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Review

A Bibliometric Analysis on Smart Cities Related to Land Use

María Teresa Bastanchury-López [1,*] and Carmen De-Pablos-Heredero [1,2]

[1] Department of Business Economics (Administration, Management and Organization), Applied Economics II and Fundamentals of Economic Analysis, Universidad Rey Juan Carlos, Paseo de los Artilleros s/n, 28032 Madrid, Spain
[2] Department of Business Administration, ESIC University, Avda. Valdenigrales, s/n, Pozuelo de Alarcón, 28223 Madrid, Spain
* Correspondence: teresa.bastanchury@urjc.es

Abstract: According to the World Bank, approximately 55% of the population lives in cities and a growing trend is expected in the future. Cities generate more than 80% of the world's GDP, so accurate urban land management would favor sustainable growth, increasing productivity and facilitating innovation and the emergence of new ideas. The use and management of public resources and the concern for cities to become increasingly smart are, therefore, of particular importance. To provide an overview and synthesize knowledge on smart cities in relation to land use, a bibliometric analysis was performed of 475 documents extracted from the Web of Science database, using the SciMAT and VOSviewer programs. Research papers published between 1 January 2000 and 8 September 2022 were considered. Three periods have been identified in which a tendency oriented to deepen in a broad concept of smart city has been evidenced. A growing interest in the topic under investigation has been found, expressed as an increase of the number of publications and research groups focused on the topic. The results of this analysis help to know the most relevant contributions published so far on urban land use in smart cities. This knowledge can help streamline decisions in urban land use in smart cities.

Keywords: smart city; urban land use; economy; business; bibliometric analysis; SciMAT; VOSviewer

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1. Introduction

The term "smart city" appears in the 1990s, to give a unified approach to how to establish an advanced urban environment. However, no consensus has yet been reached on its definition [1–6]. Among them, the following are worth mentioning:

- "A smart city is a fair and equitable citizen-centered city that continuously improves its sustainability and resilience by leveraging knowledge and available resources. Especially Information and Communication Technologies (ICTs) to improve quality of life, efficiency of urban services, innovation, and competitiveness without compromising future technological, governance, social and environmental needs" [7] (p. 7).
- "Smart cities should be regarded as systems of people interacting with and using flows of energy, materials, services, and financing to catalyze sustainable economic development, resilience, and high quality of life; these flows and interactions become smart through making strategic use of information and communication infrastructure and services in a process of transparent urban planning and management that is responsive to the social and economic needs of society" [8] (p. 5).
- "A smart city is a city that functions well for the future on these six characteristics, built on the "smart' combination of endowments and activities of self-determined, independent, and aware citizens. The characteristics of a smart city are the following: Smart Economy, smart people, smart governance, smart mobility, smart environment, and smart living" [9] (p. 11).

For other authors [10,11], the most important aspects are participative governance, human capital, technological infrastructure, and innovations.

The smart city is a multidimensional set of actions related to [12]: the people and the habitat (smart community), the economy and the governance, the energy performance, the improvement of air quality, the optimal consumption of natural resources, and the decrease in the use of private vehicles.

Bearing in mind these definitions, the importance of efficient urban land management and its interaction with the economic development of cities can be affirmed. According to the World Bank, more than 80% of the world's Gross Domestic Product (GDP) is generated in cities and approximately 55% of the population live in them, with a clear trend towards growth.

Companies, to be competitive in today's globalized world, require productivity gains from their workers [13]. However, mobility between the place of residence and work affects their performance [14–17]. In addition, they also require connected cities to have easy access to transport to facilitate their daily work activity [18].

Interest in land use law and practice has been greatly stimulated by the unpopularity of the urban sprawl and by the excitement concerning "smart growth"—a new term that urges the use of public resources and legal authority more intelligently to create sustainable communities and landscapes [19] (p. 1).

Efficient urban land management is, therefore, necessary for cities to participate in improving these aspects and contribute to the development of businesses. Smart cities, by facilitating the proper management of urban land, enhance the efficient development of these aspects, thus contributing to the development of the city's economy [20].

Considering the need to "grow smart" based on the urgency to make the best of public resources, this article aims to provide an overview and synthesize the knowledge on smart cities regarding urban land use. The main objective of this research consists of providing information concerning the research published so far on the concept of smart city and in relation to land use. There are three main specific objectives in this research: 1. To know the topics included in the academic literature related to the concepts of smart cities and land use. 2. To analyze areas of research related to this field. 3. To provide future areas of research on this topic.

Therefore, the research questions to be answered in this paper are the following: What has been the historical evolution of the literature on Smart City? Which documents have mostly influenced the intellectual structure of the research topic? Which journals present more publications on this research topic? What are the current patterns and issues in the field of Smart Cities?

The work provides academics and practitioners with an overview of the current situation and trends in the field of smart cities and their relationship with the optimization of urban land use. The results of this study are especially relevant considering the integration of society and institutions in the development of smart cities aimed at optimizing and ensuring a resource as relevant as soil.

2. Materials and Methods

In this research, bibliometric analysis has been performed using the Web of Science database, a source of great reputation in the field of Social Sciences [21] and widely used for bibliographic studies in the field of management [22].

Bibliometric analysis is a rigorous quantitative method that allows large volumes of unstructured scientific data to be reviewed and evaluated in a particular field of research [23,24]. The bibliometric analysis of these secondary data allows a transparent, reliable, and reproducible process of systematic review [23,25]. Based on the extrinsic characteristics of secondary data, bibliometric analysis allows evaluating academic productivity, its impact, and its relative influence, establishing the intellectual structure of the research topic, as well as its evolution, and identifying the different sub-themes and their conceptual structure [23,26].

On the one hand, in bibliometrics, performance assessment, analysis, and the creation of scientific maps are identified; on the other hand, the creation and analysis of scientific maps are promoted [27]. The first part analyzes scientific participants (universities, countries, researchers, etc.) and the impact of their research based on their bibliographic production. Science mapping reflects the structural and dynamic aspects of scientific production [28–30].

Regarding the criteria used in the WoS search, note that, in the first phase, the keywords (Author Keywords = "smart city" or "smart cities") have been used, obtaining a total of 10,090 works.

In the second phase, considering the orientation of research, smart cities, and land optimization, this search was redefined with the following criteria: The WoS categories selected were: Urban studies, regional urban planning, management, business, and area studies (n = 636). Concerning the document types, all were excluded except articles or review articles (n = 517). There was also a selection by language: All those that were not published in English or Spanish were excluded (n = 475).

Only the WoS categories indicated were considered as the present work is related to urban land use and its influence on the economic scope of cities.

