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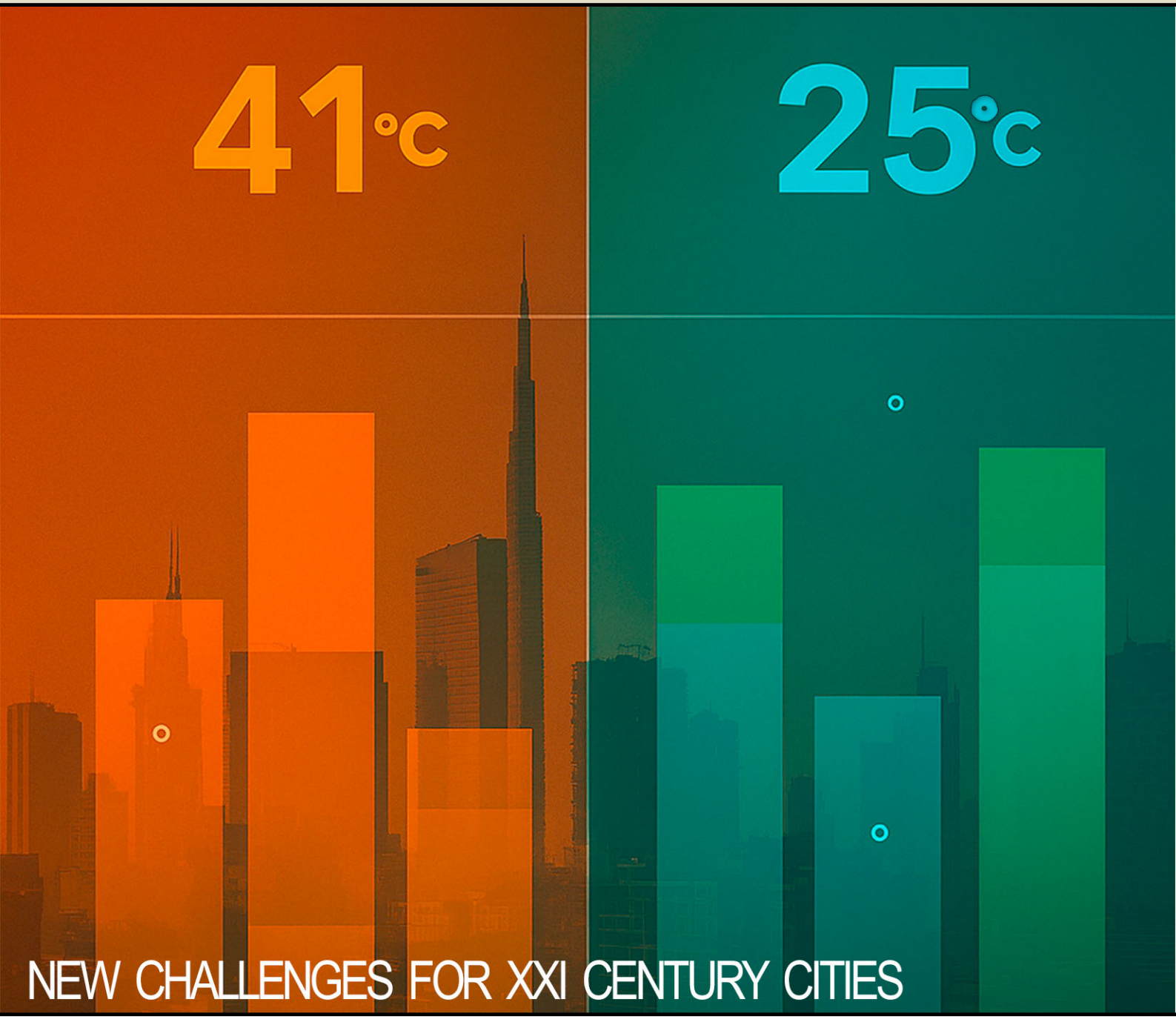
Journal of
Land Use, Mobility and Environment

print ISSN 1970-9889 e-ISSN 1970-9870
FedOA press - University of Naples Federico II

DOAJ anvur Rivista scientifica di classe A - 08/F1 Scopus WEB OF SCIENCE



NEW CHALLENGES FOR XXI CENTURY CITIES

Multilevel scientific approach to impacts of global warming on urban areas, energy transition, optimisation of land use and emergency scenario

