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Is sustainable aligning with smartness in transport domain? – marketing perspective of smart city rankings

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Abstract

Rising awareness of sustainable development challenges, along with the quest for optimization of the everyday functioning of the city, motivate many urban authorities to search for promising concepts and solutions. One of these is the smart city concept, which has gained governors of cities' attention for little more than ten years. An object of research and development, it is still a distinctive feature for the cities that adopt this concept. City marketers use such distinction towards a large palette of beneficiaries of the city. At the same time, it deploys some traits suggesting synergies between the implementation of smart city solutions and sustainable development goals.

The main objective of our work was to verify if the relationship between these aspects (smartness and sustainability of a transportation) in smart city rankings exists and, if that is true, what impact it has on marketing communication of the city comprised in such rankings. To fulfill this goal, we answered such research questions as: what place sustainability criteria in smart city rankings have occurred, how is the transport represented in these criteria, what use graded cities make of their presence in such competition, and which perspective dominates (if any) in daily marketing communication activities of the city.

To provide such an analysis, we considered the criteria used to rank the cities to find the places that accorded to sustainable ones. We examined the marketing use of the results of such rankings, referring to the official websites and social media of selected cities (random selection from the total population of 174 cities comprised). The sources used to provide the data in natural language, and their analysis proceeded with methods and tools used in NLP (natural language processing), which are accessible through CLARIN.EU infrastructure. The results determine that cities can be classed into different groups, accordingly to their sustainability/smartness pending, and ability to use accorded ranks in marketing context.

Introduction

Since the dawn of time, society has been striving to improve the conditions of people's life. Therefore, the city as one of the main forms of human functioning is constantly changing. The vision of the city of the future is a smart one, in which information and communication technology (ICT) supports sustainability thanks to modern technologies (Ahvenniemi et al., 2017). The urban center of the future should be safe, secure, environmentally green, and efficient because all structures – whether for power, water, transportation, etc. that is designed, constructed, and maintained with advanced, integrated materials,

sensors, electronics, and networks – all interfaced with computerized systems encompassing databases, tracking, and decision-making algorithms (Hall et al., 2000). To solve a wide range of problems, such as congestion and security, city authorities implement distributed sensor networks, video surveillance, and predictive analytics. Modern technology contributes to the optimization of processes occurring in the city, and it is crucial to increase the quality of life of its inhabitants. Freedom of movement within and outside the city is an important criterion for the quality of life, which is ensured by the transport function of the city, with consequences such as urban sprawl (Riera Pérez & Rey, 2013) or strong incentives (sometimes even economic pression) toward public transportation use (Zabel & Kwon, 2021).

The smart city concept, reflecting the wishes of stakeholders, aims to create a space where ICT will support city management. One goal of smart cities is to systematically collect and analyze data on all city flows and services, from traffic patterns to utility usage, in order to improve efficiencies and reduce costs (Monahan, 2018). At the same time, smartness may not hinder the sustainability understood as economic, social, and environmental objectives achievement, in a way that should not limit the development opportunities of future generations. The synergy between the sustainable development goals and the implementation of smart city solutions was recently studied by Ahveniemi et al. (Ahveniemi et al., 2017). Their meticulous work revealed the similarities between smartness and sustainability of a city in the rankings, which addresses these aspects. In the present work, we concentrate on cities classified as smart to verify how the concepts of sustainability and mobility (transportation) shape their daily communication through their official sites. Then we discuss the marketing potential of smart city rankings and the extent in which the examined cities benefit from it. The paper addresses the following research questions:

RQ1: How does the ongoing communication of a city (classified as smart) address the issues of sustainability and transport?

RQ2: Do the graded cities use the marketing potential of their presence in SC ranking?

The first part of this paper contains a literature review on two central issues. The first examines the smart sustainable city concept and features, to expose the part that accords to transportation among assessment criteria of city rankings. The second considers the city marketing framework and its potential to support smart sustainable urban development. Next, the research method is presented and, subsequently, the outcomes are obtained. The article ends with a discussion of the research results and a conclusion.

Literature Review – sustainability & smartness of the city

Towards smart and sustainable city

The concept of a sustainable and smart city was crystallized during the 1990s. A sustainable city (United Nations Sustainable Cities Programme) is supposed to develop by fulfilling the demand of respecting the environment while ensuring "equality of income, employment, shelter, basic services, social infrastructure, and transport in urban areas" (Hiremath et al., 2013). The development of cities, for which their authorities (e.g., local governments) are responsible, should also take into account intergenerational equity (Maclaren, 1996), as well as the inclusion of residents and other stakeholders in co-determining the directions of this development (Mueller et al., 2018; Mangnus et al., 2022). Among the postulates and solutions supporting sustainable urban development, one can point to the idea of the "compact city" (Jenks, Burton & Wiliams, 1996), the "shared city" (Cohen & Muñoz, 2016), or the "changing city" (Wolfram, 2016), whose characteristics are presented in Table 1.