The search was performed on 8 September 2022.

As a result, a total of 475 articles (Table S1) were considered for the bibliographic analysis (Figure 1).

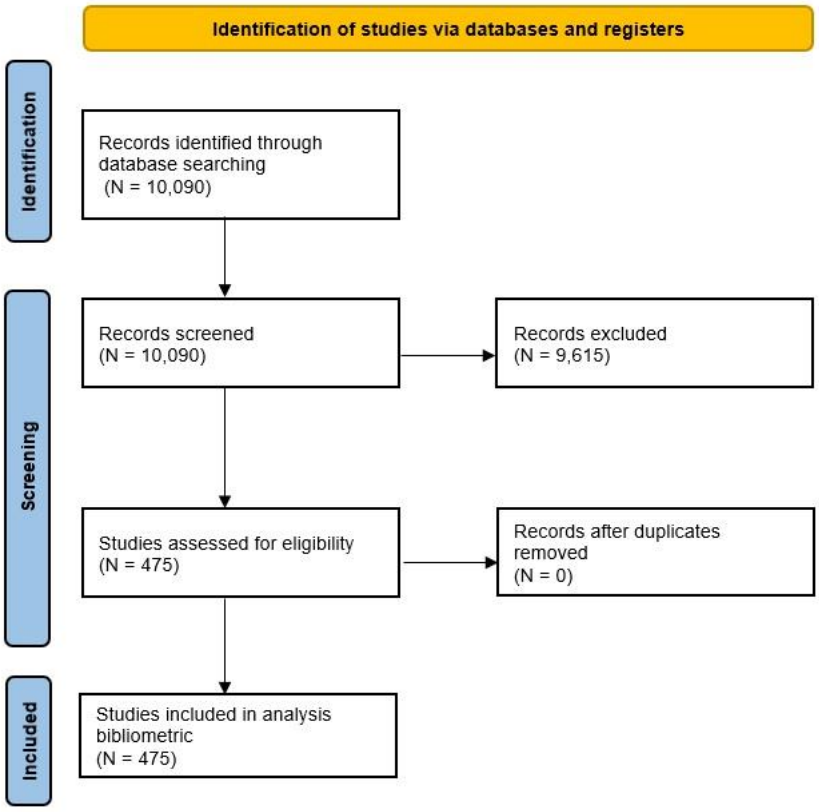

Figure 1. Review methodology based on PRISMA flow.

Two software tools were used to perform the bibliometric analysis: SciMAT v1.1.04, to answer the first three research questions and VOSviewer v1.6.18., to answer the last one (Figure S1).

SciMAT is an opensource tool that allows one to analyze an area of knowledge and its performance, as well as a set of publications or a journal [31–36].

VOSviewer is a tool built in JAVA programming language that uses the Visualization of Similarities as an analysis technique for the elaboration of scientific maps. The analyses

consider information related to the co-occurrence of words and the co-citation of authors and journals [37].

3. Results and Discussion

The results obtained together with their assessment are detailed below.

3.1. Productivity Measures

The productivity measures obtained in the present work are based on performance analysis metrics of bibliometric analysis [23,38]:

- Number total of documents per year
- Number of documents per country
- Number of documents per journal
- Number of citations per journal
- Papers according to the number of authors
- Most productive authors
- Most cited papers

3.1.1. Documents

Figure 2 shows the evolution by year of publications in the field of smart cities, concerning urban land and economic environment. The first article was published online on 18 January 2013 in the journal Urban Research & Practice. This publication analyzes 178 urban sustainability policy initiatives since the early 2000s and, among its conclusions, highlights that the idea of the ubiquitous eco-city must be locally contextualized [39].

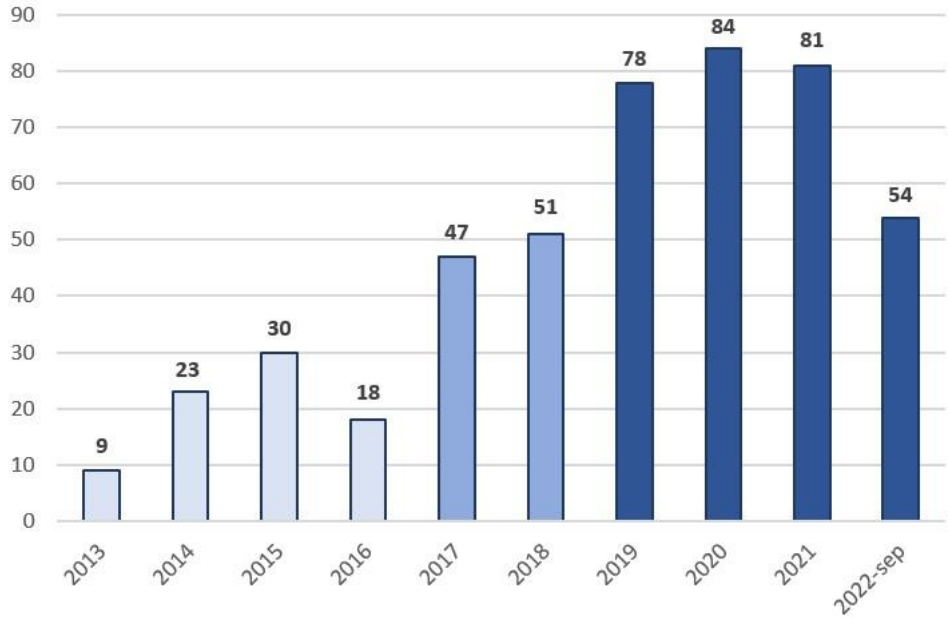

Figure 2. Total number of documents per year.

When analyzing the number of publications per year, a growing trend can be detected, which allows the identification of three periods in the evolution of academic literature on the subject studied: initial (2013–2016); development (2017–2018), and notable expansion or growth (2019–2022). A total of 62.53% of the publications were produced in the period of expansion, so the issue of smart cities in relation to urban land use is a very relevant issue, which is consistent with the major current concerns associated with the environment, the cost of energy, and concern for the well-being of citizens, both at government and business levels [40–44].

Regarding the countries that have produced the major number of publications on smart cities in relation to urban land (Table 1), it should be noted that 82.53% of the articles have been published in 5 countries out of a total of 29, representing 14.24%. Again, a high degree of concentration was observed.

Table 1. Number of documents per country.

Country	N	%
United Kingdom	210	44.21
United States	123	25.89
Italy	31	6.53
Portugal	16	3.37
Canada	12	2.53

3.1.2. Journals

An analysis of the journals that have published the most articles on the subject (Table 2) shows a high concentration, given that 65.26% of publications are found in only 7 of a total of 97 journals (7.22%).