Vol.18 n.3
Dicember 2025

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Land Use, Mobility and Environment

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3 (2025)

Published by
Laboratory of Land Use, Mobility and Environment
DICEA - Department of Civil, Building and Environmental Engineering
University of Naples Federico II, Italy

TeMA is realized by CAB - Center for Libraries at University of Naples Federico II using Open Journal System

Editor-in-Chief: Rocco Papa
print ISSN 1970-9889 | online ISSN 1970-9870
Licence: Cancelleria del Tribunale di Napoli, n°6 of 29/01/2008

Editorial correspondence
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TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2025) 551-570
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6093/1970-9870/10741
Received 29th January 2024, Accepted 10th December 2025, Available online 31st December 2025

https://serena.sharepress.it/index.php/tema

Urban planning research from 2014-2024: a systematic literature review using text mining techniques

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Abstract
Urban planning is a crucial aspect of city development as it addresses issues such as mobility, environmental concerns, and urban design. The discipline of urban planning has evolved to meet the needs and challenges of urban areas. Recent research on urban planning has focused on understanding the field's interdisciplinary nature, thus integrating aspects of design, policy, law, social sciences, and engineering. The importance of data and digitisation in urban planning as well as urban planning's crucial role in achieving sustainable cities have also been recognised. The current study examines the evolution of urban planning research through a systematic review of the literature (SRL) published between 2014 and 2024, with text-mining techniques being employed for this endeavour. The present SRL is an analysis of a corpus of 65,368 scientific articles published in Scopus. The inclusion of the term 'urban planning' in the title of the article is a fundamental criterion. In addition, a categorisation of words into three primary subgroups was conducted, based on the predominant themes that underpin scientific study and research activities. The subgroups were designated as follows: Research topics, Methods and techniques and Spatial dimensions and place. The results indicate that there is a growing emphasis on interdisciplinary approaches, complex and data-rich information integration. During the observation period, some of these approaches became more stable and significant, particularly for the words included in the Methods and Techniques and Spatial Dimensions and Places groups. For instance, the progressive affirmation of words is closely associated with the implementation of solutions involving spatial information systems and the importance of urban planning in achieving sustainable cities.

Keywords
Urban planning; text mining; research topics

How to cite item in APA format
Carpentieri, G. & Ascione., L. (2025). Urban planning research from 2014-2024: a systematic literature review using text mining techniques. *TeMA - Journal of Land Use, Mobility and Environment*, *18 (3),* 551-570. http://dx.doi.org/10.6093/1970-9870/10741

1. Introduction

Urban planning, also known as town planning, city planning, regional planning, or rural planning, is an activity that includes different steps related to knowledge, decision, management and control of a specific territory's economic, social, and environmental aspects (Papa, 2009). The extension of territory may include metropolitan areas, cities, towns, and rural areas (Batty, 2008). Urban planning aims to ensure the efficient distribution and utilization of resources within the analyzed territories (Haghani et al., 2023).

Urban planning practice involves multiple disciplines to improve the quality of life for the citizens that live in the urban areas (Kepenek et al., 2025). To reach this goal is to create better public spaces and urban environments that balance the built and natural elements. Urban planners aim to address community needs while respecting cultural significance, and they consider sustainable prosperity in urban and regional areas. Over time, urban planning theories and professional activities have evolved, moving beyond physical surveys, design, mapping, and infrastructure engineering to encompass broader social, environmental, and economic issues (Taylor, 1998).

From the beginning of the 20th century, the new methods, techniques and approaches significantly influenced urban planning theories, research, and practice (Row & Jacobs, 1962). Especially in the last decades, the urban planning domain has seen greater inclusion of knowledge from different disciplines. This trend is driven by political transformations, climate change, rapid urbanization, and technological developments. New urban paradigms such as smart growth, compact city, inclusive city, health city, resilient city, and smart city have emerged (Gordon & Richardson, 1997; Gerometta et al., 2005; De Miguel González et al., 2023).

Research and urban planning practice have different timescales for studying and including these new paradigms. Most of the past and current literature on this subject is based on subjective methods, and it is unclear which divisions have persisted, which ones have declined or disappeared, and which urban planning research and practice areas are emerging (Carpentieri & Guida, 2022).