The term smart city was first used in the 1990s to describe the importance of new information and communication technologies in relation to modern infrastructure in cities (Albino, Berardi & Dangelico, 2015). The diversity of ICT applications in supporting urban development results in multiple definitions of the smart city (Maček, Ovin & Starc-Peceny, 2019). They derive from knowledge-based creative strategies that aim to improve the socio-economic, environmental, logistical, and competitive performance of cities and harness human, infrastructural, social, and entrepreneurial capital (Kourtit & Nijkamp, 2012). A smart city is an efficient, technologically advanced, green, and inclusive city (Vanolo, 2014). In the smart city concept, we can find six main areas such as smart economy, smart mobility, smart environment, smart people, smart living, and smart governance (Albino, Berardi & Dangelico, 2015). As Korzeniowska (Korzeniowska, 2018) noted, this concept is often narrowed down to a vision focused on the integration of the physical and virtual space of the city, instead of deepening the relationship between technology and the ability to interpret data and find solutions.

Table 1. Characteristics of concepts supporting sustainable urban development (own compilation based on (Jenks et al., 1996; Cohen & Muñoz, 2016; Wolfram, 2016))

Author	City concept	Features and descriptors of the city concept
Jenks et al. (1996)	Compact city	Increase housing density, provide a mix of uses, reduce urban sprawl, and achieve social and economic diversity and vitality.
Cohen & Munoz (2016)	Shared city	Categories subject to sharing in the city and their forms: energy (energy cooperatives and group purchasing), food (joint food production, sharing of manufactured, and processed food), goods (3D printing, leasing of goods, service assistance, and libraries), mobility and transport (forms of transport), and space (places to work and stay).
Wolfram (2016)	Changing city	Components of city transformation potential: inclusive and multiform urban governance, transformative leadership, empowered communities of practice (CoP), system(s) awareness, sustainability foresight, CoP experiments, innovation embedding, reflexivity and social learning, working across human agency levels, and working across political-administrative levels and geographical scales.

Galdon-Clavell (Galdon-Clavell, 2018), while analyzing ICTs in the city and pushing for the implementation of modern technologies in every sphere of life, points to overlooked issues related to the legal, social, and ethical impact of smart environments and technological solutions introduced in a seemingly uncritical manner. This means that society may perceive smart city elements as an excessive intrusion into private life and even the tracking of people by ICT companies. Marsal-Llacuna and Segal (Marsal-Llacuna & Segal, 2016), on the other hand, pointed out the omission of social aspects of the smart city in the scientific literature, in favor of the development of IT concepts to create new tools to further improve environmental and economic efficiency. Similarly, Adamczyk et al. (Adamczyk et al., 2019) highlighted the significant divergence between technological and social rationality, while pointing out that technological development supports the formation of a new social order in which "a sustainable future is becoming the universal common good and ideology of the inhabitants of a digital world".

The similarities between the two concepts have led many researchers to search for the rationale and manifestations of this parallelism. Estevez et al. (Estevez, Lopes & Janowski, 2016), analyzing 876 scientific publications on smart cities, drew attention to the sustainability that goes hand-in-hand with the smart city. Also, Treude's (Treude, 2021) review of scientific papers from 1997 to 2020 indicated a remarkable closeness between the definitions of a smart city and a sustainable city. Toli and Murtagh (Toli & Murtagh, 2020) reviewed the definitions of a smart city, which draws attention to the sustainability orientation present in them. They pointed out that some smart city definitions combine soft capital, such as human and social capital, and hard capital, i.e., the physical infrastructure of a city, to provide a sustainable, livable, and efficient city.

The linking of smart city elements also takes place in the form of an electronic communication network developed by the inhabitants, which substitutes its nervous system and determines the 'intelligence' of the whole system (Maček, Ovin & Starc-Peceny, 2019). Bibri and Krogstie (Bibri & Krogstie, 2019), propose a model for a smart sustainable city that stresses the need for its technological and ecological sophistication. They also pointed out that this model requires adaptation of technological systems for the practice of city functioning, otherwise in one city the implemented technologies will be accepted and in another rejected. According to Dhingra and Chattopadhyay (Dhingra & Chattopadhyay, 2016), there are four attributes of smart and sustainable cities, among which are sustainability, quality of life, urban aspects, and intelligence. In contrast, Höjer and Wangel (Höjer & Wangel, 2015) described a smart sustainable city as one that:

- meets the needs of its present inhabitants,
- does not compromise the ability of other people or future generations to meet their needs and, thus, will not exceed local or planetary environmental limitations, and
- is fully supported by ICT.

