

Ibănescu, Bogdan-Constantin; Pascariu, Gabriela Carmen; Bănică, Alexandru;
Bejenaru, Ioana

Article

Smart city: A critical assessment of the concept and its implementation in Romanian urban strategies

Journal of Urban Management

Provided in Cooperation with:

Chinese Association of Urban Management (CAUM), Taipei

Suggested Citation: Ibănescu, Bogdan-Constantin; Pascariu, Gabriela Carmen; Bănică, Alexandru; Bejenaru, Ioana (2022) : Smart city: A critical assessment of the concept and its implementation in Romanian urban strategies, Journal of Urban Management, ISSN 2226-5856, Elsevier, Amsterdam, Vol. 11, Iss. 2, pp. 246-255,
<https://doi.org/10.1016/j.jum.2022.05.003>

This Version is available at:

<https://hdl.handle.net/10419/271463>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by-nc-nd/4.0/>

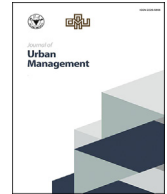
HOSTED BY



ELSEVIER

Contents lists available at ScienceDirect

Journal of Urban Management

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

Research Article

Smart city: A critical assessment of the concept and its implementation in Romanian urban strategies

Bogdan-Constantin Ibănescu^{a,*}, Gabriela Carmen Pascariu^{a,b}, Alexandru Bănică^{c,d}, Ioana Bejenaru^d^a Centre for European Studies, Faculty of Law, Alexandru Ioan Cuza University, Romania^b Faculty of Economics and Business Administration, Alexandru Ioan Cuza University, Romania^c Romanian Academy - Iași Branch, Romania^d Department of Geography, Faculty of Geography and Geology, University Alexandru Ioan Cuza, Iasi, Romania

ARTICLE INFO

Keywords:

Smart city
Romania
Smart mobility
Intelligent city
Urban development

ABSTRACT

The last decades pressured the cities all over the world to become smarter and to develop smart initiatives in order to keep up with the global trends. Nevertheless, the pace to reach this objective vary considerable from one country to another. For the urban areas from the post-communist block the race to smartness started late and run into a series of obstacles related to financing, understanding, and stakeholders' involvement. Our paper assesses the insertion, evolution, and implementation of smart city concept in such a territory (Romanian cities), while simultaneously addressing the issue of transparency of smart projects. The study found an increasing openness of authorities to integrate smart components within the city profile with a focus on smart mobility domain, mostly connected with smart apps and online platforms. However, little information is available regarding the smart projects, with discrepancies between the statistics and the available information, suggesting the need for clarifications and harmonized statistics in order to articulate more effective evidence-based policies.

1. Introduction

During the last two decades, “smart city” emerged as the leading concept in urban planning, both for the literature and the local policy makers (Albino et al., 2015; Borsekova & Nijkamp, 2018; Bănică et al., 2020; Ibănescu et al., 2020). Its expansion has crossed the boundaries of the digital sector, with which it was initially associated, being now part of almost every aspect of citizens' life (Batty et al., 2012; Batty, 2013; Komninos, 2002). However, despite its wide and intense development, the approach knows a very unequal spatial spread. The implementation, funding, and even the comprehension of smart city strategies are uneven across the planet (Komninos, 2008). For example, although the concepts related to smart cities have long been in the attention of the scientific community as early as the 1990s (Albino et al., 2015), smart city solutions were (and here and there still are) regarded as convoluted novelty in many cities of the post-communist block (Sikora-Fernandez, 2018). In Central and East European countries, it can be observed a lack of integrated and correlated smart initiatives, while cities are focused on immediate solutions to urban issues and not on long-term smart development strategies (Borsekova & Nijkamp, 2018). For many of these countries, the novelty of the term and the relative tardiness in implementation are responsible for the gap separating them for the Western Europe counterparts. Still, several CEE countries are trying to

* Corresponding author.

E-mail address: ibanescu.bogdan@uaic.ro (B.-C. Ibănescu).<https://doi.org/10.1016/j.jum.2022.05.003>

Received 1 January 2022; Received in revised form 5 May 2022; Accepted 6 May 2022

Available online 18 May 2022

2226-5856/© 2022 The Authors. Published by Elsevier B.V. on behalf of Zhejiang University and Chinese Association of Urban Management. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

reduce the gap through a very intensive set of actions supported partially by the local and national authorities and partially by the European programmes. Romania represents such an example where smart projects, although still recent, knew an exponential growth during the last eight years leading to a complete redesign of urban strategies. Its unfolding represents a typical case for the CEE region, while also displaying compelling particularities of interest for countries at the beginning of their smart city development.

The concept of smart city could be rated as relatively new in Romania, fact that would explain its late insertion both in the literature and the urban strategies. Nevertheless, its late start was followed by a rapid catch-up process. Beyond a few one-off initiatives starting in 2010 (mostly as a response to the effect of the financial crisis), the first integrated smart city projects started in 2014–2015 and reached a maximum in 2021, the most prolific in terms of smart initiatives implemented. The vast majority of initiatives was focused on the capital city and the major regional cities, although, despite the tardiness of implementing national and local strategies, the smart initiatives managed to emerge in rural areas as well (Ciugud – Alba County and Luncăvița – Tulcea county became the first smart communes), and even to be developed county-wide (Cluj county was named the first smart territory, with Ilfov county intending to follow).

Despite the positive dynamics, a couple of issues are often signaled by the academia or media. Articles in the local press mention that only a few of these projects are functional and with a real impact on the local economy while the majority are yet to provide a societal and technological impact. Moreover, the lack of an integrated and unitary database makes extremely difficult the inventory, synchronization and long-term evaluation of the abovementioned initiatives. There is no reporting system or obligation to provide statistics on the results and sustainability of smart projects other than those associated with the funding programs supporting them.

In light of the mentioned context, our paper aims to provide radiography of the current state of the implementation of the smart city concept in Romania from both theoretical and empirical points of view. First, it assesses the emergence of smart cities in literature and institutional environment, highlighting the main topics and moments that marked the evolution of this context in Romania. Second, the paper evaluates the implementation of smart initiatives that emerged in the largest Romanian cities and succeeded in putting a defining stamp on the recent evolution of the selected regional development poles. Finally, the paper discusses the current policy implications, the overall societal implications and the development perspectives of Romanian smart cities.