Since 2010, more than 50% of the global population has resided in urban areas, and by 2024, the total urban population was approximately 4.5 billion (World Bank, 2023). By 2050, it is estimated that about 68% of the world's population will live in urban areas (UN DESA, 2018). The World Bank indicates that the level, pace, and processes driving urbanisation are uneven around the world, with significant differences existing between developing (2.6% urban population growth rate) and developed countries (0.8% urban population growth rate). To sustainably manage urban population growth and its related phenomena, technicians must develop appropriate urban planning solutions and tools to support adequately decision processes (De Noia et al., 2024). Additionally, obtaining information about urban areas and their characteristics is crucial to urban planning (Lynch, 1984), with this knowledge encompassing the spatial organisation of urban development, particularly in the context of urbanisation (Levy, 2016). Thus, urban planning is indebted to both the practical application of planning and the academic pursuit of knowledge construction (Pinson, 2004). Castells (2005) identified three key considerations for urban planning that are particularly relevant in the current global context: (a) the planning of mobility and connectivity to address the challenges presented by networked communication and information and communication technologies (Bertolini, 2012); (b) environmental planning as a response to the multi-dimensional nature of urban life, including quality of life and pressing environmental concerns (Myers, 1988; Northridge & Freeman, 2011; Mouratidis, 2021); and (c) urban design and architecture, which aim to imbue meaning in the urban landscape (Ahern 2013; Heymans et al., 2019). Ultimately, urban planning entails the human and social sciences considering a range of problems in urban issues as well as promoting the integration of technicians' and researchers' knowledge with that of specialists in other fields. Researchers have scientifically investigated the different phenomena that are included in urban areas so as to develop new methods and tools to support the process of urban planning (Kapelan et al., 2005).

Throughout history, the discipline of urban planning has continually evolved to meet people's needs and overcome the challenges in the field (Anttiroiko, 2012). The numerous and complex economic, social, and

environmental challenges that will have to be faced in the coming decades in terms of governing urban and territorial transformations will require the use of new approaches that can orient the development of these territorial contexts towards social, economic, environmental, and institutional sustainability (Özkan et al.,2025; Santangelo et al., 2018). Transformation choices and interventions must guarantee citizens an adequate quality of life and conditions that reduce the adverse effects of environmental, social, and economic issues (Sanfilippo et al., 2025).

In the last decades, research on urban planning has undergone significant developments in various areas: (a) there has been a growing emphasis on understanding the interdisciplinary nature of urban planning by integrating aspects of design, policy, law, social sciences, and engineering (Bibri & Krogstie, 2017); (b) the importance of data and digitisation in urban planning as well as the need to incorporate and analyse complex and data-rich information have been recognised (Papa & Fistola, 2016; van Winden & de Carvalho, 2017); (c) the patterns and dynamics of urban agglomeration and dispersion have been explored, with a particular focus on population density and development policies (Johnson & Munshi-South, 2017); (d) the crucial role of urban planning in achieving sustainable cities has been increasingly acknowledged, with an emphasis on overcoming social, economic, and environmental challenges (Gargiulo & Russo, 2017); and (e) there has been increasing awareness of the impact of urbanisation on the quality of life of various categories of citizens, particularly those who are vulnerable (Barquilla et al., 2023; Guida & Carpentieri, 2021).

This study seeks to understand how the state of knowledge for urban planning discipline has evolved and the modification of its relationship with other topics of interest in urban areas in the international scientific debate. The study proposes an alternate perspective on the development of urbanization studies and presents a systematic bibliometric analysis of published urban planning in the last decade. This analysis aims to reveal categorical, temporal, and geographical patterns in scientific. The significance of the study for the discipline is highlighted by the consideration that the findings could also help identify future urban planning trends in the scientific research sector and urban planning practice.

This article examines the past trajectories of urban planning research from a scientific standpoint using a systematic review of the literature on urban planning. This study's main focus was on the past decade's publications (2014-2024), but the literature analysed starts in 1926, when the oldest article included in this SLR was published. Scopus database was used as the source of analysed data. It is structured as follows: Section two focuses on the text mining methods and techniques used for systematic literature reviews (SLRs); Section three describes the data collection process, which entailed obtaining research from the Scopus database published between 2014 and 2024; Section four describes the steps taken in the analysis and the specific software used for this; Section five presents the results obtained from the text analyses; and the last section discusses the results and conclusions of this study on the evolution of urban planning in the scientific community between 2014 and 2024.