Both the sustainable and the smart city are becoming objects of observation for extensive monitoring systems that facilitate their management. The monitoring of urban sustainability started in the 1990s with various indicators. Urban sustainability indicators support stakeholders to take appropriate actions. Indicators should contribute to an improved comparison, assessment, and forecasting of processes in individual cities. Among the tools for measuring urban sustainability are BREEM, LEED, Green Star, and CASBEE (Reed et al., 2009). Published rankings of sustainable cities can be used for benchmarking and further strategy development by city authorities. Work on measurement systems has both

Table 2. Distribution of smart city and urban sustainability indicators among sectors and impact categories (Ahvenniemi, 2017)

Impact categories	Framework type: A – smart city; B – urban sustainability	Sectors										Total
		Natural environment	Built environment	Water and waste management	Transport	Energy	Economy	Education, culture, science, and innovation	Well-being, health and safety	Governance and citizen engagement	ICT	
Environmental sustainability	A	5%	1%	7%	4%	2%	0%	0%	0%	0%	1%	20%
	B	11%	5%	10%	7%	5%	1%	0%	0%	2%	0%	43%
Economic sustainability	A	0%	1%	0%	1%	0%	15%	5%	0%	2%	3%	28%
	B	0%	1%	0%	0%	0%	5%	1%	0%	1%	0%	10%
Social sustainability	A	3%	2%	1%	2%	0%	4%	11%	15%	8%	7%	52%
	B	5%	7%	3%	4%	1%	3%	3%	15%	5%	1%	47%

an academic and a commercial character. The comparison of indicators from methodologies (frameworks) for measuring smart and sustainable cities by Ahveniemi et al. (Ahveniemi et al., 2017) confirmed that both concepts describe the same reality. This is evidenced by the comparison of indicators (958 in total) included in both types of frameworks that assess cities according to their smartness and sustainability (Table 2).

The work of Ahvenniemi et al. (Ahvenniemi et al., 2017) justifies treating both dimensions of the modern city concept (smart and sustainable) as substantially similar. This seems acceptable, as these authors have documented the fact that both smart city models and sustainable city models have similar indicators, with similar sectoral and categorical distributions. What is important in this comparison is the co-occurrence of mobility-related criteria in both types of measurement methodologies and in all the impact categories. This means that the transport dimension is important for both sustainable and smart city objectives and supports their development in environmental, economic, and social terms.

City marketing concept and features

The application of the concept of marketing in the activities of cities can be dated back to the 1980s, to the practice of promotional activities of cities in Denmark (Braun, 2008) and England (Kavaratzis & Ashworth, 2005) and, since the 1990s, the first texts on this subject have begun to appear (Gertner, 2011) justifying the treatment of spatial units (city, region, community, and country) as an object of marketing activities within location marketing. The rationale for its emergence was the competition between cities and their regeneration efforts, for both of which the city image became a tool (Braun, 2008). The successive phases of the evolution of awareness and marketing activities of cities or locations have been the subject of many studies (Braun, 2008; Kavaratzis, 2008; Lucarelli & Olof Berg, 2011; Gertner, 2011; Osorio-Andrade, Murcia-Zorrilla & Arango-Espinal, 2021), which indicates a diversity of approaches and perspectives to these issues. Gertner (Gertner, 2011) concluded from 211 texts on this topic (location marketing) that, until 2009, research in this area was in the first stage of the theory-building process (descriptive, not normative stage). The review conducted by Osorio-Andrade et al. (Osorio-Andrade, Murcia-Zorrilla & Arango-Espinal, 2021) of 295 texts on city marketing from 2003 to 2015, from the Web of Science resources, did not attain any new information in this regard, because the authors focused on bibliometric analysis.

According to Brawn (Braun, 2008) "city marketing is the coordinated use of marketing tools supported by a shared customer-oriented philosophy, for creating, communicating, delivering, and exchanging urban offerings that have value for the city's customers and the city's community at large." For place/city marketing, it is important to plan its development (Metaxas, Juarez & Gaby, 2021), which involves meeting the needs of residents and businesses (constant users) and tourists (occasional users), increasing the attractiveness for potential target markets (Metaxas, 2006), through tailored offers, i.e., for residents (Lee & Lee, 2014) or tourists (Liu, Yu & Liu, 2015). Place/city marketing activities were initially narrowed down to promotion, gradually becoming part of strategy planning for cities – especially their brand (Braun, 2008; Eshuis et al., 2018), namely, by responsible city authorities seeking to achieve competitive advantage (Moilanen, 2015). A distinctive

brand supports the city's decision-making processes (i.e., spatial planning and leisure activities) (Eshuis et al., 2018). It is an important locational factor in the context of global competition – it identifies and distinguishes a city from others, attracting residents and visitors (Kaufmann & Arnold, 2018), but its definition is fraught with challenges.

Moilanen (Moilanen, 2015) included: large number of stakeholders; limited understanding of branding among key stakeholders; limited internal buy-in among stakeholders; difficulties in securing sufficient funding; general slowness and time-related challenges; organizational issues and lack of authority to lead; operational level challenges in marketing communication campaigns and in transferring the brand identity to product experiences; and, finally, weak situational awareness resulting from poor monitoring. Different stakeholders perceive the city differently (Merrilees, Miller & Herington, 2012; Braun, Kavaratzis & Zenker, 2013), which complicates the development of its brand and, at the same time, opens the opportunity to understand the needs of target groups (Maček, Ovin & Starc-Peceny, 2019) and adapt marketing activities to them (Kavaratzis & Ashworth, 2005). In terms of target groups, tools for measuring the effectiveness of city marketing are also proposed, taking into account their economic dimension (Goovaerts, Van Biesbroeck & Van Tilt, 2014).