2. The emergence of smart city concept in Romanian literature

In Romania, the smart city concept has emerged rather timidly, the first initiatives being launched by the business environment, while the scientific community followed rapidly with theoretical contributions adapted for the uniqueness of the territory. A particularity of the Romanian case is that the roots of smart city approach is found in papers analyzing the digitalization process (digital democracy, digital services) within the e-governance framework (Stoica & Ilas, 2009). Since 2009 numerous papers published on e-governance and e-government can be considered as the first attempts for introducing and operationalizing digital tools as promoters of smart approaches in the Romanian cities¹ (Vrabie, 2018a, 2021, pp. 377–384). In 2016 appeared the first comprehensive review of the concept in relation to the Romanian context - “Elements of E-Government” (Vrabie, 2016) marking a key point in the development of smart literature. On a similar note, a series of papers gathered under the umbrella of “intelligent city” concept promoted the first approaches related to the use of ITS Technologies as smart solutions in transportation, introducing and discussing the concept of “smart city” for the Romanian context (Batagan, 2012; Florea & Costea, 2014; Manolea et al., 2009; Stinga et al., 2010).

In fact, the concepts “intelligent city” and “smart city” were used alternatively or simultaneously in different papers regarding the Romanian urban context. This is shown by the statistics of Web of Science Core Collection (Clarivate Analytics) that illustrate the transition of digital/technological related approaches of urban management from “intelligent” to “smart” cities “dominance” (Fig. 1). One can notice, nevertheless, two visible facts: a) more the 75% of the papers were published solely during the last 7 years, a clear sign of the novelty of the concept for the Romanian literature; b) while the concept “intelligent city” was the first to emerge in the Romanian literature, it was quickly overcome by the “smart city” concept.

Starting with 2013, several studies tackling the “smart city” topic are published, although the first attempts were lacking deeper analyses and used rather vague definitions of the term. These papers focused almost exclusively on smart development in relation to cities in a broader context of sustainable and inclusive development (Lengyel et al., 2015; Suciu et al., 2013), in relation to human resources (Schebesch et al., 2014), or discussed the development of smart urban communities in a regional context of innovative clusters dispersion (Suciu & Florea, 2014). During the same period, the first purely theoretical papers appear, highlighting the importance of including Open Government Data in a coherent form in smart city applications (Vert, 2015) or discussing the potential of smart cities approaches in increasing quality of life (Banica et al., 2020).

After 2016, the first papers dealing with the results of smart projects developed in Romanian cities are published, most of them analyzing their impact (Kadar, 2016), the smart learning domain (Dascalu et al., 2017), and the transfer of smart practices in the periurban area (Profiroi & Radulescu, 2019; Tirziu, 2017). More technical approaches materialized as well, highlighting the opportunities related to the role of 5G mobile network's operator in developing smart projects (Oproiu et al., 2017) or systemic approaches evaluating energy infrastructure and the role of renewable energies in smart initiatives (D'Ascenzo et al., 2019; Petrica & Birova, 2018; Savastano, Suciu, Gorelova, & Stativa, 2020; Tantau & Santa, 2021; Teremranova and Mutule, 2019). It is worth mentioning, however,

¹ The most noticeable initiatives taken in the late 2000s and the beginning of 2010s are: *Competence Management and the Adoption of E-Governance*, 2009; *E-Government Challenges. Barriers and Benefit*, 2009; *Barriers in implementing E-Government*, 2009; *Citizens Goals Online*, 2010; *Citizens, Digital Governance (in Romanian Municipalities) and its relation with the IT education*, 2010; *Developing citizens' safety - A joint venture between Police and citizens using software applications*, 2011; *Romanian E-government Overview*, 2012; *The Influence of Context on Participatory E-Government Applications: A Comparison of E-government Adoption in Romania and South Korea*, 2012; *E-Government challenges in Romania*, 2013.

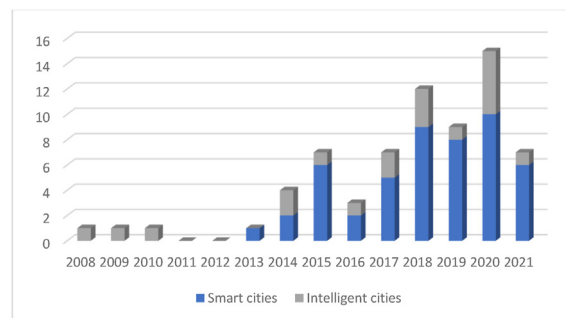


Fig. 1. Number of yearly papers written by authors with Romanian affiliation indexed in Web of Science Core Collection (Clarivate Analytics) (own representation).

that most of these studies are not focused exclusively on Romanian territory, but represent rather comparative approaches of smart cities in EU or South-Eastern Europe. A similar example is the study of [Di Leo and Salvia \(2017\)](#) which undertook a straightforward analysis of the role that local strategies play in sustaining ambitious initiatives related to smart and sustainable development of cities from South Eastern Europe (including Romania).

During the last four years, the fields records a visible shift towards theoretical assessments, with redefinitions of smart city concepts adapted for the Romanian context ([Vrabie, 2018a, 2018b](#), pp. 377–384) and a greater attention given to the differences between financing individual smart projects and implementing a smart vision that could enhance sustainable urban change ([Bănică et al., 2020](#); [Romanelli & Ionescu, 2020](#)). Of equally importance is considered the international conceptual and empirical context and how the Romanian cities are fitting within this framework, especially when taking into consideration the use of big data and internet of things ([Rotunda et al., 2017](#)). In fact, Internet of things (IoT) is acknowledged in some papers as a core element of smart city concept, bringing a real improvement in the relation between citizens and authorities ([Vrabie, 2018b](#)).

Another characteristic of the research undertaken during the last decade is the apparition of focus on specific domains of smart city, a clear sign of the diversification of the field. There are numerous recent approaches concentrating exclusively on the impact of smart initiatives for:

- *Smart economy*: [Grab and Ilie \(2019\)](#) analyzed the impact of business management digitalization in the context of smart cities solutions which requires structured approaches towards innovation management options, while [Lazarescu et al. \(2020\)](#) highlighted the role of universities in preparing human capital for smart economy. Other approaches linked the concept of smart city to creative industries ([Mazilu et al., 2020](#)), cultural tourism ([Briciu et al., 2020](#)), or historical events ([Nicula et al., 2020](#)).
- *Smart people* is one of the main domains of smart city concept closely related to identity, social innovation in the context of the dichotomy “technology and/or the human factor” ([Hosu & Hosu, 2019](#)). This is approached in a straightforward way by [McElroy \(2020\)](#) when analysing the effects of “siliconizing” Cluj-Napoca city upon Roma population that become “digital nomads”, as digitalization can be seen as a mark of technoimperialism. [Ivan et al. \(2020\)](#) addressed another criticism related to Romanian smart cities – the fact that they often fail to address the need or even exclude certain demographic categories, e.g. the elder population.
- *Smart mobility* is one of the most important domains studied in Romanian smart cities approaches. This domain is one of the first to be fully scrutinized by the literature ([Florea & Costea, 2014](#); [Manolea et al., 2009](#); [Stinga et al., 2010](#)) and resulted in collaborative end-user clients for communication and computation within urban transport systems ([Neagu, 2018](#)).
- *Smart governance* – the domain displayed a high initial interest ([Vrabie, 2016, 2018a](#), pp. 377–384), which was double during the last years by in-depth analyses ([Banica et al., 2020](#); [Ibănescu et al., 2020](#)). A constant result of these studies is presenting the difficulties to empower smart city partnerships as a prerequisite in effectively managing smart infrastructure and technology.
- *Smart environment* - comprehensive approaches addressed the issue of urban bioregions and territorial identities through the lens of smart cities perspective, focusing on improvement and innovation of municipal waste management in the context of smart cities ([Aceleanu et al., 2019](#); [Muntean et al., 2021](#)), or assessing the utility of Machine Learning to mitigate air pollution ([Popa et al., 2021](#)).
- *Smart living* is addressed through a series of papers focusing on smart home technologies ([Maer et al., 2021](#)), renewable energy systems creating Nearly-Zero energy buildings ([Manco et al., 2021](#)), the digital synchronization of Romanian communities with EU initiatives ([Tavella et al., 2021](#)), or the reduction of plastic waste in households ([Cerasi et al., 2021](#)).