2. Systematic literature reviews

The systematic literature reviews (SLR) offers a scientific and rigorous approach to identifying, analysing, and interpreting the available evidence for a specific research question (Esfandi et al., 2024; Mohamed and Yamu, 2023). They are conducted to provide a complete and valid understanding of the topic, and they involve planning, conducting, and reporting the reviews in a structured manner. SLRs are different from traditional literature reviews as they aim to identify all studies that address a specific question and minimise bias through rigorous methodology. It is the method of choice for evidence-based practice projects, and they are used to identify the most precise and reliable estimate of an intervention’s effectiveness. The SLR process has been adapted from medicine to serve the needs of various disciplines, and it involves developing a review protocol, selecting databases, defining inclusion and exclusion criteria, characterising the corpus, and synthesising the findings.

To obtain significant results from the SLR of urban planning papers, this study employed the tools and resources of text mining (Carpentieri et al., 2023; Gobster, 2014). Also known as text data mining, this process involves extracting previously unknown knowledge from textual data (Feng et al., 2017). This technique has been used on a wide range of documents, including patent data for technology trend analysis (Lim, 2025), customer opinions to provide insights into customer behaviour (Jansen et al., 2009), feedback (Ordenes et al., 2014), and scientific documents to provide an understanding of specific research fields (Wang et al., 2021; Jo et al., 2009). Recently, machine learning algorithms have been applied to text data to discover knowledge hidden within it (Hickman et al., 2020; Popoff et al., 2020). For instance, clustering algorithms have been used to identify unknown categories of documents (Aggarwal & Zhai, 2012), while classifiers have been used to automate the classification of spam mail and identify significant words (Yu et al., 2008). One of the most prominent algorithms for text mining is the topic modelling algorithm, which uses techniques such as latent Dirichlet allocation (Blei et al., 2003) and non-negative matrix factorisation (Lin, 2007) to uncover hidden topics within a set of documents. The effective interpretation of the results from a text data analysis requires visualisation as most text mining analyses involve numerous features and require semantic interpretation (Lim et al., 2021). For example, a visualisation of the network between different keywords can be used to understand the key links between the keywords, thereby allowing them to be efficiently categorised (De Jong et al., 2015).

Moreover, this study also employed textometric analysis, which is a quantitative method for analysing textual data. It is used to identify the frequency of words and phrases as well as the relationships between them, thus gaining insights into the topics and relationships in the text (Helme-Guizon & Gavard-Perret, 2004). Textometric analysis has been used in various fields, such as spatial planning, in which it was used to identify the key themes and concepts discussed in the literature on spatial planning (Bart, 2011), track the evolution of spatial planning theorisation over time, compare different stakeholders' views on spatial planning issues, identify gaps in the literature on spatial planning, and determine emerging trends in spatial planning (Marchand & Ratinaud, 2012). Buhler et al. (2018) used textometric analysis to identify the key themes in urban policy discussions on urban transport plans in France, Bueno et al. (2021) used it to identify the key themes in urban resilience research, and Carpentieri and Guida (2022) employed it to track the evolution of urban planning in Italy.

Thus, these studies demonstrated textometric analysis's ability to provide insights into spatial planning. However, it is important to note that textometric analysis is a complex technique that requires careful planning and execution. Moreover, researchers need to be aware of its limitations, such as its ability to only identify explicit themes and concepts that are mentioned in the text. Overall, while textometric analysis is a valuable tool that can be used to gain insights into spatial planning literature, it needs to be used in conjunction with other methods such as qualitative analysis to obtain a complete understanding of the issues being studied.

The analysis herein entails calculating the "proximity" between words by analysing the words that recur less and more often, according to centrality values (Mandják et al., 2019).

In particular, this technique involves distinguishing the most recurrent and connected words from the peripheral (i.e., the less recurrent and connected) words. The frequency of single words is examined, and the direct links between words in terms of proximity within the sentences of the analysed text are also analysed (Gonçalves Júnior et al., 2021). The frequencies and proximity links are illustrated using a tree diagram, the branches of which represent the connections between the different words. These branches or "segments" are created from the distribution of the words in the text, with the proximity and proximity recurrency indicating the existence of an encompassing conceptual framework: the closer the words are to one another, the stronger the indication that they are included in a conceptual framework. Moreover, although two concepts may seemingly pertain to different lexical fields, a high frequency of occurrence in the same connection segment indicates that they share a conceptual link.