From the beginning, the development of the concept of place/city marketing was accompanied by criticism directed at the successively identified limitations of the dominant approaches of the time. Initially, this criticism was directed at the commodification of the city caused by the application of the marketing concept to the complex reality of the city. As the concept crystallized, it drew attention to the risk of focusing on selected target groups, which can have side effects on other members of the city community (Braun, 2008). In the same direction is a more contemporary critique of city branding, whose main axis is the inclusion of citizens in the branding process and its democratization (Vanolo, 2018) or the broadening of its spectrum to include aesthetics and ethics (Lucarelli & Olof Berg, 2011). In a similar vein, Kavaratzis (Kavaratzis, 2009) commented on the discrepancy between the theory and practice of city marketing. In this study, the aim of marketing activities, by involving as many stakeholders as possible in the design of the activities, is also the rationale for the pilot study of tools that could achieve this effect on the basis of textual data.

Research Methodology

Involvement in activities that result in the inclusion of smart cities in the rankings is an expensive challenge for cities. Discounting the expenditures incurred for this purpose should include all activities – including the marketing use of the "smart city" label. This allows the building of a coherent image of the city. However, the advantage of appearing in the smart city rankings is not always used. In order to determine the situation in this respect, we planned a study with the use of methods and tools for natural language processing available through the CLARIN infrastructure (https://clarin-pl.eu/index.php/en/home/). For the cities drawn from the smart city rankings, these tools enabled the identification of how the concept of transport occurs in the context of the messages posted on the official websites of cities. The next step was to determine whether the cities from the smart city rankings use this label in their communication with the environment. The research results presented in the paper are part of the research project entitled "Smart City Maturity Model 4.0", which started in 2020 at the Department of Logistics and Marketing of the University of Opole by Anna Bruska, Nataliia Boichuk, Sabina Kauf, and Iwona Pisz.

The research procedure consisted of five phases (Figure 1): (1) selection of city rankings, (2) selection of research sample, (3) selection of websites, (4) collection of text data, and (5) text processing using the CLARIN infrastructure tools.

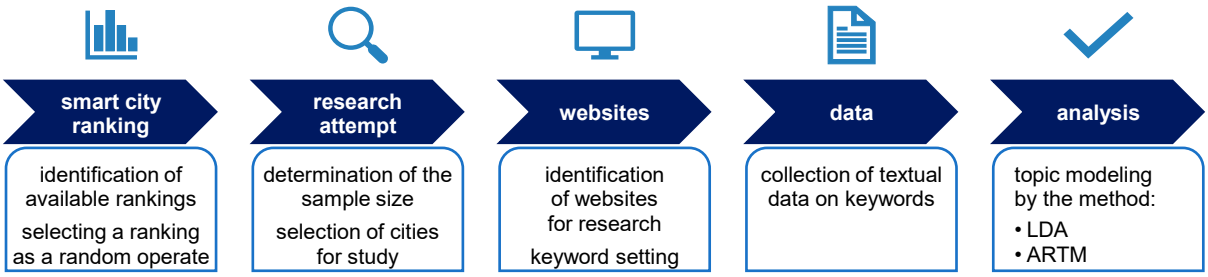


Figure 1. The research framework

We used the smart city rankings available on the web. From the gathered set, 16 were chosen, in which complete lists of cities included in the ranking were accessible. In 16 selected rankings, the number of classified smart cities ranged from 20 to 174, and the analyses were carried out in different time periods. We compared the cities nominated for those rankings to find the most exhaustive possible, and the final choice of reference classification fell on the list of 174 cities in the world, included in the IESE Cities in Motion Index ranking, prepared in 2019 (Berrone & Ricart, 2019). This ranking covered the largest number of cities and was the latest of the available ones, in which a complete list of analyzed cities was published.

Due to the pilot nature of the study, the number of cities included in the sample was limited without maintaining its minimum size. Using a representative method, the sample size is determined by (1) internal variation of the characteristics of the general population (variability of phenomena), (2) applied drawing scheme determining to a significant extent the effectiveness of the study, (3) the assumed level of reliability of the results – the level of confidence, (4) the method used to estimate the parameters characterizing the community, and (5) the available financial resources. It should be added that the increase in the sample size increases the precision of the estimator, but the overall sample size does not depend on the size of the population but on internal differentiation. With this in mind, the permissible margin of statistical error was set at 5% for confidence level, $\alpha = 0.95$, a population fraction equal to 0.5, and a population size of 174 smart cities. If the drawing procedure was used the necessary sample size would be set at 120 cities. Of the 174 cities selected for analysis, using systematic selection, the number 10 was taken as the interval of the draw, which allowed the selection of 17 cities, such as: Tokyo, Los Angeles, Wellington, Gothenburg, Edinburgh, Lyon, Santiago, Seville, Moscow, Nottingham, Athens, Naples, Doha, Cordoba, Salvador, Novosibirsk, and New Delhi.

