknowledge financial support from Centro per l’Economia e Tecnica dell’Energia “Levi Cases”, University of Padova.

References

Asadi, M., & Agah, A. (2017). Characterizing user influence within Twitter. In *International Conference on P2P, Parallel, Grid, Cloud and Internet Computing* (pp. 122–132).
Bauman, Z., & Lyon, D. (2015). *Sesto potere: la sorveglianza nella modernità liquida*. Gius. Laterza & Figli Spa.
Belanche, D., Casaló, L. V., & Orús, C. (2016). City attachment and use of urban services: Benefits for smart cities. *Cities, 50*, 75–81.
Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2010). Using ICTs to create a culture of transparency: E-Government and social media as openness and anti-corruption tools for societies. *Government Information Quarterly, 27*(3), 264–271. https://doi.org/10.1016/j.giq.2010.03.001
Bertot, J. C., Jaeger, P. T., & Hansen, D. (2012). The impact of polices on government social media usage: Issues, challenges, and recommendations. *Government Information Quarterly, 29*(1), 30–40. https://doi.org/10.1016/j.giq.2011.04.004
Bonsón, E., Perea, D., & Bednárová, M. (2019). Twitter as a tool for citizen engagement: An empirical study of the Andalusian municipalities. *Government Information Quarterly, 36*(3), 480–489.
Bonsón, E., Royo, S., & Ratkai, M. (2015). Citizens' engagement on local governments' Facebook sites. An empirical analysis: The impact of different media and content types in Western Europe. *Government Information Quarterly, 32*(1), 52–62.
Bonsón, E., Royo, S., & Ratkai, M. (2017). Facebook practices in Western European municipalities. *Administration & Society, 49*(3), 320–347. https://doi.org/10.1177/0095399714544945
Bryer, T. A. (2013). Designing social media strategies for effective citizen engagement: A case example and model. *National Civic Review, 102*(1), 43–51. https://go.gale.com/ps/i.do?p=AONE&sw=w&issn=00279013&v=2.1&it=r&id=GALE%7CA329365390&sid=googleScholar&linkaccess=fulltext.
Bryer, T. A., & Zavattaro, S. M. (2011). Social media and Public Administration. *Administrative Theory and Praxis, 33*(3), 325–340. https://doi.org/10.2753/ATP1084-1806330301
Calzada, I., & Cobo, C. (2015). Unplugging: Deconstructing the smart city. *Journal of Urban Technology, 22*(1), 23–43. https://doi.org/10.1080/10630732.2014.971535
Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. *Journal of Urban Technology, 18*(2), 65–82. https://doi.org/10.1080/10630732.2011.601117
Cheela, V. R. S., Ranjan, V. P., Goel, S., John, M., & Dubey, B. (2021). Pathways to sustainable waste management in Indian Smart Cities. *Journal of Urban Management, 10*(4), 419–429. https://doi.org/10.1016/j.jum.2021.05.002
Coe, A., Paquet, G., & Roy, J. (2001). E-governance and smart communities. *Social Science Computer Review, 19*(1), 80–93. https://doi.org/10.1177/089443930101900107
Coleman, J. S. (1990). *Foundations of social theory*. London: Belknap Press of Harvard University Press. Cambridge, Mass.
Criado, J. I., Sandoval-Almazan, R., & Gil-Garcia, J. R. (2013). Government innovation through social media. *Government Information Quarterly, 30*(4), 319–326. https://doi.org/10.1016/j.giq.2013.10.003
Daft, R. L., Lengel, R. H., & Trevino, L. K. (1987). Message equivocality, media selection, and manager Performance: Implications for information systems. *MIS Quarterly, 11*(3), 355. https://doi.org/10.2307/248682
Douglass, M., Douglass, C. M., & Friedmann, J. (1998). *Cities for citizens: Planning and the rise of civil society in a global age*. John Wiley & Son Limited.
Edmunds, A., & Morris, A. (2000). The problem of information overload in business organisations: A review of the literature. *International Journal of Information Management, 20*(1), 17–28. https://doi.org/10.1016/S0268-4012(99)00051-1
Ellison, N., & Hardey, M. (2013). Developing political conversations? *Information, Communication & Society, 16*(6), 878–898. https://doi.org/10.1080/1369118X.2012.740495

Engin, Z., van Dijk, J., Lan, T., Longley, P. A., Treleaven, P., Batty, M., & Penn, A. (2020). Data-driven urban management: Mapping the landscape. *Journal of Urban Management, 9*(2), 140–150. https://doi.org/10.1016/j.jum.2019.12.001

Everitt, B. S. (1979). Unresolved problems in cluster analysis. *Biometrics, 169–181*.

Fabbris, L. (1990). *Analisi esplorativa di dati multidimensionali*. Padova: cleup editore.

Florida, R. (2000). *The economic geography of talent*. Pittsburgh, PA: Heinz School of Public Policy and Management. Carnegie Mellon University.