Table 2. Number of documents per journal.

Journal (Country of Journal)	N [1]	%
Cities (United Kingdom)	107	22.53
Technological Forecasting and Social Change (United States)	72	15.16
Journal of Urban Technology (United Kingdom)	46	9.68
TeMa-Journal of Land Use and Environment (Italy)	29	6.11
International Journal of e-Planning Research (United States)	28	5.89
Urban Planning (Portugal)	16	3.37
Technology Innovation Management Review (Canada)	12	2.53

[1] Number of publications of the journal.

As indicated in Table 2, Cities is the journal that has published most of the articles, in its scope in urban planning and policy research, which shows the growing interest in taking these aspects into account when dealing with smart cities. Table 2 includes journals with a wide variety of points of view on smart cities in the field of urban land: from the elaboration of a taxonomy of the different aspects to consider [45], proposal of indicators [46], integration of technological aspects with cultural aspects and governance to increase the habitability of cities and boost their economic growth [47], or case studies [48], among others.

With respect to the most cited and, therefore, most influential journals (Table 3), it can be seen that they coincide with the journals that publish more articles on the topic in question and that 77.59% of the citations are concentrated in three journals.

Table 3. Number of citations per journal.

Journal	N	%
Cities	5268	35.75
Technological Forecasting and Social Change	3570	24.23
Journal of Urban Technology	2595	17.61
TeMa-Journal of Land Use and Environment	352	2.39
Journal of Science and Technology	316	2.14
Journal of Business Research	231	1.57
Urban Research & Practice	230	1.56
Technology Innovation Management Review	198	1.34
International Journal of e-Planning Research	159	1.08

It should be noted that the most cited article (1133 citations) is "*Smart Cities: Definitions, Dimensions, Performance, and Initiatives*" [49], published in the Journal of Urban Technology, representing the citations of this article almost half (43.66%) of all, and it is also the one that presents more weight in the total number of citations in the study area (7.69%). The importance of this article highlights the concern of scientists about the lack of consensus on the definition and dimensions of the "smart city".

3.1.3. Authors

Most of the articles were written by two or three authors. Figure S2 shows the percentage of articles written by participating authors.

A total of 89.5% of authors have only appeared in one paper, 6.76% in two and 3.74% have appeared in three or more papers related to smart cities in relation to urban land.

The total number of authors who wrote the articles included in the bibliographic analysis is 1153. Table 4 shows the authors who have written the most articles.

Table 4. Most productive authors.

Author	Country	Institution	N
Yigitcanlar, T.	Australia	Queensland University of Technology	10
Mora, L.	United Kingdom	Edinburgh Napier University	9
Ferraris, A.	Italy	Università di Torino	7
Angelidou, M.	Greece	Aristotle University of Thessaloniki	6
Bresciani, S.	Italy	Università di Torino	6
Deakin, M.	United Kingdom	Edinburgh Napier University	6
Joss, S.	United Kingdom	University of Glasgow	5
Crutzen, N.	Belgium	Liège Université	5
Gargiulo, C.	Italy	Università di Napoli Federico II	5
Alizadeh, T.	Australia	University of Sydney	5

A detailed study of the research coming from the three most prolific authors allows us to affirm that Yigitcanalar, in his studies, focuses on knowing the factors of smart cities, as well as establishing a route to turn cities into independent cities. Mora is concerned about existing knowledge and helps researchers in their work. He highlights the importance of establishing strategies that connect physical space with the economic and social dimensions of cities and considers the spatial differences of cities established by their leaders. Ferraris studies human resources practices in companies that facilitate the development of smart city projects and identifies the lack of capacity and innovative approach of public governments to participate in such projects.

Table 5 shows the most cited papers. The most cited work [49] carries out a study showing how it is possible, through roadmaps, to represent technological changes and uncertainties of innovative strategies.

Table 5. Most cited papers.

Title	Authors	Year	Journal	N
Smart cities: definitions, dimensions, performance, and initiatives [49]	Albino, V Berardi, U Dangelico, RM	2015	Journal of Urban Technology	1133
Current trends in smart city initiatives: Some stylised facts [45]	Neirotti, P De Marco, A Cagliano, AC Mangano, G Scorrano, F	2014	Cities	977
What are the differences between sustainable and smart cities? [50]	Ahvenniemi, H Huovila, A Pinto-Seppa, I Airaksinen, M	2017	Cities	459

Table 5. *Cont.*

Title	Authors	Year	Journal	N
Smart city policies: A spatial approach [51]	Angelidou, M	2014	Cities	378
Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco [52]	Lee, JH Hancock, MG Hu, MC	2014	Technological Forecasting and Social Change	359
Smart cities: A conjuncture of four forces [53]	Angelidou, M	2015	Cities	324
An integrated service-device-technology roadmap for smart city development [54]	Lee, JH Phaal, R Lee, SH	2013	Technological Forecasting and Social Change	249
On big data, artificial intelligence and smart cities [47]	Allam, Z Dhunny, ZA	2019	Cities	220
The First Two Decades of Smart-City Research: A Bibliometric Analysis [55]	Mora, L Bolici, R Deakin, M	2017	Journal of Urban Technology	218
How do we understand smart cities? An evolutionary perspective [56]	Kummitha, RKR Crutzen, N	2017	Cities	200
Lessons in urban monitoring taken from sustainable and liveable cities to better address the Smart Cities initiative [46]	Marsal-Llacuna, ML Colomer-Llinas, J Melendez-Frigola, J	2015	Technological Forecasting and Social Change	194
Understanding 'smart cities': Intertwining development drivers with desired outcomes in a multidimensional framework [57]	Yigitcanlar, T Kamruzzaman, M Buys, L Ioppolo, G Sabatini-Marques, J da Costa, EM Yun, JJ	2018	Cities	184
The governance of smart cities: A systematic literature review [58]	Ruhlandt, RWS	2018	Cities	181
How to strategize smart cities: Revealing the SMART model [59]	Ben Letaifa, S	2015	Journal of Business Research	175
The management of organizational ambidexterity through alliances in a new context of analysis: Internet of Things (IoT) smart city projects [60]	Bresciani, S Ferraris, A Del Giudice, M	2018	Technological Forecasting and Social Change	174

The journals in which the most cited articles have been published, except for the Journal of Business Research, agree with those that have published the most on the subject, again showing the influence they have in this area of research.

3.2. Co-Word Analysis

This analysis, through keywords, will identify current patterns and themes in the field of Smart Cities and urban land.