In the next step, we identified the websites of the drawn 17 cities, to gather the data and defined keywords on these websites from the texts relevant to our study (e.g., smart city, technology, and sustainable development). We send the selected links to the CLARIN support team, and they collected for us all the links that the Google browser returned. The links were presented in the following form: site "X" and "Y", where X is the address of the page and Y is the search term. Here, inverted commas indicate a direct hit on the page content. The links identified in this way, i.e., with texts that meet the criteria, have been processed using newspapers to download the content of the page (see Table 3).

Table 3. Initial text distributions

Smart City	Smart City rank	Initial texts	ICT texts	SD texts	Smart texts	Tech texts
Athens	106	0	0	0	0	0
Cordoba	136	140	0	5	8	1
Delhi	166	134	5	3	3	16
Edinburgh	46	220	19	12	9	40
Lyon en	56	335	0	29	8	21
Lyon fr	56	316	0	11	0	35
Goteborg	36	232	9	2	5	11
Los Angeles	16	345	1	52	47	63
Moscow	86	770	83	30	153	216
Naples	116	311	22	10	20	39
Nottingham	96	168	14	13	6	26
Novo Sybirsk	156	50	0	0	5	3
San Salvador	146	133	3	6	3	11
Santiago	27	5	0	0	3	3
Sevilla	76	92	0	0	47	30
Tokyo	6	400	46	22	69	96
Wellington	26	372	3	1	4	87
Total		4023	205	196	390	698

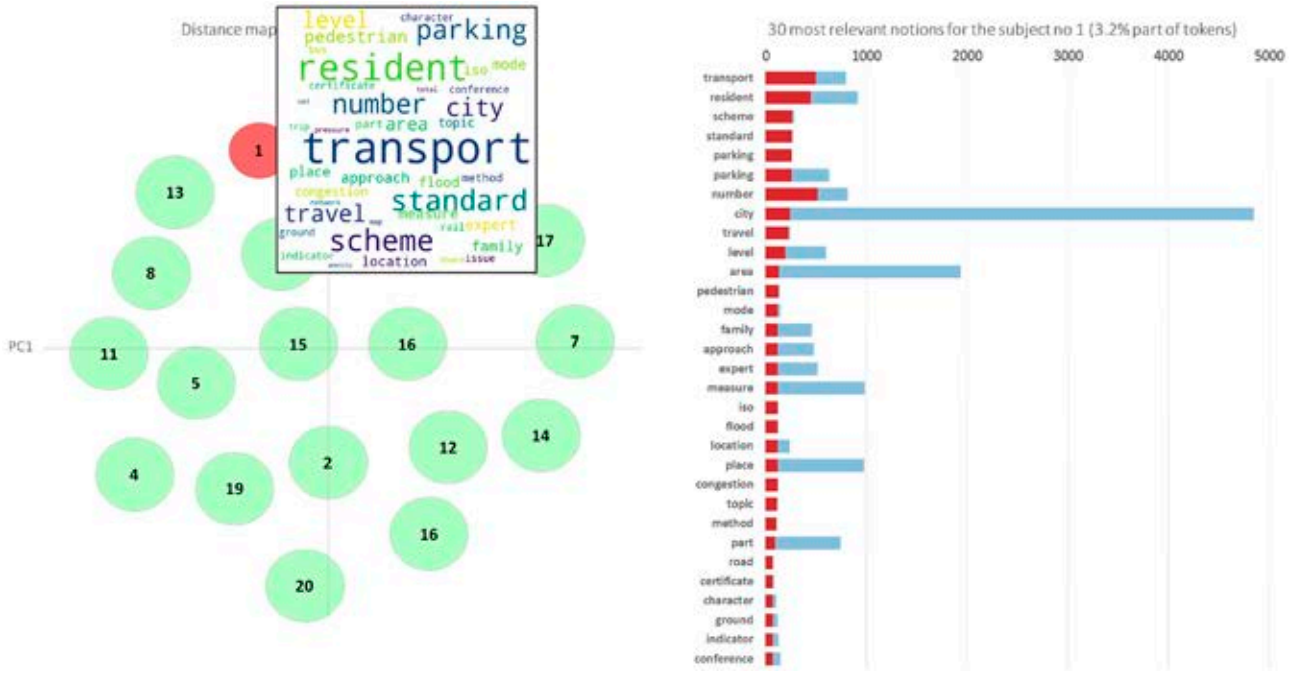
Using this method, a set of texts was obtained, which were analyzed through thematic modeling (Walkowiak & Gniewkowski, 2020), using the "Multilingual Topic" tool, provided by the CLARIN-PL scientific infrastructure, via the webservice portal (http://ws.clarin-pl.eu/). This set was cleaned by removing the texts containing only page navigation commands, which reduced the number of texts analyzed. The method assumes the separation of strings of non-accidentally occurring words by: (1) creating a model of the co-occurrence of words (how often words accompany each other in the corpus and individual texts), and (2) calculation of the probability of occurrence of individual words in a random text drawn from the corpus. Then the words were combined into so-called topics, i.e., sets of co-occurring words. With the help of statistical activities, such sets of words have been distinguished, which probably do not coexist with each other accidentally (the sum of the probabilities of occurrence must equal 1). The latent dirichlet allocation (LDA) algorithm (Nicolas, Kim & Chi, 2021) and additive regularization of topic models (ARTM) were used to extract the fuses. It allowed the determination of thematic consistency, i.e., content connections of the meanings of words that make up a single topic. The results are presented in graphical form. At the same