To date, probably the most comprehensive approach of smart cities in Romania belongs to [Vrabie and Dumitrascu](#) (“Smart cities. From idea to implementation”) published in 2018 which not only introduces an exhaustive definition of the concept but also analyses it in a clear and attractive manner (topics like smart citizens, infrastructure, technology and data; innovation and entrepreneurship; strategies and smart leadership are fully addressed) ([Vrabie & Dumitrascu, 2018](#)).

As it can be observed from the list of papers researching the smart city concept implementation in Romanian cities, the field is still in its developing stages. While a massive interest has been displayed during the last years, several limitations and drawbacks of smart cities approaches are still visible. [Baltac \(2019\)](#), for example, argues that most Romanian cities took smart solutions as a fashionable topic

without integrating it within the overall (predominantly non-technological) functionalities, therefore creating deep digital divides within cities and among citizens.

3. The implementation of smart city initiatives in urban development strategies

If the literature emerged rather late and timidly in Romania, the transposition of smart ideas in local urban strategies was even slower and meet several difficulties. By the mid-2021, according to the most analytical periodic report published on the development of smart initiatives, 860 smart initiatives were completed or in implementation in Romania, approximately 45% more projects than in 2020 (Vegacomp Consulting, 2021).

An important role in increasing the interest of Romanian communities in initiating projects associated with the concept of smart cities was played by the Structural and Investment Funds, within the European Cohesion Policy (the main source of financing smart projects in Romania, followed by private company funds, according to the same report), especially in relation to smart specialization strategies. At European level, specific support initiatives and tools such as ERA-NET Cofund Smart Cities and Communities (ENSCC), under the Horizon 2020 program or Smart Cities Marketplace (integrating the two platforms: Marketplace of the European Innovation Partnership on Smart Cities and Communities (EIP-SCC Marketplace) and the “Smart Cities Information System (SCIS)” have stimulated the integration of the smart concept in urban planning policies. Last but not least, the pressure exerted by technological development and digitalization on the business environment, the governance system, and also the transformation of behavioral models has been translated into an administrative need for adopting smart strategies and solutions.

There were also reported joint strategies for developing transport infrastructure and increase ecological mobility through public transportation as it was the case for Cluj-Napoca – Timisoara – Oradea – Arad i.e. the Western Alliance. Nevertheless, most these strategies were considered, to a great extent, intentions or on-going projects rather than actual strategic documents available for the general public. In 2015, following its first smart city pilot project, Bucharest was included in the list of 100 world smart cities (while acclaimed at the time, the capital city started its smart developed with a slight delay compared with *Timisoara Smart City*, , Sibiu – 2013, or Cluj-Napoca - 2018). Three years later, in 2018, Bucharest started its smart strategy focusing on traffic management, transport infrastructure, e-governance, telecommunications, smart buildings, green energy, public safety and intelligent tourism. Starting 2016 the national initiatives emerged (Fig. 2): Smart City Guide published in 2016 by Romania's Ministry for ICT, *Smart City Magazine* (2016), the *Annual Smart City Urban Projects fair* (2017), and Smart City Caravan (2017). The training of Smart Cities experts became a strategic focus in 2017, when Smart City Academy,² a National platform for local institutions and companies, was launched. Since 2016, the programmatic document Romanian Smart City Projects integrates all smart initiatives from the Romanian territory.

Moreover, in 2018 the National Strategy for Smart Cities was adopted by the Ministry of Regional Development and Public Administration which transformed smart cities initiative in a priority development direction for the upcoming years. More recently, Smart Cities of Romania Cluster (SCoR) was launched (2019), followed, in the same year, by Intelligent City 2030, promoting smart cities through educational activities targeting high school students. In 2020, the Center of Digital Inclusion was launched in order to diffuse digital knowledge within various social categories. At the end of 2021, the first smart city standard was adopted: ASRO SR ISO 37120 – Sustainable cities and territorial communities.

Regarding the local level, for a long time, smart solutions were approached individually, in narrow projects that aimed to improve certain aspects of urban life mainly through digitalization. Integration of these propositions in coherent plans and strategies followed

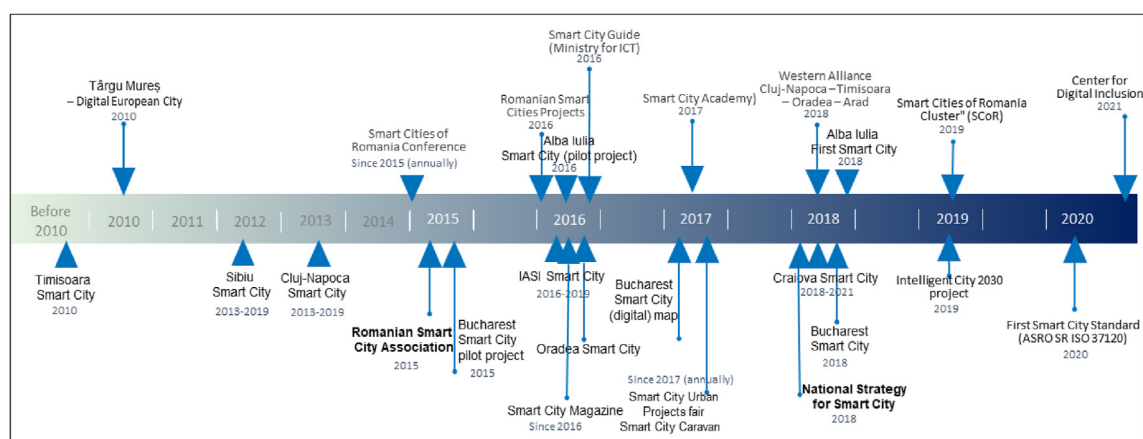


Fig. 2. Main milestones in the evolution of Romanian smart cities (own representation; different sources).