Previously, three periods were identified in the evolution of Smart Cities academic literature in relation to urban land:

- Initial period (2013–2016)
- Development period (2017–2018)
- Period of remarkable expansion or growth (2019–2022)

In this paper, a co-occurrence analysis will be performed for each of the identified periods.

3.2.1. Initial Period: 2013 to 2016

A total of 80 articles were published in this period, with a total of 410 keywords, since some of them were similar, for example, "smart city" and "smart cities". A data cleansing process was performed. These similar words were considered in the analysis by creating a VOSviewer thesaurus file with the replaced words (Table S2). As a result, of the 410 initial words, 393 were analyzed.

The analysis considered those words that appeared in at least five publications, so they were reduced to a total of 13 words. Table S3 shows the most common words.

Figure 3 shows the display of the word network of the initial period.

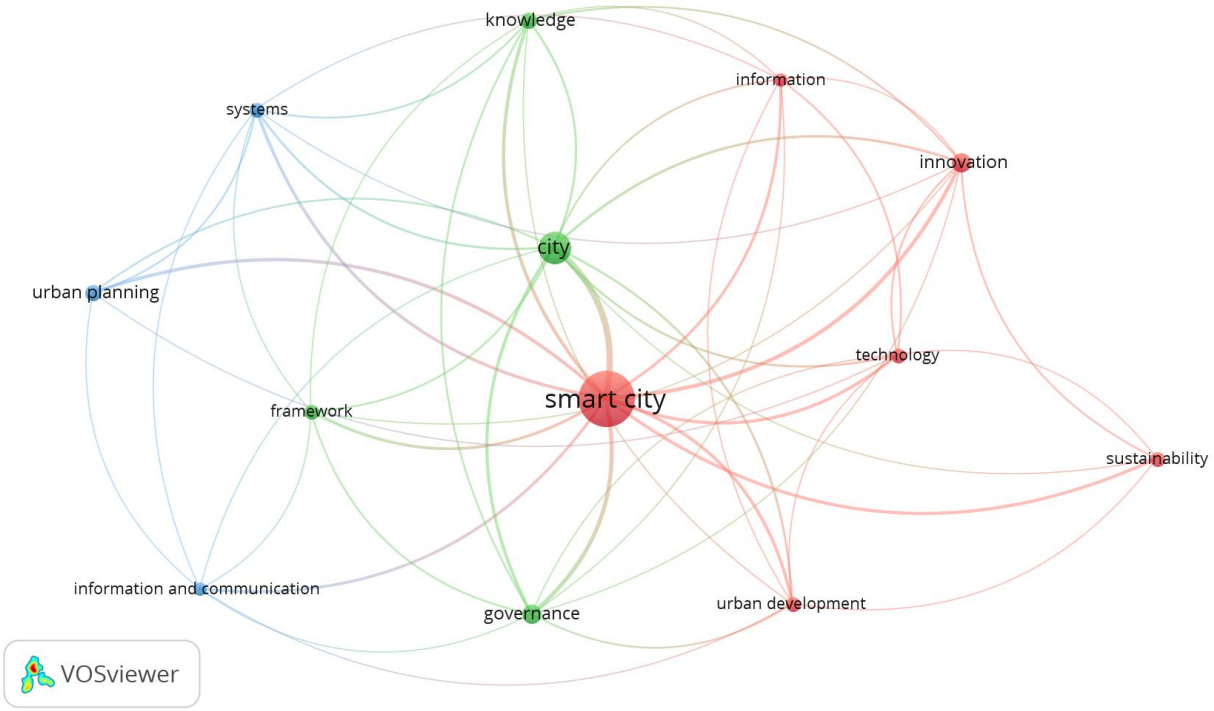

Figure 3. Network visualization Initial Period.

A total of three clusters were identified in this network:

- Cluster 1. It is represented in red color, and comprises a total of six items (information, innovation, smart city, sustainability, technology, and urban development).
- Cluster 2. It is represented in green color, and comprises a total of four items (city, framework, governance, and knowledge).
- Cluster 3. It is represented in blue color, and comprises a total of three items (information and communication, systems, and urban planning).

In this period, the node "smart city" is related to all the nodes of the clusters and the frequency of occurrence of this keyword was 44% (see Table S3). However, although at lower percentages, the following keywords often appear: governance (5.71%), innovation (5.14%), knowledge (4%), urban planning (4%), or sustainability (3.43%), which seems to indicate that no longer is attention only paid to the technological dimension of the concept "smart city" but to other dimensions, associated to sustainability, governance, and urban planning, are beginning to gain importance. Some scholars probably begin to wonder if "sustainability" and "smart" are synonymous [61].

Sustainability must be understood from the perspective of strong sustainability [62,63], which considers human and natural capital to be complementary. This vision will allow cities to be sustainable in the long run. For example, Angelidou [53] identifies the forces that make up the concept of "smart city" (urban futures, knowledge and innovation economy, technology push, and application pool). It proposes an integrated model of an intelligent city in which citizens are empowered, intellectual capital, and knowledge are promoted, social sustainability, and digital inclusion are advanced, and citizens' commitment to the city and technology are at the service of the citizen. In line with this study, La Rocca [64] analyzes the relationship between tourism and the Smart City. Thus, she points out that in the concept of smart city, differences can be found between the digital city and an eco-

sustainable city, which rely on a third element which is social capital, considering within this capital to tourists.

Another publication analyzes 178 urban sustainability policy initiatives since the early 2000s and, among its conclusions, highlights that social sustainability measures must be established to locally contextualize the idea of the ubiquitous eco-city [39].

Salvati [65], by developing a methodology, analyzes how knowledge and smart city programs contribute to economic sustainability. The most important factors for achieving sustainability are optimization, innovation, and behavioral change.

Marsal-Llacuna [66] built a four-step method which suggests that what makes an urban plan interesting are the collaborations, both quantitative and qualitative, of the urban subsystem with other related subsystems (environmental management; services; food; living; transport; waste management; production, sales; socialization; water; and fossil resources) to ensure its sustainability and promote its development.

Previous works refer to social sustainability, characterized by five dimensions [67] (p. 1): person (demographic and household characteristics), place (accessibility, social infrastructure, open spaces, and places for daily operations), people (sense of community, social relations, and social network), perception (sense of place, security and safety), and process (participation and future of space), and, therefore, a strong sustainable perspective that ensures the sustainability of cities.