time, the size of words in the graphical representation of the topic depends on the relative frequency of occurrence, i.e., the probability of occurrence of the word in each document of the corpus.

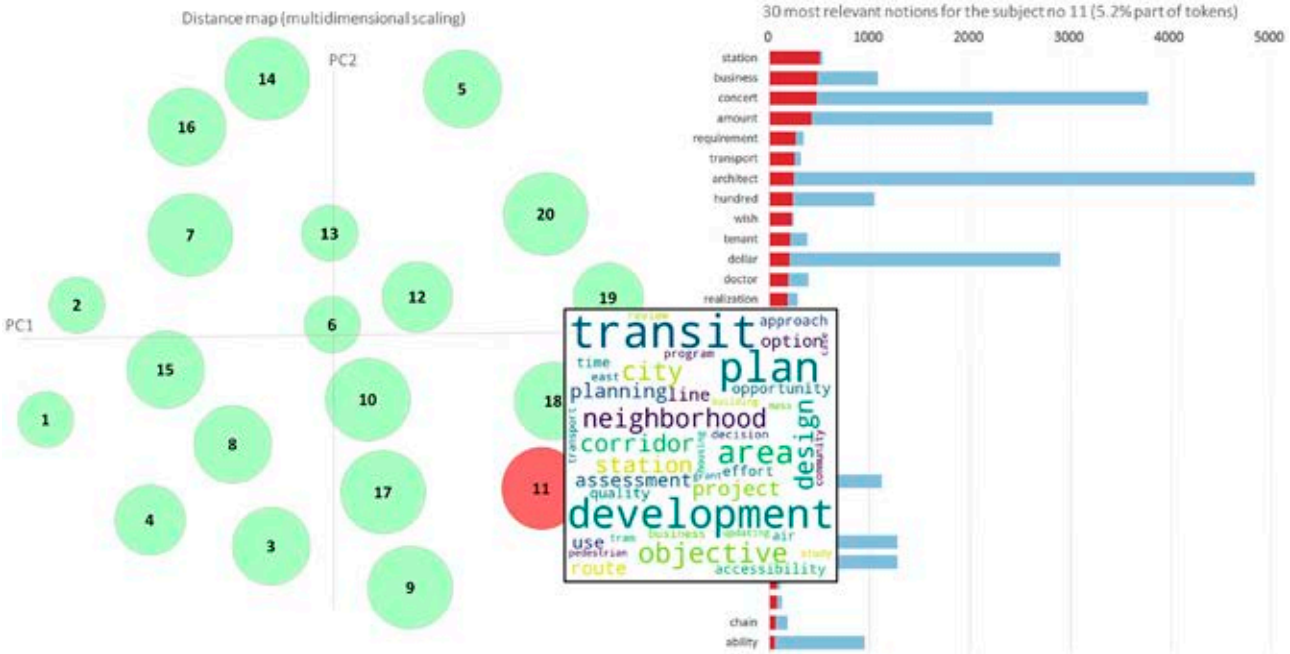
Research result

The topic modeling provided interesting results both in terms of the results of both analytical methods, as well as the content of word clouds (Figure 2).

It was used to reduce the dimension of textual data, and to highlight the concepts that emerged most frequently in the selected texts with the keywords "sustainability" in the context of transport. For the 50 iterations applied to the blocks of 20 000 signs, we obtained one relevant topic using the LDA method and two in the ARTM method, all referring to transport. Some of the identified topics contained only foreign language words (such as Swedish and Russian), which in the context of a given keyword most