² <https://academiasmartcity.ro/>.

afterwards. Some sectorial approaches including smart solutions in city planning were accomplished in Timisoara (2007–2013) or Brasov (starting 2008). Nevertheless, the first attempt to create and implement a coherent Smart City strategy came in 2010 in Târgu Mureş, transposed in the project “Târgu Mureş – Digital European City”, a strategy proposing, among others, a unique VISA card that could be used for all urban services. In 2010 Alba Iulia City begun a branding initiative focused initially on cultural tourism, but extended afterwards to smart solutions in other urban areas. This initiative made Alba Iulia the first smart Romanian city declared as such by a coherent strategy (Alba Iulia Smart City, 2018; approved in 2016 as a pilot project) with 106 smart projects implemented until 2021. It was followed later by the Smart city strategy of Sibiu (2012–2015), Cluj-Napoca (2013–2019), Iasi (2016–2019), Oradea (2016–2020), Craiova (2018–2021).

Some major features are noticeable in the structure and dynamics of the smart city initiatives in Romania. There is a high degree of concentration of smart initiatives in the county capital cities and major regional cities with a relatively high level of GDP/inhabitant. This could be a result of the development of the IT sector - over 250 initiatives (>30%) are concentrated in the top 5 leading cities of the IT industry in Romania (Bucharest, Cluj, Timisoara, Iasi and Brasov). The top 8 Romanian cities in terms of population (included in the paper), each concentrating over 250 thousand inhabitants, concentrate the vast majority of most impactful smart initiatives (Fig. 3).

From a thematic point of view, on the first position at national level are the smart mobility initiatives, followed by smart governance and smart living initiatives, somehow reflecting the specific priorities for the development of cities in Romania. These are also the topics that experienced the most significant growth in 2021 compared to 2020 (Vegacomp Consulting, 2021). The smart environment and smart people projects are the least represented in the areas of interest of the Romanian cities, in opposition to the European trend that prioritizes the green and inclusive fields.

4. Data and results

In order to provide a clearer image of the smart city initiative in Romanian cities, we selected and investigated all smart city initiatives from cities with over 250.000 inhabitants (Fig. 3). This threshold was selected in order to single out the main urban areas which are functioning as regional development poles and as innovation diffusion vectors. We consider that the selected cities display the ideal condition for fully benefiting from smart projects, while simultaneously acting as a catalyzer for metropolitan development. Moreover, the 8 selected cities detain 75% of technological hubs presented on Romanian territory.

Data was collected from the official websites of local authorities, metropolitan associations, ICT stakeholders and smart city specialized platforms. We collected information regarding the funding, value, initiator (public, private or public-private partnership), domain and type for each smart project with available data from all the selected cities. Our database included only the smart initiatives that presented detailed information regarding their calendar of implementation (the initiative must be either approved, either already implemented, therefore the smart initiatives still in the planning process were excluded), the funding agency (public, private, public-private partnership) and their intended impact.

As the statistics presented in the national reports display rather large and unusual numbers of smart city projects, we proceeded with an investigation of all smart initiatives from the major Romanian cities. This approach was deemed necessary in order to identify the gaps between the official statistics and the impact of the smart initiatives. This selection allowed us to identify and single out the projects implemented in the field from the declarative ones (projects declared as smart in the official reports). The 94 smart initiatives identified cover all smart domains, such as mobility (e.g. ticket acquisition system, transportation apps), governance (e.g. official multifunctioning platforms, online services for citizens), environment (e.g. environmental monitoring system, green spots), living (e.g. intelligent streets, notification systems, wi-fi spots), economy (e.g. payment services, local businesses boutiques), people (e.g. education apps, citizen portals).

The first striking result is the discrepancy between the number of declared initiatives and the number of initiatives that present detailed information (Fig. 4, left). This could be explained either by a tendency of the local authorities to overestimate (or overdeclare) the number of smart initiatives, either by a lack of detailed information and transparency regarding smart initiatives. In this context, Craiova represents a rather eccentric case, the city declaring less initiatives than actually existing on the field. While the other major

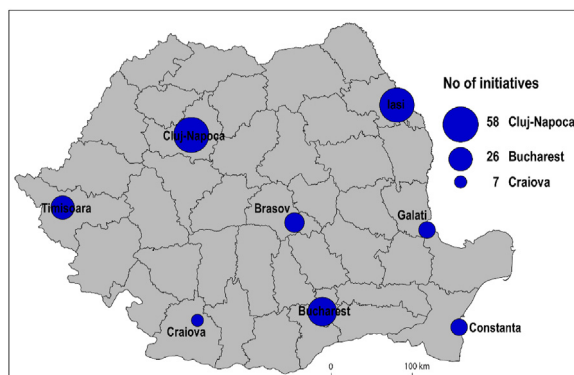


Fig. 3. The number of declared smart projects in the largest Romanian cities, according to Vegacomp Consulting Report, 2021

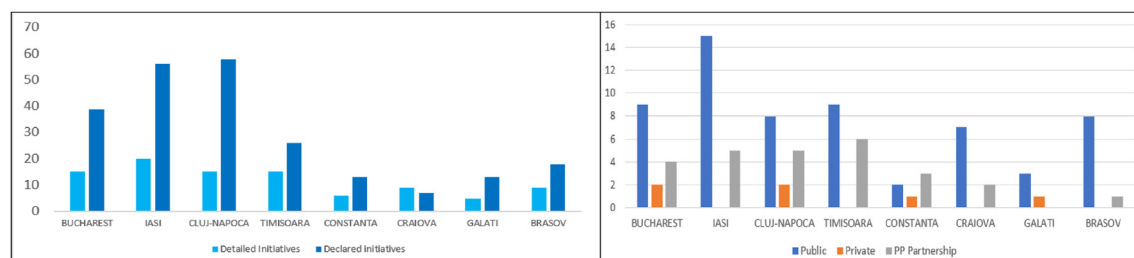


Fig. 4. The number of detailed and declared smart initiatives for the major Romanian cities (left), and their financing source (right).