Among the different themes that influence a city in general, and in a smart city in particular, is governance, including in this concept both conventional forms and new forms of collective and participatory decision-making [68]. Governance shapes economic development in cities and ICTs should be part of the overall approach to improving inclusion while providing the city with opportunities to change: this would be smart governance [69] (p. 20). In a smart city, citizens can access and interconnect information, so changes are needed in the local government of these cities [70].

In the field of smart city governance, Gargiulo [71] studies the recommendations of the European Commission in three documents (Cohesion Policy 2014–2000, Digital Agenda and Urban Agenda) providing a cohesive environment for the transformation of European cities. Other researchers define the concept of Smart City by analyzing key words in existing literature, focusing on the academic, industrial, and governmental domains that are involved in political decision-making and the Smart City plan, providing initiatives to identify objectives, components, and key actors [72].

Empirical research was also found on the design and construction of the Centre Direzionale of Naples [70], identifying it as a best practice of city administration.

The study of the city of Chennai (India), which analyzes it from various perspectives such as social, economic, political, and environmental, proposes measures that local authorities should take into consideration, such as the creation of a database in which information corresponding to different dimensions is stored [73].

Other authors [74] study the responsibilities and curricula of the Smart City Manager, for which they have conducted an empirical study through a questionnaire aimed at public and political managers. With the information collected, and through a factorial analysis, they define an index of responsibility that allows them to know the main competencies and skills required for the figure studied.

Another study, based on a Smart City case study from Denmark, develops an organic framework for collaboration between citizens, businesses, academic institutions, and municipalities [75]. Using this framework, Smart Aarhus was analyzed, and a set of beneficial lessons are drawn for the public and the policymakers carrying out smart city initiatives.

In this current period, research on governance has a more traditional approach; although, research is beginning to adopt more innovative approaches, which establish the importance of citizen participation in decision-making.

Another fundamental aspect related to the Smart City is urban planning. Since the second half of the last century, there has been a growing need for integrated multi-faceted approaches that interact with each other in urban planning to respond to increasingly complex urban problems, such as transport, social inclusion, or pollution [76,77].

In the case of smart cities, some authors [78] refer to the crucial role of urban planning in the coordination and integration of different urban regulations by providing a holistic vision in the construction of a Smart City.

There are also case studies such as that of the city-territory of L'Aquila (Italy), in which its evolution towards smart city-territory must contemplate comprehensive planning of three areas: the Macroregion that forms the city-Land, Land Use Project, and Urban Planning Project [79]. In addition, the case of Amsterdam, which analyzes the most important projects and policies of this city and, considering the results obtained 4 years after its implementation, highlights the strong relationship between energy policies and urban planning and design [80].

Others analyze the planning projects and measures they have adopted in Cilia, identifying differences in the adoption of urban planning schemes and how the transition measures between linear, cluster, sequence, policy, and regulatory framework while the circular, flexible, and multi-purpose approach needs to address urban and local resilience [81].

Research has been found that studies the challenge that, for planners, involves how to manage and use the volumes of information that are generated. It is this information that can empower them by acting as mediators in local government–business relations [82].

In the case of the Smart City, planning should not only consider the interactions between the different areas of a city, but it should also use available volumes of data to respond to present and future needs for the accurate development of cities.

From the co-word analysis, it can also be seen from Figure S3, that the highest number of publications with keywords were published approximately between August 2104 and early 2015.

With respect to item density (Figure S4), the important keywords are "smart city" and "city", both with a great number of occurrences and strong links, as reflected in Table S3.

3.2.2. Development Period: 2017 to 2018

A total of 98 articles were published in this period, with a total of 588 keywords. Given that some of them were similar, for example, "sustainability" and "sustainable development", a data cleaning process was performed. These similar words were considered in the analysis by creating a VOSviewer thesaurus file with the replaced words (Table S4). As a result, of the initial 588 words, 554 were analyzed.

The analysis considered those words that appeared in at least five publications, so they were reduced to a total of 20 words. Table S5 shows the most frequent words of that total of 20 words.

Figure 4 shows the display of the word network of the development period.

A total of four clusters were identified in this network:

- Cluster 1. Represented in red color, it has a total of eight items (challenge, city, governance, internet, smart city, strategy, system, and urban development). This cluster is oriented to the challenges that arise in relation to governance and urban development strategies.
- Cluster 2. Represented in green color, it has a total of eight items (big data, citizens, framework, future, information, innovation, sustainable city, and technology). This cluster aims to establish environments and technologies that facilitate innovation.
- Cluster 3. Represented in blue color, it has a total of three items (management, model, and sustainable development). It is clearly management-oriented along with the idea of achieving sustainable development of these smart cities.
- Cluster 4. Represented in yellow color, it has a total of one item (information and communication). It is focused on the technological dimension.