Florida, R. (2002a). *The rise of the creative class : and how it's transforming work, leisure, community and everyday life*. Basic Books.

Florida, R. (2002b). Bohemia and economic geography. *Journal of Economic Geography, 2*(1), 55–71. https://doi.org/10.1093/jeg/2.1.55

Florida, R. (2017). *The new urban crisis: How our cities are increasing inequality, deepening segregation, and failing the middle class-and what we can do about it*. Basic Books.

Florida, R., Mellander, C., & Stolarick, K. (2008). Inside the black box of regional development–human capital, the creative class and tolerance. *Journal of Economic Geography, 8*(5), 615–649. https://doi.org/10.1093/jeg/lbn023

Fukuyama, M. A., & Sevig, T. D. (1999). *Integrating spirituality into multicultural counseling* (Vol. 13). Sage Publications.

Graham, M., & Avery, E. J. (2013). Government public relations and social media: An analysis of the Perceptions and Trends of social media use at the local government level. *Public Relations Journal, 7*(4).

Grover, P., & Kar, A. K. (2020). User engagement for mobile payment service providers – introducing the social media engagement model. *Journal of Retailing and Consumer Services, 53*, Article 101718. https://doi.org/10.1016/j.jretconser.2018.12.002

Halpern, D., & Katz, J. E. (2012). From e-government to social network government: Towards a transition model. In *Proceedings of the 3rd Annual ACM web science Conference on - WebSci '12*. https://doi.org/10.1145/2380718

Haro-de-Rosario, A., Sáez-Martín, A., & del Carmen Caba-Pérez, M. (2018). Using social media to enhance citizen engagement with local government: Twitter or Facebook? *New Media & Society, 20*(1), 29–49. https://doi.org/10.1177/1461444816645652

Hiltz, S. R., & Turoff, M. (1985). Structuring computer-mediated communication systems to avoid information overload. *Communications of the ACM, 28*(7), 680–689. https://doi.org/10.1145/3894.3895

Hofmann, S., Beverungen, D., Räckers, M., & Becker, J. (2013). What makes local governments' online communications successful? Insights from a multi-method analysis of Facebook. *Government Information Quarterly, 30*(4), 387–396. https://doi.org/10.1016/j.giq.2013.05.013

Hollands, R. G. (2008). Will the real smart city please stand up? *City, 12*(3), 303–320. https://doi.org/10.1080/13604810802479126

Jaeger, P. T., & Bertot, J. C. (2010). Transparency and technological change: Ensuring equal and sustained public access to government information. *Government Information Quarterly, 27*(4), 371–376. https://doi.org/10.1016/j.giq.2010.05.003

Johnson, S. C. (1967). Hierarchical clustering schemes. *Psychometrika, 32*(3), 241–254.

Karakiza, M. (2015). The impact of social media in the Public sector. *Procedia - Social and Behavioral Sciences, 175*, 384–392. https://doi.org/10.1016/j.sbspro.2015.01.1214

Khan, G. F., Yoon, H. Y., Kim, J., & Park, H. W. (2014). From e-government to social government: Twitter use by Korea's Central Government. *Online Information Review, 38*(1), 95–113. https://doi.org/10.1108/OIR-09-2012-0162/FULL/PDF

Kitchin, R. (2014). The real-time city? Big data and smart urbanism. *Geojournal, 79*(1), 1–14.

Kitchin, R. (2015). Making sense of smart cities: Addressing present shortcomings. *Cambridge Journal of Regions, Economy and Society, 8*(1), 131–136.

Kite, J., Foley, B. C., Grunseit, A. C., & Freeman, B. (2016). Please like me: Facebook and Public Health Communication. *PLoS One, 11*(9), Article e0162765. https://doi.org/10.1371/journal.pone.0162765

Ksiazek, T. B., Peer, L., & Lessard, K. (2016). User engagement with online news: Conceptualizing interactivity and exploring the relationship between online news videos and user comments. *New Media & Society, 18*(3), 502–520. https://doi.org/10.1177/1461444814545073

Kummitha, R. K. R., & Crutzen, N. (2017). How do we understand smart cities? An evolutionary perspective. *Cities, 67*, 43–52.

Lee, N. (2019). Inclusive growth in cities: A sympathetic critique. *Regional Studies, 53*(3), 424–434. https://doi.org/10.1080/00343404.2018.1476753

Lee, S. Y., Florida, R., & Acs, Z. (2004). Creativity and entrepreneurship: A regional analysis of new firm formation. *Regional Studies, 38*(8), 879–891. https://doi.org/10.1080/0034340042000280910

Loeffler, E., & Martin, S. (2015). Citizen engagement. In *Public management and governance* (pp. 301–318). https://doi.org/10.4324/9781315693279-35/CITIZEN-ENGAGEMENT-ELKE-LOEFFLER-STEVE-MARTIN. Routledge.