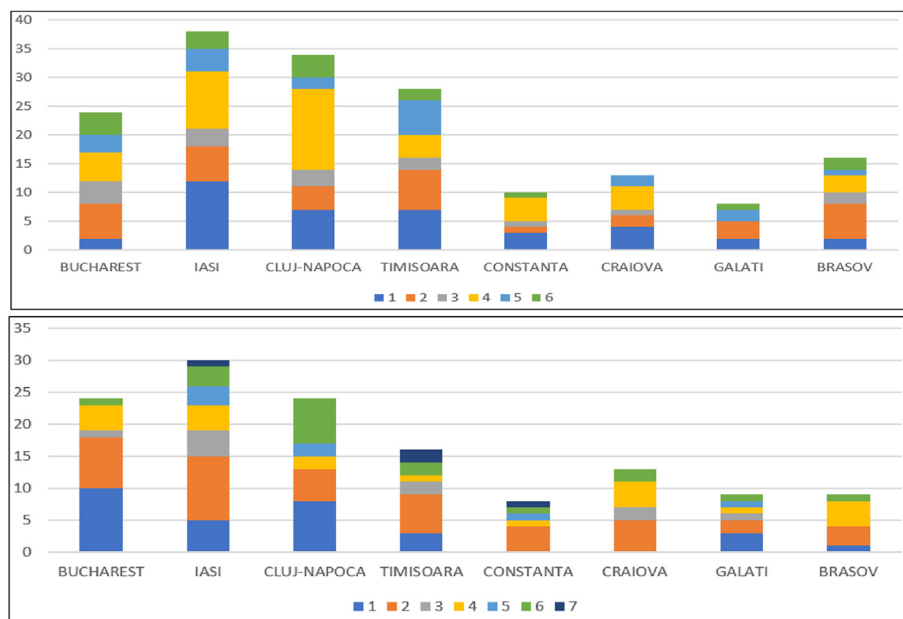


Fig. 5. The distribution of smart projects by domain – up (1 - Smart Mobility, 2 - Smart Governance, 3 - Smart Environment, 4 - Smart Living, 5 - Smart Economy, 6 - Smart People) and by type – down (1 - Smart App, 2 - Transportation, 3 - Stakeholder/screening platform, 4 - Online reservations/payment, 5 - City discovery/Digital Itinerary, 6 - Wifi/connectivity, 7 - Social networks).

* A smart project can be included in more than one category/type.

cities have larger number of declared smart initiatives in the official reports than identified in the database, Craiova declared less initiatives in the official reports than available on-line. This may suggest a deficient connection between the local administrative system and the smart initiatives (see Fig. 5).

The number of detailed projects found during this investigation shows that the actual degree of implementation of smart initiatives is lower and more uniform than in the official reports. Overall, the relation tends to be dependent to the demographical weight of the city, the largest urban areas having the most initiatives as well, although, as previously found in the literature, due to the lack of a unitary national strategy, it is highly possible that the degree of understanding (and therefore reporting) of smart projects to be extremely different from one city to another (Banica et al., 2020).

Except for the capital, in terms of major cities, the most advanced smart city are Cluj-Napoca, the first city in Romania to advance the idea of becoming a smart city, and Iasi. In 2021, in the Emerging Europe competition, Cluj-Napoca was awarded the 1st place in the Smart City category, ahead of cities such as Tallinn (Estonia) or Vilnius (Lithuania). The priority theme is smart mobility, but important projects are being developed in the last three years in the fields of smart environment, green energy, and smart people. Iasi, a city located on the eastern part of the country, is the first city in Romania to win the Digital Cities Challenge competition (organized by the European Commission) and is the first Romanian city to design a Digital Transformation Strategy (2019). In 2020, Iasi was selected in the Intelligent Cities Challenge competition, a project through which it receives support to adopt a strategy of intelligent, green, and socially responsible transformation.

Regarding the financing of smart initiatives, the preponderance of the public initiatives is observed (Fig. 4, right). This can be explained by the existence of a European strategy for smart projects materialized through numerous funds for local administration, especially for digitization and the green transition. The solely private smart initiatives are rather rare, but the presence of public-private partnerships in the major cities (Bucharest, Iasi, Cluj-Napoca, Timisoara) is encouraging. There is a steady increase in projects carried

out in public-private partnerships, although the legislative and institutional context in Romania (quality of government, level of corruption, weak informal institutions) are not very favorable yet to this type of initiatives.

Regarding the areas of smart projects implemented in the major Romanian cities, three major trends are visible. First, a certain dominance of smart mobility, smart governance, and smart living as the key domains of action is visible. As a whole, the cities in Romania have developed rapidly, without benefiting from spatial planning integrated strategies that include the mobility component, the infrastructure is outdated and unable to cope with the growing demand for transport and to adapt to the spatial reorganization of cities; furthermore, the existing transport models are non-durable (Florea & Comsulea, 2015, pp. 2959–2965). The priority given to smart mobility therefore stems from the specific needs of urban development and transformation. Second, the type of smart projects shows a vast majority of initiatives materialized through smart applications, online reservation or online payment platforms, and transportation-related. If the transportation-based initiatives have the same explaining circumstances as the smart mobility domain, the density of smart apps and online platforms is a supplementary proof for the important role that ICT sector played in smart city development in Romanian cities. Third, a modest presence of initiatives citizen-orientated could be observed to the detriment of projects focused on the technological aspect. This is highlighted through the low presence of the smart initiatives which could be categorized as being part of smart people domain, or social networks type.

Overall, the distribution of smart city projects within the major Romanian cities, while displaying variances in absolute terms between urban areas, shows similarities residing in the common heritage. The main four cities (Bucharest, Iasi, Cluj-Napoca, and Timisoara) managed to take a considerable advantage in terms of smart initiatives due to their superior demographic weight and the highest share of the CIT sectors.

Certain similarities can be highlighted when analyzing Romanian smart cities' profiles. Romanian case is emblematic of the former communist countries, so conclusions can be extrapolated to other smart cities from Central and Eastern Europe. They all had a late and timid emergence and still lack comprehensive systemic approaches and a longer-term perspective (Borsekova & Nijkamp, 2018; Sicora-Fernandez, 2018). There is a high degree of concentration of smart initiatives in the county capital cities, with a relatively high level of GDP/inhabitant, with a large population, growth poles attractive for business and population. There is also a strong correlation with the development of the IT sector. The concentration pattern tends to be replicated at a national scale as well, with most smart initiatives being found in the southern, western and central regions, a decoupling of eastern smart cities markets being noticeable. Similar findings are reported in the recent literature focused on smart cities from Central and Eastern Europe (Bănică et al., 2020; Kadar, 2016; Ninčević Pašalić et al., 2021; Sandu et al., 2021; Serbanica & Constantin, 2017; Sikora-Fernandez, 2018).

5. Conclusions and policy recommendations

The smart city implementation proved to be still in incipient phases in Romanian major cities. While it covers a large variety of forms from usual adaptations, like apps, to integrated projects covering urban infrastructure and large-scale strategies, the smart urban policies still lack unitary statistics, national-wide funding and a harmonized approach. There is still little information available about the adopted initiatives, whereas the reports themselves are not fully available for public. Nevertheless, several solutions, both at European and national level, could significantly improve the smart city development in Eastern European urban areas.