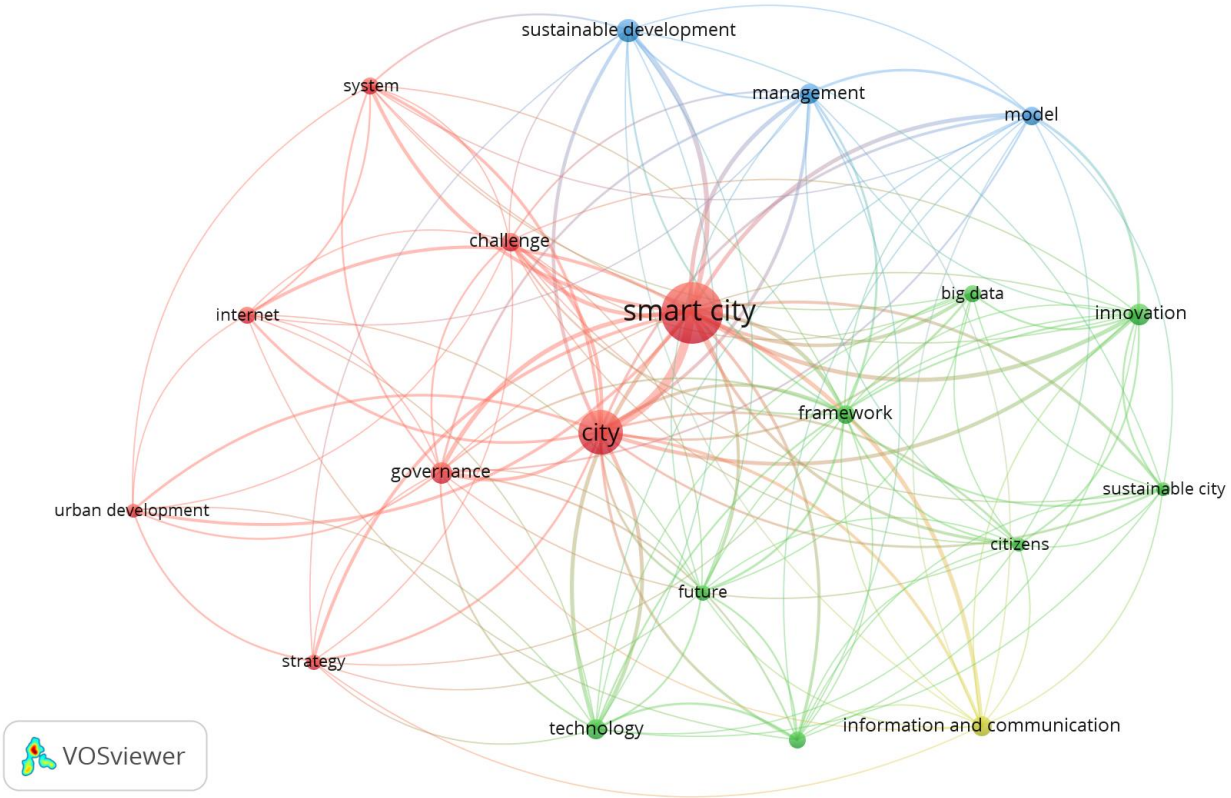

Figure 4. Network visualization Development Period.

As in the initial period, the "smart city" node is related to all the cluster nodes and the percentage of occurrence of this keyword was 31.71% (see Table S5). However, other words appear with a relatively high frequency, fundamentally the same words that had greater weight in the previous period, although, as can be seen below, they show an evolution. These are the keywords sustainability (4.53%), governance (3.83%), management (3.48%), and innovation (3.83%).

In the previous period, the research was focused on the city's intellectual capital. In this period, the deep concern of researchers is focused on the achievement of the sustainable development of cities, understanding it from a triple perspective: economic, environmental, and social [83,84].

This idea of sustainable development is also transferred to the area of research on the smart city in relation to land use, which is evidenced through work performed at this stage. For example, using a 5W + 1H model (why, what, who, where, when, and how) some authors study practical solutions for the sustainable development of intellectual cities, arguing that to make them effective solutions, smart energy proposals must be combined with other sustainable solutions [85].

Others [86] focus on the proposed smart city model for a particular country, such as India. They conclude that this model does not consider fundamental aspects of environmental sustainability, such as the provision of services for common-use resources. The authors consider that a systematic change in the concept of urban sustainability is necessary for cities to be ecologically intelligent as socio-cultures.

In this period, studies focused on the existing critiques in the literature on urban sustainability. Through a systematic review of the literature on smart cities, limited to Europe and North America, they identify that citizen empowerment is fundamental to unlocking forms of smart and sustainable urban development [87].

Some studies focus on the economic and social dimension of sustainability, studying through structural equations the differences in digital skills that influence the employability of young people between Eurozone countries and those of other European countries [88]. They determined that digital skills positively influence the employability of young people.

In terms of governance, articles of this period show an evolution in the research topics. Citizens' participation in decision-making is becoming increasingly important, in line with the concept of governance outlined by [68,69].

In this sense, a study was made of the results of an EU urban API FP7 RTD project, in which three ICT applications (3D Scenario Creator, Mobility Explorer, and the Urban Development Simulator) were implemented in four pilot cities: Bologna, Ruse, Vienna, and Vitoria-Gasteiz. They found that the application of these tools had a positive effect by improving spatial planning assessments, facilitating public participation, informing different stakeholders, and identifying key risks [89].

Other authors [90] compare cities in Lithuania and Sweden, focusing on smart economy, smart mobility, smart environment, and smart governance. They conclude that the cities of Lithuania rank below those of Sweden in all aspects analyzed.

Research was also conducted based on information collected through electronic surveys of European smart cities and the study of 47 local governments of smart cities included in a EUROCITIES network working group. The survey includes aspects of smart governance, while the survey of 47 local governments collected data on technologies applied to e-participation. The authors found that less than 50 percent of cities have platforms for citizen participation, although they consider collaborative governance to be fundamental [91].

Systematic reviews of the literature are performed, including the one performed on the different elements of smart city governance, the metrics used to measure these elements, the results obtained, and the contextual factors. Depending on the concept of smart city governance, there are substantial differences [58].

Traditional models of governance are not fully valid for implementation in smart cities, so a literature study was conducted to establish the importance of the dimensions of the city governance model proposed by The European Commission's White Paper [92].

Management refers to the activities performed to achieve certain objectives, whether in the private or the public sphere, with differences between the two areas [93].

As far as smart cities are concerned, focus is placed on the public sphere. In this area, there are studies that pay attention to public management to help different stakeholders, such as civil servants, urban planners, and legislators, to develop smart neighborhoods that meet future needs in developing countries [94]. Others, however, drive their studies to the management of human resources in the strategic alliances of multinationals for the realization of projects in the field of smart cities, identifying differences in practices applied to internal or external resources [95].

Studies on the urban and tourist management model of 40 cities have also been performed through a structural modeling analysis, which shows that the attractiveness of the city for tourists is strongly influenced by the urban environment and states that the balance between the habitability of cities and the environment influences the volume of visitors [96].

Researchers are concerned about the management of different areas and resources that influence the smart city.

Finally, the innovation dimension has been identified. This dimension refers to significant changes or improvements in products or processes [97,98]. This concept, transferred to the scope of study of the present work, is reflected in publications based on the importance of the data generated in smart cities in the economic field of both private and public organizations, propose a model in three phases that, from the data, analyzes the mechanisms oriented to the development of innovative products and/or services and their impact on society [99].

Other authors analyze new approaches to smart cities, such as the case of Christchurch, today immersed in an ongoing project. The research collects lessons learned on how to implement new technologies and, after examining the different initiatives, they conclude that those led by citizens are the ones that facilitate inclusion when addressing urban problems [100].

Citizen participation in smart city research has been a constant in numerous studies, for example, through the Imagine method, information was obtained from citizens on how information systems foster innovation. Among the most effective were visual participatory methods and group discussions [101].

From the information provided in Figure S5, it can be confirmed that the highest number of articles with keywords with respect to the article density was published in the second half of 2017 (Figure S6). The important keywords continue to be "smart city" and "city", both occurring often and with strong links, as reflected in Table S5.

3.2.3. Expansion Period: 2019 to September 2022

A total of 297 articles were published in this period, with a total of 1507 keywords. As some of them were similar, for example, "local government" and "local governance", a data cleaning process was performed. These similar words were considered in the analysis by creating a VOSviewer thesaurus file with the replaced words (Table S6). As a result, of the initial 1507 words, 1399 were analyzed.