3. Data collection and analytical approach

This SLR utilised Scopus as a source database due to its substantial content coverage, convenience, practicality, and reliable impact indicators. Scopus was also chosen as it potentially provides more specialised coverage in urban planning, which is particularly pertinent to this review. Furthermore, compared to the Web of Science database, the Scopus database includes a more extensive collection of scientific journals and numerous published articles supporting a more comprehensive urban planning debate analysis.

The first selection considers the words *urban* and *planning* included in the titles, abstracts, and keywords published in English and indexed in the Scopus database. This selection includes 105,166 documents published from 1926 to 2025. Until 1960, the Scopus database contained only a few articles per year. This likely reflects the uncommon practice of publishing in international scientific journals or book series during this historical period, which favored alternative local or national forms of disseminating research results. In this first time interval, United States research institutions published the majority part of these articles. In 1970, the number of articles published per year was over 100. Only since 2002 have the indexing articles been over 1,000 documents, predominantly published by the United States, the United Kingdom, and Canadian research institutions. Since 2014, the number of annual publications has reached 3,266 documents, surpassing 3,000 publications per year for the first time.

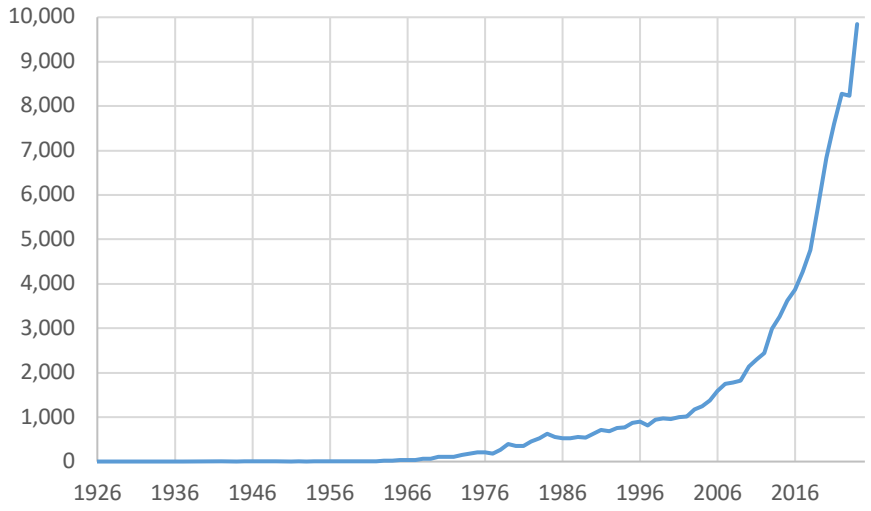

Fig.2 Number of articles for each year from 1926-2024

This method involves choosing clear and reproducible survey techniques, allowing for a comprehensive overview of the literature. It helps to accurately identify the current key issues and highlights the main topics raised by the scientific community within the selected time frame.

This study focuses on the past decade (2014-2024), because this time interval is the most productive in terms of the number of index publications (over 62% of total publications indexed in Scopus from 1926 to 2024) compared with the previous decade and considers the recent trends that interest the discipline researches (e.g. Climate changes, COVID, energy transition, inequalities, …). The outcomes of this analysis could offer the possibility of better understanding the future research directions in this field. To achieve the objective of this research, the criteria for selecting articles from the Scopus database are outlined as follows:

- *urban* and *planning* needed to be included in the papers' titles, abstracts, and keywords;
- the article needed to be published between 2014 and 2024;
- the documents could only be peer-reviewed journal articles or full-article proceedings collected from Scopus;
- the articles had to be in English;
- the articles that were published were the final versions.

The code of the query generated for the Scopus search module was TITLE-ABS-KEY (urban AND planning) AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")).

These criteria resulted in the Scopus tool returning 65,368 articles. This number of articles aligned with the investigation of the ongoing evolution in urban planning research according to the topics, methodologies, and geographical areas of interest.