At the European level, in addition to the key role of ESIF in stimulating smart urban development, a priority integrated into the financial program 2021–2022 in connection to the objectives of sustainable and inclusive urban development, an important role in the immediate perspective for smart cities, will be played by the funding of the Recovery and Resilience Facility the key tool of the NextGenerationEU plan. The plan includes ambitious goals in the digital field regarding urban mobility, energy efficiency, environmental protection, education and health, the governance system, thus being expected an increase of smart cities initiatives in all 6 thematic domains. From this point of view, even if the 6 current themes - environment, mobility, governance, people, living, and economy - cover all types of smart projects, we consider that the future individualization of projects associated with the concept of “green energy transition”, possibly with specific financial lines from European or national public funding, could be stimulating for the initiation of projects that contribute significantly to the sustainable transformation of the European urban areas in terms of energy (Clerici Maestosi, 2022).

The emergence and diversification of financing sources for smart cities (also beyond EU funding) could increase even more the creativity and productivity of smart cities initiatives. In Romania, smart initiatives were promoted mainly after 2015 by the business environment and then embraced by some local authorities as an attractive concept showing their openness towards novelty and innovation. Nevertheless, one can argue that smart cities were not translated yet, in most Romanian cities, to a critical mass of urban stakeholders to become a generally understood and accepted concept.

In the future, it is expected that the smart sustainable projects would increase in Romanian cities, in the context generated by the implementation of the Green Deal Strategy and by the 2030 Agenda for Sustainable Development, including Sustainable Development Goal 11 (“Make cities inclusive, safe, resilient and sustainable”). Similarly, the Romanian National Smart City Strategy adoption should pave the way towards a clearer and more comprehensive integration of smart city initiatives within the general development strategies of cities.

The high connection between the smart city projects and the IT sector leads to the conclusion that in the case of financing through the structural and investment funds (ESIF), the allocated funding for the ICT sector should increase, an aspect which represented a main priority for Romania during the multiannual program 2014–2020.

Given the multiplier effects of smart projects and urban hubs on development, especially from the perspective of sustainable development and the objectives of digital and green transformation included in the European strategies, a development priority should be made in avoiding the core-periphery imbalances at local or regional level. Such a spatial imbalance risks amplifying intra- and inter-

regional disparities, with an emphasis on the core-periphery model on a European scale. The clear divide between the north-western part of the country where most smart initiatives are concentrated and the extra-Carpathian areas where the emergence of smart cities was less pronounced could be a consequence of general lagging in development and lower governance performance (Banica et al., 2020; Surd et al., 2011). Nevertheless, in the last years, this imbalance was reduced to a certain point. Consequently, in allocating projects financed from European funds taking into account a spatial correction coefficient (for example, increasing the financial allocation for projects in regions less reflected in smart cities maps or allocating additional points in the evaluation process of proposals from these regions) would ensure a better correlation of smart city initiatives with the EU's institutional objective of economic, social and territorial cohesion (EU, 2007), as well as the Smart Specialization Strategy for Sustainability – S4 (European Commission, 2021). An efficient tool in supporting the urban communities could be the implementation of the international standard ISO 37120:2018 “Sustainable cities and communities — Indicators for city services and quality of life”, with the updated version ISO 37106:2021 “Sustainable cities and communities — Guidance on establishing smart city operating models for sustainable communities. In this sense, the wide promotion of the standard, the training of experts and the wide public debate of the standard and its opportunities in association with smart cities strategies should be a priority of the associations in the field.

The most important components of smart cities remain focused on urban mobility and smart governance. The first shows the urgency of adopting effective measures to solve the traffic and transport infrastructure issues in the cities, while the second is related to the original focus of introducing digitalization of cities: making more efficient the decisional and administrative local systems by e-governance. On the contrary, the least represented component of smart cities is “smart people” which shows that there are still drawbacks related to communicating and making technology-driven innovation accessible to everyone. There are for example issues regarding the ageing population, the population lacking tertiary education or having lower income when it comes to accepting and using digital innovations. Meanwhile, the environmental component of smart cities will probably become increasingly important as it is a primary concern of EU policies (as stated above when discussing current policies). The COVID-19 context was, on the one hand, a barrier in accomplishing certain goals by slowing down some initiatives, but, on the other hand, it functioned as a catalyzer for other initiatives and multiplied not just the actual smart solutions but also complementary instruments to implements smart city concept e.g educational projects such as “Intelligent city 2030” and social services (Center of Digital Inclusion) (Giurgea, 2020; Ignat & Constantin, 2020).

Meanwhile, the integration of smart initiatives within the broader sustainable development, green and resilience objectives is not very clear at the moment, nor there is a clear methodology to evaluate the implementation of strategies. Last but not least, smart urban development must be based on 3 pillars: technological development, public-private partnership and social partnership (with citizens). From this perspective, smart development strategies will need to horizontally integrate the 3 dimensions, in a stimulating and coherent legislative and public policy context.

There is a need for integrating “smartness” in all city areas, but this should be done in an adapted form by taking into account the specificities of each city, addressing all categories of potential users (without leaving any social categories behind) and without over-complicating urban functionalities. Integrating urban and rural areas smart strategies or even including in comprehensive strategies larger territories (counties or even regions) could increase even more the effectiveness and the development potential of smart initiatives as components of intelligent policies and planning.

Last but not least, the institutionalization of associations in the field, the formation of clusters and networks at national, regional or local level could create a favorable dynamics of the smart city markets, generating a stimulating context for cooperation and connectivity in the construction of integrated smart, large-scale, projects with a high potential to support a smart, green and inclusive transformation of Romania, correlated with the major trends and strategic context defined at European level.

Declaration of competing interest

The authors declare no conflict of interest.