The analysis considered those words that appeared in at least five publications, so they were reduced to a total of 88 words. Table S7 shows the 10 most common words.

Figure 5 shows the word network display of the expansion period.

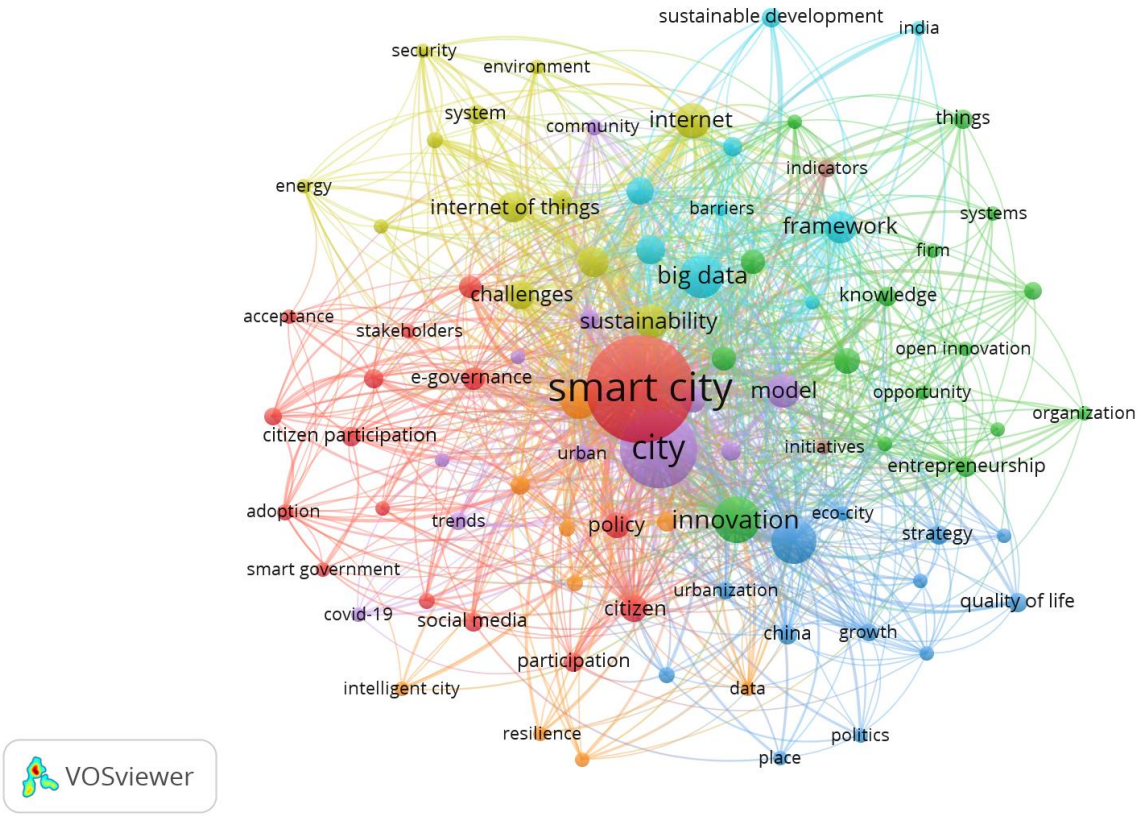

Figure 5. Network visualization Expansion Period.

A total of eight clusters were identified in this network:

- Cluster 1. Represented in red, it has a total of 16 items (acceptance, adoption, citizen, citizen participation, e-governance, implementation, information-technology, local

governance, participation, policy, service, smart city, smart government, social media, stakeholders, and user acceptance). This cluster is oriented to the role of citizens and policymakers.

- Cluster 2. Represented in green color, it has a total of 16 items (bibliometric analysis, co-creation, entrepreneurship, firm, impact, innovation, knowledge, knowledge management, lessons, open innovation, opportunity, organization, performance, systems, things, and value co-creation). This cluster is oriented to business management, knowledge, and learning. It corresponds mostly to the economical dimension of the concept of "smart city".
- Cluster 3. Represented in blue, it has a total of 13 items (China, dimension, eco-city, governance, growth, perspective, place, politics, quality of life, strategy, urban governance, urbanism, and urbanization). It is clearly oriented to the future, to the governance of cities.
- Cluster 4. Represented in yellow, it has a total of 12 items (blockchain, challenges, energy, environment, internet, internet of things, management, security, smart mobility, sustainability, system, and transport). It is focused on sustainability and environmental aspects.
- Cluster 5. Represented in purple color, it has a total of 11 items (city, community, COVID-19, design, information, model, public-participation, space, trends, urban, and urban planning). It is focused on the city model and on considering all aspects related to space as well as trends.
- Cluster 6. Represented in turquoise color, it has a total of 9 items (barriers, big data, framework, future, India, information and communication, sustainable city, sustainable development, and typology). It is focused on information and how to apply it to achieve sustainable city developments.
- Cluster 7. Represented in orange color, it has a total of 9 items (data, infrastructure, intelligent city, open data, resilience, sustainable urban development, technology, transformation, and urban innovation). It is focused on how technology can help urban sustainable development and foster innovation.
- Cluster 8. Represented in brown color, it has a total of 2 items (indicators and initiatives).

After analyzing Figure 5, it can be observed that the union between concepts, such as "smart city", internet of things, big data, sustainability, the well-being of citizens, the economy, and entrepreneurship, are getting closer.

Based on the information provided by Figure S7, it can be confirmed that the largest number of articles with keywords were published in the second half of 2020.

With respect to item density (Figure S8), important keywords continue to be "smart city" and "city", both with a lot of occurrences and strong links (19.63% and 10.39%, respectively), as shown in Table S7, although others such as, "innovation" (3.87%) or "sustainability" (2.01%) are becoming more popular.

Looking at the three periods, when considering the field of smart cities in relation to urban land, there has been an evolution in which new topics, of interest for scientists, have been included. This is related to the initial confusion about the concept of "smart city", it evolved from the initial idea, which focused almost exclusively on technology, to a broader concept that views other dimensions such as governance, the economy in which business, citizen welfare, sustainable development, and urban growth are included. That is, a broader concept and opened to the idea of "city".

About the research question *"What are the current patterns and themes in the field of Smart Cities?"*, it can be stated that, on the one hand, the fields of research have been explored in depth. Therefore, in the Initial Period, most of the research appears related to "smart city" and "city", and other aspects such as "governance", "urban planning", "urban development", as well as technological aspects, begin to be analyzed. While in the Expand Period, new aspects appear that are undoubtedly related to the previous ones and imply going beyond them. In this last period, for example, research begins to appear with the words "e-governance", which delves into aspects of governance, or

"knowledge management", which appears as a further step towards the age of knowledge. Note that the word "knowledge" already appeared in the Initial Period but not in the Development Period.