The software Iramuteq (http://www.iramuteq.org/) was used to conduct different text analyses, such as the basic lexicography related to lemmatisation and word frequency, descending hierarchical classification, post-hoc correspondence factor analysis, and similarity analysis. Moreover, comprehensive vocabulary distributions are presented in graphical representations that are derived from the lexicographic analysis. These analyses can be performed using texts centred around specific themes (text corpus) that are grouped in one text archive or comprising spreadsheet data (matrices with individuals in a row and words in a column), such as the dataset derived from free evocation tests.

This study focuses on the analysis of the words included in the titles of selected documents. The analysis of words considers the titles of selected scientific documents, this is a consolidated approach to tracing the processes of discourse formation and the cognitive structure of fields or disciplines (Milojević et al., 2011). Much has been written about the importance of titles in scientific journal articles, but little research has been carried out on the text analyses of titles (Hartley, 2005). There are two primary aspects to consider about the significance of titles for scientific publication (Lewison & Hartley, 2005). First, titles must attract readers: "Here is something important you need to read". Second, titles must also inform readers immediately of the contents of the papers.

The methodological approach adopted includes three steps, as outlined by Lavissière et al. (2020):

1. The software lemmatises content words such as nouns, verbs, adjectives, and adverbs, resulting in the grammatical information, such as the plural or verb tense, being removed from the corpus;
2. The software divides the corpus into segments that become the basic unit of context used in the statistical analyses;
3. The software performs a basic statistical analysis to determine the following information: (a) the number of texts in the corpus; (b) the number of words in the corpus; (c) the number of active forms in the corpus; (d) the number of hapaxes in the corpus; and (e) the average number of words per text. In addition, four tables are created in this step:
   - active forms ranked from most to least frequent;
   - supplementary forms, including grammatical words such as "a," "the," and "for," which are not counted as part of the active forms category;
   - hapaxes (i.e., words that occur only once in the corpus);
   - the total number of words, including both the active and supplementary forms.

With the support of this analysis, it extracted quantitative information through the systematic identification of words and the related information useful to better understand the evolution of discipline in the selected decade (Illia et al., 2014; Sarrica et al., 2020).

4. Findings

From the application of the method described in section 3, it was selected a sample of 65,368 papers included a total of 999,531 occurrences (total words), 33,146 forms (unique words), and 17,896 Hapax legomena (analysed words). Tab.1 details these data for each year. The paper proposes two approaches to analysing the results obtained by the frequency analysis: The first entails using a word cloud to analyse the results obtained from all articles, and the second comprises comparing the results for each year to identify the variation in the use of words in the papers' titles.