Ma, L. (2013). The diffusion of government microblogging. *Public Management Review, 15*(2), 288–309. https://doi.org/10.1080/14719037.2012.691010

Marino, V., & Lo Presti, L. (2018). From citizens to partners: The role of social media content in fostering citizen engagement. *Transforming Government: People, Process and Policy, 12*(1), 39–60. https://doi.org/10.1108/TG-07-2017-0041/FULL/PDF

Martí, C., Royo, S., & Acerete, B. (2012). The effect of new legislation on the disclosure of performance indicators: The case of Spanish local governments. *International Journal of Public Administration, 35*(13), 873–885.

Mergel, I. (2013). Social media adoption and resulting tactics in the U.S. Federal Government. *Government Information Quarterly, 30*(2), 123–130. https://doi.org/10.1016/j.giq.2012.12.004

Nijkamp, P., & Cohen-Blankshtain, G. (2013). The importance of ICT for cities: e-governance and cyber Perceptions. *Advances in Spatial Science, 72*, 295–308. https://doi.org/10.1007/978-3-642-32141-2_13. Springer, Berlin, Heidelberg.

North, D. C. (1990). *Economic performance*. New York.

OECD, & EUROSTAT. (2005). *Oslo Manual*. https://ec.europa.eu/eurostat/documents/3859598/5889925/OSLO-EN.PDF.

Perez-Diaz, V. M. (1993). *The return of civil society: The emergence of democratic Spain*.

Putnam, R. D. (2000). *Bowling alone: The collapse and revival of American community*. Simon and schuster.

Putnam, R. D., Leonardi, R., & Nanetti, R. Y. (1994). *Making democracy work*. Princeton university press.

Rahim, A. A., Ibrahim, M., Salim, F. A., & Ariffin, M. (2019). Health information engagement factors in Malaysia: A content analysis of Facebook use by the Ministry of Health in 2016 and 2017. *International Journal of Environmental Research and Public Health, 16*(4), 591. https://doi.org/10.3390/ijerph16040591

Rodríguez-Pose, A., & Storper, M. (2009). Better rules or stronger communities? On the social foundations of institutional change and its economic effects. *Economic Geography, 82*(1), 1–25. https://doi.org/10.1111/j.1944-8287.2006.tb00286.x

Samuel, M., Doctor, G., Christian, P., & Baradi, M. (2020). Drivers and barriers to e-government adoption in Indian cities. *Journal of Urban Management, 9*(4), 408–417. https://doi.org/10.1016/j.jum.2020.05.002

Schwartz, H. A., & Ungar, L. H. (2015). Data-driven content analysis of social media: A systematic overview of automated methods. *The Annals of the American Academy of Political and Social Science, 659*(1), 78–94.

Skoric, M. M., Zhu, Q., Goh, D., & Pang, N. (2016). Social media and citizen engagement: A meta-analytic review. *New Media & Society, 18*(9), 1817–1839. https://doi.org/10.1177/1461444815616221

Söderström, O., Paasche, T., & Klauser, F. (2014). Smart cities as corporate storytelling. *City, 18*(3), 307–320.

Torres, L., & Pina, V. (2001). Publicprivate partnership and private finance initiatives in the EU and Spanish local governments. *European Accounting Review, 10*(3), 601–619.

Van Rossum, G., & Drake, F. L., Jr. (1995). *Python reference manual*. Centrum voor Wiskunde en Informatica Amsterdam.

Vanolo, A. (2014). Smartmentality: The smart city as disciplinary strategy. *Urban Studies, 51*(5), 883–898.

Verma, R. K., Kumar, S., & Ilavarasan, P. V. (2017). Government portals, social media platforms and citizen engagement in India: Some insights. *Procedia Computer Science, 122*, 842–849. https://doi.org/10.1016/j.procs.2017.11.445

Warren, A. M., Sulaiman, A., & Jaafar, N. I. (2014). Social media effects on fostering online civic engagement and building citizen trust and trust in institutions. *Government Information Quarterly, 31*(2), 291–301. https://doi.org/10.1016/j.giq.2013.11.007

Zacharias, C., & Poldi, F. (2018). *TWINT - Twitter intelligence tool*. https://github.com/twintproject/twint.

Zafiropoulos, K., Antoniadis, K., & Vrana, V. (2014). Sharing followers in e-government Twitter accounts: The case of Greece. *Future Internet, 6*(2), 337–358. https://doi.org/10.3390/fi6020337

Zavattaro, S. M., & Sementelli, A. J. (2014). A critical examination of social media adoption in government: Introducing omnipresence. *Government Information Quarterly, 31*(2), 257–264. https://doi.org/10.1016/j.giq.2013.10.007

Zheng, C., Yuan, J., Zhu, L., Zhang, Y., & Shao, Q. (2020). From digital to sustainable: A scientometric review of smart city literature between 1990 and 2019. *Journal of Cleaner Production*, Article 120689.

Zheng, L., & Zheng, T. (2014). Innovation through social media in the public sector: Information and interactions. *Government Information Quarterly, 31*(SUPPL.1). https://doi.org/10.1016/j.giq.2014.01.011. S106–S117.