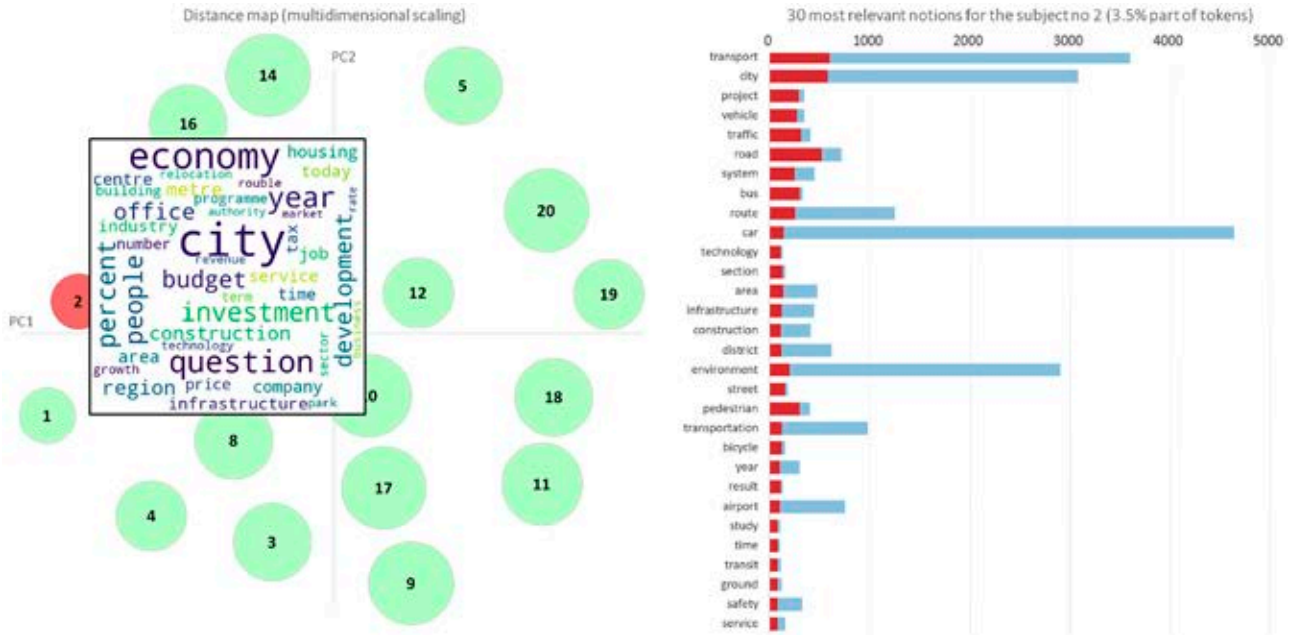


a) LDA method used with sustainability as the keyword (topic No. 1)



b) ARTM method used with sustainability as the keyword (topic No. 11)

Figure 2. Topic modeling results obtained with different clustering algorithms: a) LDA, and b), c) ARTM



c) ARTM method used with sustainability as the keyword (topic No. 2)

Figure 2 (cont.). Topic modeling results obtained with different clustering algorithms: a) LDA, and b), c) ARTM

often appeared in texts of a specific language (usually conjunctions). The first cloud (topic No. 1) included words referring to the processes (transport, travel, and location), users (resident and pedestrian), space (city and area), procedures (scheme, standard, number, certificate, and ISO) and infrastructure (parking, route, corridor, rail, and bus) with its features (accessibility, congestion, time, and pressure). Alternatively, ARTM provides two topics, which can be connected to the management of transport processes or systems (topic No. 11) and the users (topic No. 2).

The topics obtained contain many similar concepts, which may be due to the relatively small number of objects included in the study (both cities and source texts). However, they display different features, especially when using the ARTM method, which may signal its greater discriminatory potential, which is worth using in the next stage of the research.

The results obtained confirmed that mobility is one of the important threads in the communication of a smart city, interacting with its sustainable dimension. The link between the smart – sustainable – mobile triad was, therefore, confirmed at the level of the city authorities' ongoing (daily) communication, for which the official website is a tool.

In the second part of our task, we checked how different the websites of the surveyed 17 cities can be. Surprisingly, only a few used the smart city argument (Moscow, Tokyo, Naples, and Los Angeles). For some of them, any information referring to the "smart city" topic (Athens and Lyon – version in French) was accessible (see Table 3). In the case of Tokyo, Naples, and Los Angeles, the collected mobility messages (topic transport) are user- and process-focused. In the case of Moscow, on the other hand, many messages are personal branding of the city authorities, which inform about events in the context of their activities. Most of the cities surveyed have smart city strategies available in the form of pdfs, or information on smart city objectives and activities on subpages (e.g., https://www.thisisgothenburg.com/smart-city) or separate websites that are dedicated to this topic (https://smartcity.ndmc.gov.in). However, they are mostly not available on the city's homepage, which means that the argument of being a smart city is not used marketing-wise.

It may be the purpose of the official website to communicate with direct stakeholders (inhabitants, entrepreneurs, investors, and public services), for whom other topics are more important. Therefore, some of the studied cities create additional websites (usually in English) dedicated to, e.g., tourists, where a lot of information related to the characteristics of a smart and sustainable city is provided in the form of curiosities (e.g., https://en.visiterlyon.com/). The example of Lyon also points to the extension of the smart city concept to climate neutrality as part of the EC's "100 climate-neutral cities" program. The "smart city" label was a factor of distinction for Lyon in 2013–2014 (1st place in the rankings of French smart cities), but nowadays the term no longer appears on the city's official pages in French. In 2020, it becomes a standard, requiring the position

to be maintained and complemented by new lines of action. The chosen climate neutrality allows the city's transformation to be supported by European funding for this purpose (European Commission, 2021).