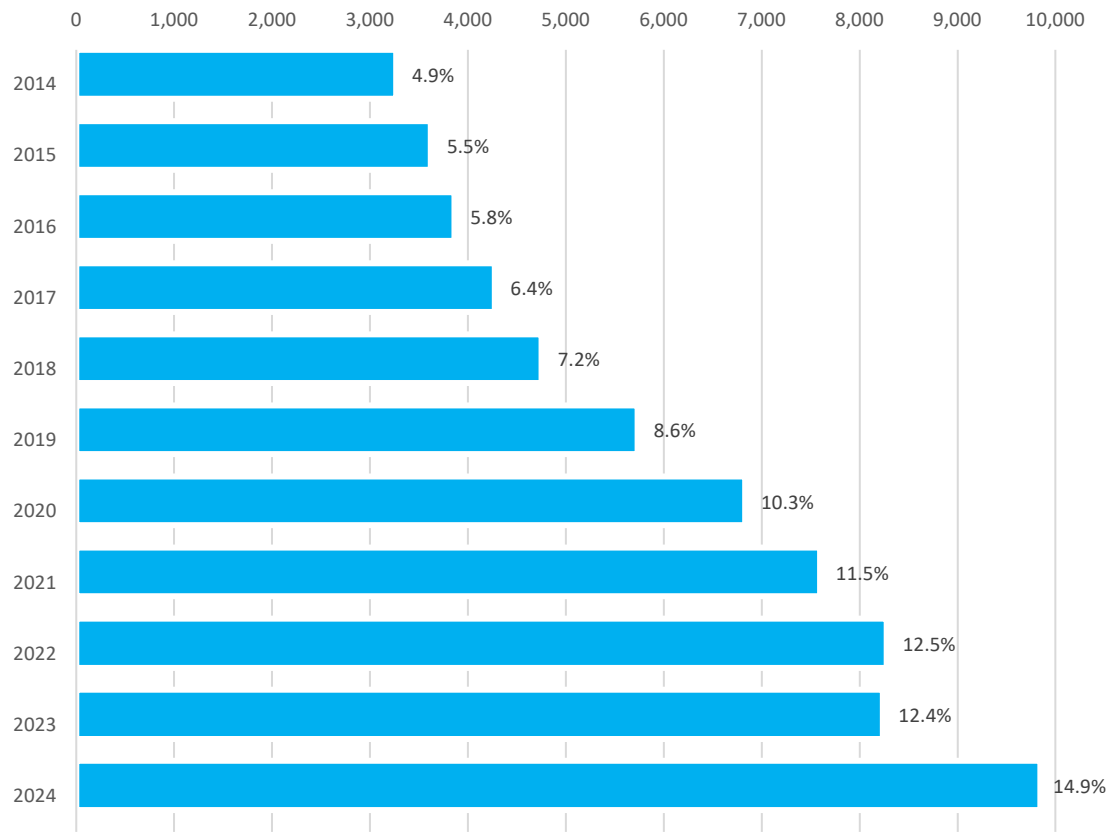

Fig.2 Number of articles for each year from 2014-2024

Year	No. of articles	Occurrences	Forms	Hapax legomena
2014	3,266	46,750	6,481	3,525
2015	3,624	51,505	6,755	3,632
2016	3,862	55,131	6,927	3,720
2017	4,273	61,537	7,204	3,846
2018	4,755	69,168	7,625	4,129
2019	5,735	84,637	8,518	4,575
2020	6,831	101,738	9,457	5,111
2021	7,595	115,094	9,724	5,146
2022	8,278	125,348	10,289	5,509
2023	8,242	130,966	10,427	5,563
2024	9,907	157,632	11,362	6,032

Tab.1 Data for each year from 2014-2024

As indicated in Tab.1, the number of articles increased steadily in this decade, suggesting that the scientific debate on urban planning became increasingly consistent. Fig.3 details the number of articles on urban planning per country.

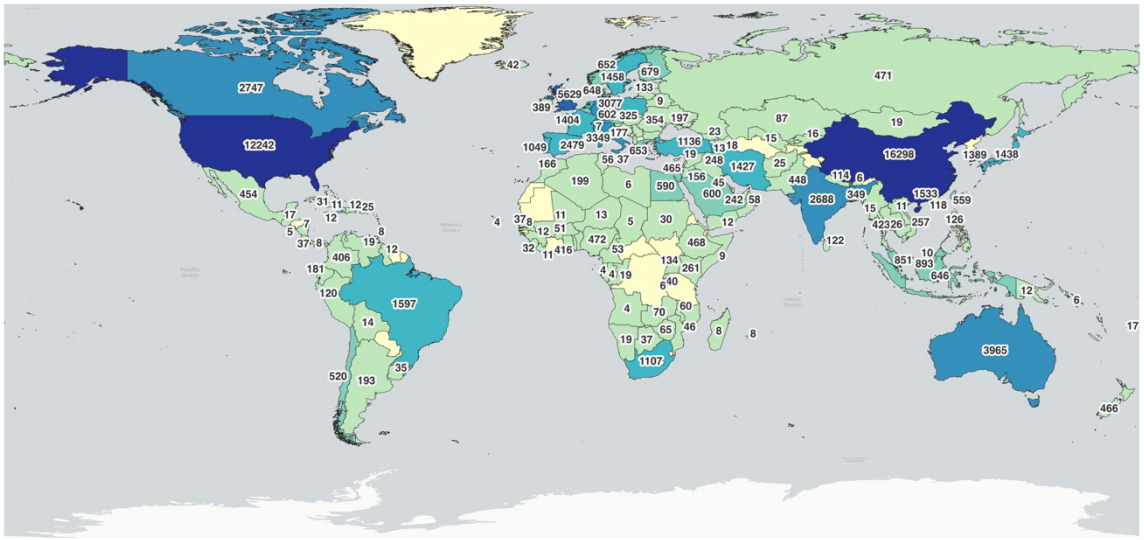

Fig.3 The Number of articles per country from 2014-2024

Fig.3 indicates that urban planning is a global field of research. The China published the majority of the total articles (24.6%), followed by United States (18.4%), but the following countries also made significant contributions: The United Kingdom (8.5%), Australia (6.0%), and Italy (5.0%). The distribution of scientific publications in this decade shows a focus on developed countries that have consolidated urban contexts (e.g., Europe) and developing countries (e.g., some Asian countries), in which new urban areas are being created to meet citizens' needs. Urban planning is a growing field of research and is becoming increasingly important in the face of rapid urbanisation and other significant issues that affect urban areas.