References

- Aceleanu, M., Serban, A., Suci, M., & Bitoiu, T. (2019). The management of municipal waste through circular economy in the context of smart cities development. *IEEE Access*, 7, 133602–133614. <https://doi.org/10.1109/ACCESS.2019.2928999>
- Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart cities: Definitions, dimensions, performance and initiatives. *Journal of Urban Technology*, 22(1), 3–21.
- Annual Smart City Urban Projects fair. <https://scup2018.romaniansmartcity.ro/>.
- Baltac, V. (2019). Smart cities - a view of societal aspects. *Smart Cities*, 2(4), 538–548. <https://doi.org/10.3390/smartcities2040033>
- Bănică, A., Eva, M., Corodescu-Roșca, E. M. A., Ibănescu, B. C., Opria, A. M., & Pascariu, G. C. (2020). Towards smart (er) resilient cities. Evidences from Romanian urban areas. *Geografie*, 125(4), 397–422.
- Batagan, L. (2012). The use of intelligent solutions in Romanian cities. *Informatica Economica*, 16(4), 37.
- Batty, M. (2013). Big data, smart cities and city planning. *Dialogues in human geography*, 3(3), 274–279.
- Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G., & Portugali, Y. (2012). Smart cities of the future. *The European Physical Journal - Special Topics*, 214(1), 481–518.
- Borsekova, K., & Nijkamp, P. (2018). Smart cities: A challenge to research and policy analysis. *Cities*, 78, 1–3.
- Briciu, A., Briciu, V., & Kavoura, A. (2020). Evaluating how “smart” Brasov, Romania can be virtually via a mobile application for cultural tourism. *Sustainability*, 12(13). <https://doi.org/10.3390/su12135324>
- Cerasi, I., Sanchez, F., Gallardo, I., Gorri, M., Torrijos, P., Aliaga, C., & Franco, J. (2021). Household plastic waste habits and attitudes: A pilot study in the city of Valencia. *Waste Management & Research*, 39(5), 679–689. <https://doi.org/10.1177/0734242X21996415>
- Clerici Maestosi, P. (2022). Smart cities and positive energy districts: Urban perspectives in 2021. *Energies*, 15, 2168. <https://doi.org/10.3390/en15062168>
- Dasca, M., Bodea, C., Mogos, R., Stanica, I., Velikic, G., & Huemann, M. (2017). In L. Chova, A. Martinez, & I. Torres (Eds.), *Start -Sopi Project- feasibility study on implementing a Pan-European social platform to support lifelong learning and employability* (pp. 5070–5078).
- D'Ascenzo, F., Tantau, A., Savastano, M., & Santa, A. (2019). New energy policies for smart cities a Comparison among. *Smart Cities in the European Union*, 13(1), 1140–1149. <https://doi.org/10.2478/picbe-2019-0100>

- Di Leo, S., & Salvia, M. (2017). Local strategies and action plans towards resource efficiency in South East Europe. *Renewable and Sustainable Energy Reviews*, 68, 286–305. <https://doi.org/10.1016/j.rser.2016.09.115>
- European Commission. (2021). *A boost to green and digital recovery with regional Smart Specialization Strategy*. <https://s3platform.jrc.ec.europa.eu/w/a-boost-to-green-and-digital-recovery-with-regional-smart-specialisation>.
- European Union, & EUR-Lex. (2007). *Lisbon treaty*. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:12007L/TXT&from=EN>.
- Florea, C. A., & Comsulea, I. (2015). *Dispersion of clusters in Romania: Causes and solution*. Proceedings of the 26th International Business Information Management Association (IBIMA), ISBN 978-0-9860419-5-2.
- Florea, A., & Costea, I. (2014). Analysis of improvements the urban transport conditions by using Electronic Intelligent transports systems—case study: Urban transportation. In *Proceedings of the 2014 6th international conference on electronics, computers and artificial intelligence (ECAI)*.
- Giurgea, M. (2020). In M. Tofan, I. Bilan, & E. Cigu (Eds.), *The equipment of Romanian pre-university education units, support of teaching activities in the context of the covid-29 pandemic* (pp. 159–176).
- Grab, B., & Ilie, C. (2019). In M. Ibrahimov, A. Aleksic, & D. Dukic (Eds.), *Innovation management in the context of smart cities digital transformation* (pp. 165–174).
- Hosu, R., & Hosu, I. (2019). Smart "in between people and the city. *Transylvanian Review Of Administrative Sciences*, 5–20. <https://doi.org/10.24193/tras.SI2019.1>
- Ibănescu, B. C., Bănică, A., Eva, M., & Cehan, A. (2020). The puzzling concept of smart city in central and Eastern Europe: A literature review designed for policy development. *Transylvanian Review of Administrative Sciences*, 16(61), 70–87.
- Ignat, R., & Constantin, M. (2020). Multidimensional facets of entrepreneurial resilience during the COVID-19 crisis through the lens of the wealthiest Romanian counties. *Sustainability*, 12(23). <https://doi.org/10.3390/su122310220>
- Ivan, L., Beu, D., & van Hoof, J. (2020). Smart and age-friendly cities in Romania: An Overview of public policy and practice. *International Journal of Environmental Research and Public Health*, 17(14). <https://doi.org/10.3390/ijerph17145202>
- Kadar, M. (2016). In R. Yager, V. Sgurev, M. Hadjiski, & V. Jotsov (Eds.), *Smart learning environment for the development of smart city applications. IEEE 8th international conference on intelligent systems (IS)* (pp. 59–64). <https://doi.org/10.1109/IS.2016.7737500>
- Komninos, N. (2002). *Intelligent cities: Innovation, knowledge systems and digital spaces* (1st ed.). Routledge. <https://doi.org/10.4324/9780203857748>
- Komninos, N. (2008). *Intelligent cities and globalisation of innovation networks* (1st ed.). Routledge. <https://doi.org/10.4324/9780203894491>
- Lazarescu, E., Iftime, S., Filipescu, H., Frigura-Iliasa, F., Iorga, M., & Petrenci, R. (2020). In L. Chova, A. Martinez, & I. Torres (Eds.), *The mission of universities in the development of intellectual capital and "smart" economy in Romania* (pp. 8080–8088).
- Lengyel, I., Imreh, S., & Lukovics, M. (2015). In P. Nijkamp, K. Kourtit, M. Bucek, & O. Hudec (Eds.), *Smart specialisation strategy of szeged city-region: Dream or reality?* (pp. 479–490).
- Maer, E., Pop, A., Popa, D., Gros, I., & IEEE. (2021). Hybrid water collecting and management system using Smart Home Technologies. 2021. In *28TH international workshop on electric drives: Improving reliability of electric drives (IWED2021)*. <https://doi.org/10.1109/IWED52055.2021.9376351>
- Manco, G., Guelpa, E., Colangelo, A., Virtuani, A., Morbiato, T., & Verda, V. (2021). Innovative renewable technology integration for nearly zero-energy buildings within the Re-COGNITION project. *Sustainability*, 13(4). <https://doi.org/10.3390/su13041938>
- Manolea, G., Cerban, L., Stanga, A., & Damian, G. (2009). In I. Rudas, M. Demiralp, & N. Mastorakis (Eds.), *The use of ITS technologies—solutions for the traffic flow in large urban areas and the increase of the public transport quality* (p. 328).
- Mazilu, S., Incaltarau, C., & Kourtit, K. (2020). The creative economy through the lens of urban resilience. Analysis of Romanian cities. *Transylvanian Review of Administrative Sciences*, 59E, 77–103. <https://doi.org/10.24193/tras.59E.5>
- McElroy, E. (2020). Digital nomads in siliconising Cluj: Material and allegorical double dispossession. *Urban Studies*, 57(15), 3078–3094. <https://doi.org/10.1177/0042098019847448>
- Muntean, A., Caranfil, R., & Ilovan, O. (2021). Urban bioregions and territorial identities in Romania. The role of information and communication technology. *Journal of Settlements and Spatial Planning*, 78–93. <https://doi.org/10.24193/JSSPSI.2021.8.07>
- Neagu, I. (2018). Sustainable smart cities: A fog computing framework for a smart urban transport network. *Studia Universitatis Vasile Goldis Arad Seria Stiinte Economice*, 28(4), 68–80. <https://doi.org/10.2478/sues-2018-0021>
- Nicula, A., Botan, C., Gligor, V., & Cocis, E. (2020). Celebrating the great union through smart digital solutions: Lessons from Alba Iulia, Romania. *Journal of Urban History*. <https://doi.org/10.1177/0096144220940713>
- Ninčević Pašalić, I., Čukušić, M., & Jadrić, M. (2021). Smart city research advances in Southeast Europe. *International Journal of Information Management*, 58, 102127. <https://doi.org/10.1016/j.ijinfomgt.2020.102127>
- Oproiu, E., Iordache, M., Patachia, C., Costea, C., & Marghescu, I. (2017). *Development and implementation of a smart city use case in a 5G mobile network's operator* (pp. 83–86).
- Petrica, N., & Birova, S. (2018). In I. Popa, C. Dobrin, & C. Ciocoiu (Eds.), *Understanding a smart city. Social, economic and political perspectives. From smart cities to intelligent communities* (pp. 1–9).
- Popa, C., Dobrescu, T., Silvestru, C., Firulescu, A., Popescu, C., & Cotet, C. (2021). Pollution and weather reports: Using machine learning for combating pollution in big cities. *Sensors*, 21(21). <https://doi.org/10.3390/s21217329>
- Profiroi, M., & Radulescu, C. (2019). In I. Popa, C. Dobrin, & C. Ciocoiu (Eds.), *Local development opportunities in the context of sustainable development by applying the concept of "Smart village" in Romania* (pp. 1059–1067).
- Romanelli, M., & Ionescu, A. (2020). In C. Bratianu, A. Zbucnea, F. Anghel, & B. Hrib (Eds.), *Driving smart cities and projects in Romania* (pp. 565–578).
- Rotunda, C., Cîrnu, C. E., Smada, D., & Gheorghită, A. (2017). Smart city applications built on big data technologies and secure IoT. *Ecoforum*, 6(3), 1–9.
- Sandu, A., Bănică, A., & Muntele, I. (2021). Urban resilience: An instrument to decode the postsocialist socio-economic and spatial transformations of cities from central and eastern Europe. *Eastern Journal of European Studies*, 12(Special Issue), 170–195.
- Savastano, M., Suciu, M., Gorelova, I., & Stativa, G. (2020). *Smart grids, prosumers and energy management within a smart city integrated system*, 14 pp. 1121–1134). <https://doi.org/10.2478/picbe-2020-0105>, 1.
- Schebesch, K., Tome, E., & Soim, H. (2014). In D. Caganova, & M. Cambal (Eds.), *The potential for regional intellectual capital formation: Towards a computational approach* (pp. 199–208).
- Serbanica, C., & Constantin, D. L. (2017). Sustainable cities in central and eastern European countries. Moving towards smart specialization. *Habitat International*, 68, 55–63. <https://doi.org/10.1016/j.habitatint.2017.03.005>
- Sikora-Fernandez, D. (2018). Smarter cities in post-socialist country: Example of Poland. *Cities*, 78, 52–59.
- Smart City Alba Iulia 2016–2018 pilot project. <https://hub.beesmart.city/city-portraits/alba-iulia-how-central-romania-quietly-created-a-smart-city-champion-in-europe>.
- Smart City Magazine. <https://smartcitymagazine.ro/>.
- Stinga, A., Manolea, G., Bulucea, C., & Boteanu, N. (2010). In L. Zadeh, J. Kacprzyk, N. Mastorakis, A. KuriMorales, P. Borne, & L. Kazovsky (Eds.), *Current solutions for increasing the comfort, safety and optimizing the energy consumption in electrical urban transport* (p. 196).
- Stoica, V., & Ilaș, A. (2009). *Romanian urban e-government. Digital services and digital democracy in 165 cities*. Electronic Journal of E-government.
- Suciu, M., & Florea, C. (2014). In D. Caganova, & M. Cambal (Eds.), *Regional innovative clusters as key sources of a long-run sustainable competitive advantage* (pp. 240–248).
- Suciu, C., Suciu, N., & Schawłowski, D. (2013). In K. Soliman (Ed.), *Creative entrepreneurship and urban vitality as key determinants for a smart, sustainable and inclusive development* (pp. 1595–1601).
- Surd, V., Kassai, I., & Giurgiu, L. (2011). Romanian disparities in regional development. *Procedia-Social and Behavioral Sciences*, 19, 21–30.
- Tantau, A., & Santa, A. (2021). New energy policy directions in the European union developing the concept of smart cities. *Smart Cities*, 4(1), 241–252. <https://doi.org/10.3390/smartcities4010015>
- Tavella, C., Spoerndli, C., Beu, D., & Ceclan, A. (2021). CoME EASY-synchronizing European energy award with other initiatives. Case study: Romanian local communities. *Energies*, 14(19). <https://doi.org/10.3390/en14196248>