Discussion

Sustainability issues should go hand-in-hand with the smart city concept, especially in relation to smart mobility. The results of this study indicated that city communications contain limited information on transport in the context of sustainability and the use of ICT in the city. The work of Ahvenniemi et al. (Ahvenniemi et al., 2017) also provided an interesting indication that the issue of transport is associated with environmental and social issues, rather than economic ones (impact categories). It is noteworthy that, in both types of rankings, they are relatively poorly represented: for the smart city model, 7% of the total number of indicators was identified (36 out of 510), and for urban sustainability 11% (49 out of 448) related to transport. Our results also indicated a relatively small presence of the transport thread on the pages of cities selected from the smart city rankings, as evidenced by its appearance in a single number of topics for each of the keywords. These can be related to the mobility scenarios up to 2030, in which Miskolczi et al. (Miskolczi et al., 2021) identified automation, shared mobility, and electrification as the main themes to address road congestion, social attitudes, and GHG emissions.

The topics obtained in the study also included key terms relating to the main problems identified in the literature by Miskolczi et al. (Miskolczi et al., 2021): congestion, pressure, and accessibility. The generated word clouds do not refer directly to solutions to these problems but contain references to mobility management (topic No. 11), e.g., planning, decision, and development, which can be interpreted as evidence of a more extensive solution to mobility problems – through infrastructure development (design, study, and grant) and influencing the way it is used (transit, plan, corridor, use, accessibility, and location – topic No. 2) in specific locations (neighborhood and area). In the observation of the websites of the studied cities, one can notice the limited presence of the mentions of smartness in marketing communication. According to Trindade et al. (Trindade et al., 2017), the smart city concept should be seen as a vision, a manifesto, and a promise to represent a sustainable and ideal form of the 21st-century city. According to Starc-Pecena et al. (Starc-Peceny, Maček & Ovin, 2017), smart city marketing should not only be based on sustainability issues presented in specific messaging but should seek to co-design economic policies by the local community.

The limitations that occurred in our study can be grouped in relation to the data source and its characteristics, the object of analysis and its diversity, and the use of the research tool. The first challenge was the multilingualism of the data, in which natural language messages were formulated. The difficulty, in this case, is related to the translation of keywords, which determines the effectiveness of the search into the original language. A manifestation of this difficulty was, for example, the lack of texts retrieved from the Athens website. A feature of the sources used was the potential richness of the content accessed by the CLARIN tools. However, it turned out that keywords are also not consistently used by the authors of the messages on the source pages, indicating the need to adapt the method used in subsequent studies. Moreover, with a small number of messages or objects under study, specific events or situations can significantly affect the results obtained. This is because they become embedded in the information resources of the website, e.g., through a large number of messages on a given topic, which leads to the overrepresentation of a given concept in the word cloud generated by the multilingual topic. The tool itself provides the possibility to eliminate random words within the so-called "stop list"; however, its use means interference of the researcher in the collected source data and should be used with great caution.

The subject of analysis, where the city services' own communications are in a natural language, is generated by those responsible for external communication. Outside the scope of the study remained the messages of residents and other stakeholders available, for example, in social media. Insight into this area of information is planned for the next stages of the research project, as the tools available through the CLARIN infrastructure continue to develop. The survey we conducted also highlighted differences in the level of communication activity between cities. The information available on their official websites was obtained from different years, which determined the degree of validity of the data obtained and, consequently, the quality of the results obtained, and conclusions formulated.

Finally, the use of the research tools themselves – despite full support of the process by the CLARIN staff – requires multiple testing to minimize the risk of misinterpretation of the results. In order to

eliminate the noted limitations, it is advisable to involve researchers speaking the natural languages of the material under study in the research process (at the stage of designing the study and collecting data) and confirming their consistency. This pilot study has revealed points in the research design that needs to be corrected, and their improvement in the next phase of the research will allow the potential of the tools used in the current study to be exploited to a greater extent.

Conclusions

The concepts of the smart city and the sustainable city have many common features. In our view, a modern city should strive to meet the needs of its inhabitants by making use of modern technologies, but at the same time caring for sustainable development. Our conclusions concern three areas: the methods used, the link between transport and a sustainable and smart city, and the marketing use of smart city rankings. The applied topic modeling methods allow us to recognize the data available in the source languages and can, therefore, be considered promising for further research. This is also important because analysis of texts on websites that are not only in English but in the languages of different countries (e.g., Italian, Russian, Greek, etc.), is possible. The issue of transport, in the light of the collected data, does not seem to be sufficiently present either among the criteria of smart city or sustainable city rankings. The surveyed cities do not seem to be interested in marketing the use of the potential behind the position in the smart city rankings. In our opinion, the use of the smart city title should be widely promoted on websites, in order to build awareness of the city's assets among stakeholders. When the city authorities inform the public about projects related to improving the quality of life of its inhabitants, implementing innovative technologies, caring for the environment, etc., the inhabitants will become more involved in these activities, helping to implement them more quickly. This paper opens the field up to further research on the multifaceted approach to the role and importance of transport in the smart/sustainable city model.

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