The keyword "e-governance" refers to the use of ICT in the governance of cities, facilitating and involving citizens in decision-making and increasing the transparency of local governments [102,103]. This concept is transferred to the area of study, where research that focuses on digital platforms can be found. Thirteen e-platforms were surveyed in cities in different countries seeking to understand the link between e-government and smart city initiatives. For these researchers, these platforms show the use of ICT to involve citizens in the local decision-making process [104].

The research also reveals the complex nature of intelligent cities, as well as the conflicts and interdependencies in these cities. Through a qualitative comparison of the Helsinki, Singapore, and London smart city initiatives, the authors identified the need for a holistic approach [105].

Research based on three theories (dynamic capabilities, public value, and the collaborative public innovation approach) was performed to identify government capacities through a factor analysis applied to a sample of 143 projects in Spanish municipalities and a regression of the aforementioned factor analysis. Evidence was found of a positive relationship between citizen orientation and provider focus and public efficiency, effectiveness and social challenges [106].

There is also a case study of the cities of Barcelona, Amsterdam, Kocaeli, and Ankara in which the transformative effect of the so-called intelligent governance is discussed, while at the same time, it explains how the governance structures change as ICT evolves [107].

On the other hand, the concept of knowledge management is a process that helps organizations to capture, organize, disseminate, and share knowledge, that is, information in the context of an experience, among all their workers, using it in decision-making and strategic planning [108,109].

This term is part of the research performed through the Bangalore case study, which shows that accurate knowledge management, obtained through big data from data derived from the Internet of Things and smart cities, can explain how cardiovascular diseases spread in this city, identifying where to take action [110].

In this area, the work focused on the measurement of soft assets in the implementation of the smart city. Assets that are very important create value and, together with other assets, generate results in the implementation of smart cities. The research reviews several approaches to this issue and identifies that the frameworks used to measure these assets, and the consideration of said assets as part of knowledge management, give rise to different ways of addressing them [111].

In this period, the scarcity of research on smart cities from a knowledge management perspective is evident. For this reason, an exploratory case study of 20 innovative city projects was performed, which shows that universities act as innovators, providers, and evaluators of both internal and external knowledge [112]. A semi-systematic bibliographic review was also performed that detected gaps in the adaptation of knowledge management models and their effect on smart cities [113]. Other studies, after an analysis of 1092 publications, develop a system that allows researchers to recover knowledge of the analyzed research [114] or the analysis of collective co-production for interventions in a public park with the smart city approach, of a multidisciplinary group using the method of investigation-action [115].

Organizational culture influences the successful implementation of a knowledge management system. Therefore, authors have focused their research on studying how to change organizational culture for successful knowledge management in smart cities through a systematic review [116].

Other authors believe that knowledge management systems for smart cities should be adapted to encourage the development of increasingly collaborative and innovative communities and facilitate more participatory decision-making processes. To this end, a

multiple case study of 18 innovative companies that have redesigned their organizations from elements of the smart city model is provided [117].

Nowadays, essential issues in cities, on which research is expected to increase, focus on:

- Technology. That is, how technology innovates and facilitates the achievement of the concept of "smart city" in relation to urban land.
- Governance. Advancing this concept towards e-governance and the incorporation of citizens actively in the achievement of these smart cities.
- Information and its management. It must take advantage of the amount of data and information generated in smart cities for the benefit of citizens and the development of cities.
- Planning. Many cities have grown and developed without accurate planning. This has generated, among others, problems for proper transport management and differences in land use. Planning is essential to avoid mistakes made in previous decades.
- Economy. It should analyze the effects that land use decisions can have on the local economy, the attraction of companies, the number of firms that are installed, and the entrepreneurial spirit of citizens.

4. Conclusions

The objective of this work has been to perform a bibliometric analysis of the research topic "smart city" concerning urban land use. The analysis reveals the importance of this research topic, which is evidenced by an increase in the number of publications produced with a clear growing trend over the years.

With respect to the sources used, a high concentration in terms of countries and journals that publish in this field has been found. This is also reflected in the high concentration of citations to papers published mainly in three journals, making Cities a clear journal of reference.

Most of the research has been written by two or three authors, which seems to indicate the existence of research groups interested in this topic.

As for the most cited works, classical references have been generated in this area of research:

1. Smart cities: Definitions, dimensions, performance, and initiatives [49]
2. Current trends in smart city initiatives: Some stylized facts [45]
3. What are the differences between sustainable and smart cities? [50]

Thus, the first three research questions have been answered: What has been the historical evolution of the literature on Smart City? Which documents have mostly influenced the intellectual structure of the research topic? Which journals have the most publications on this research topic?

Regarding the fourth research question, "what are the current patterns and issues in the field of Smart Cities?", as indicated above, there is a growing interest in deepening and exploring new aspects related to the different dimensions of the concept of "smart city".

The authors consider that this research contributes to the knowledge of scientists and practitioners in the field studied and provides them with an understanding of the issues on which the concept of "smart city" on urban land is evolving, focusing on the results of previous bibliographic reviews performed exclusively on the concept of "smart city". The bibliometric analysis and discussion of the different results became starting points for policymakers to consider when making decisions on smart city investment and the importance of considering land-use optimization.

As a limitation of this research, it should be taken into account that only papers published in journals that are indexed in Web of Science categories related to land use and business management have been considered, so it could be interesting to extend it to other categories by including restrictions on search words and compare the results with the present study.

As for future lines of research, it would be fascinating to conduct a study of the concept of "smart city" applied to rural populations and oriented to offer recommendations to avoid depopulation of these areas.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/land11122132/s1, Table S1: List of WoS downloaded items, Table S2: VOSviewer thesaurus file Initial Period, Table S3: The most frequent keywords, Table S4: Example of VOSviewer thesaurus file Development Period, Table S5: The most frequent keywords, Table S6: Example of VOSviewer thesaurus file Expansion Period, Table S7: The most frequent keywords, Figure S1: Bibliometric analysis Source and Software, Figure S2: Papers according to a number of authors, Figure S3: Overlay visualization Initial Period, Figure S4: Density items visualization Initial Period, Figure S5: Overlay visualization Development Period, Figure S6: Density items visualization Development Period, Figure S7: Overlay visualization Expansion Period, Figure S8: Density items visualization Expansion Period.

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