- Teremranova, J., Mutule, A., & IEEE. (2019). Sustainable city development as a result of close cooperation with citizens: Europe and LAC experiences. In *2019 11TH international symposium on advanced topics in electrical engineering (ATEE)*.
- Timisoara Smart City. <https://mysmartcity.ro/>.
- Tirziu, A. (2017). In A. Taranu (Ed.), *Promoting social innovation in rural areas through living labs* (pp. 155–160).
- Vegacomp Consulting. (2021). *Mapping of smart counties, cities and villages in Romania. The digitalization of communities is expanding in Romania mapping of smart counties, cities and villages in Romania*. <https://vegacomp.ro/smart-city-scan-for-romania-snapshot-860-projects-in-124-cities/>.
- Vert, S. (2015). In B. Patrut, D. Andone, C. Holotescu, & G. Grosseck (Eds.), *Linked open government data for smart city applications* (pp. 401–406).
- Vrabie, C. (2016). *Elemente de E-guvernare (Elements of E-Government)*, Pro Universitaria, București.
- Vrabie, C. (2018a). *Fast-track to start developing a city to become smart* (pp. 377–384). A. Taranu.
- Vrabie, C. (2018b). In C. Bratianu, A. Zbucea, & A. Vitelar (Eds.), *Global urbanization and the need of smart cities development* (pp. 1175–1185).
- Vrabie, C. (2021). Converting municipal waste to energy through the biomass chain, a key technology for environmental issues in (smart) cities. *Sustainability*, 13(9). <https://doi.org/10.3390/su13094633>
- Vrabie, C., & Dumitrașcu, E. (2018). *Smart Cities, from idea to implementation; or how technology can make the urban environment shine*. Bucharest: Universul Academic.