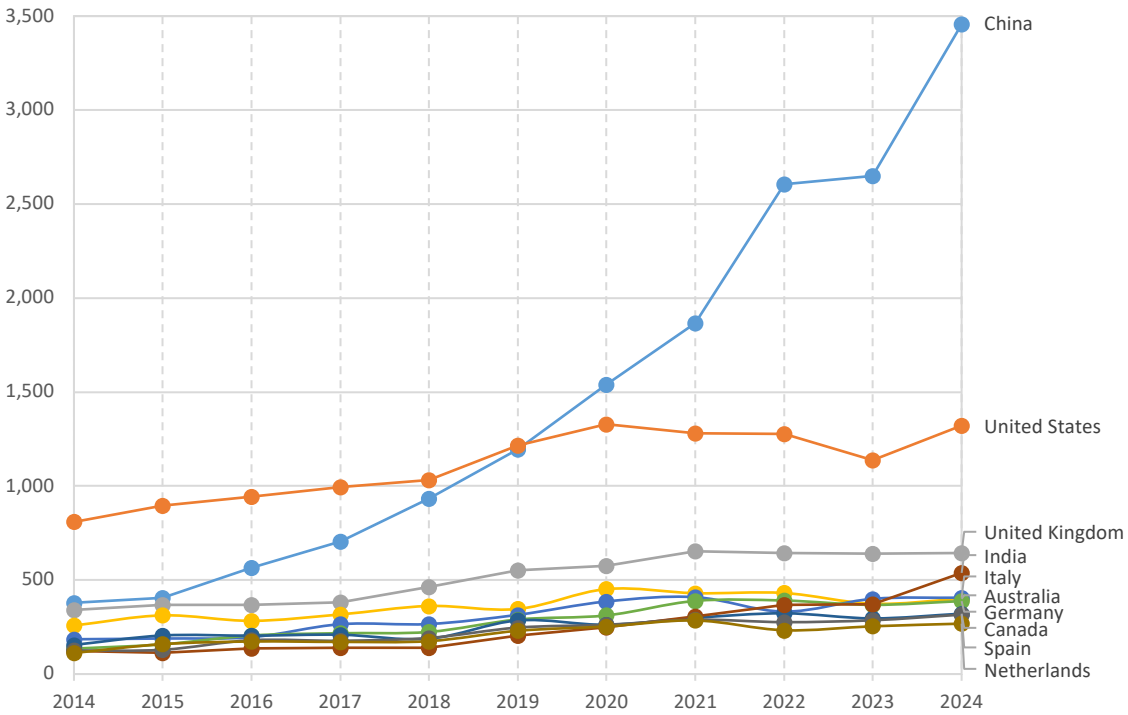

Fig.4 The ten countries that produced the majority of the studies on urban planning from 2014-2024

In terms of institutions' studies (see Tab.2), the Chinese Academy of Sciences published the highest number of urban planning papers in this time span. Indeed, only four of the 15 institutions in the world that produced the highest number of publications were not Chinese. Chinese institutions' growing interest in the scientific debate on urban planning is evidenced in Fig.4, which indicates that Chinese research institutions have been

progressively catching up to the United States by more than doubling their scientific output between 2019 and 2024.

Rank	Institution	Nationality	No. of articles
1	Chinese Academy of Sciences	China	1,760
2	Ministry of Education of the People's Republic of China	China	1,223
3	Wuhan University	China	887
4	University of Chinese Academy of Sciences	China	800
5	Tongji University	China	721
6	University College London	United Kingdom	717
7	University of Melbourne	Australia	662
8	Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences	China	615
9	Peking University	China	606
10	The University of Hong Kong	China	597
11	Delft University of Technology	Netherlands	539
12	Beijing Normal University	China	504
13	Zhejiang University	China	498
14	Sun Yat-Sen University	China	490
15	The Hong Kong Polytechnic University	China	476

Tab.2 The institutions with the highest number of urban planning publications

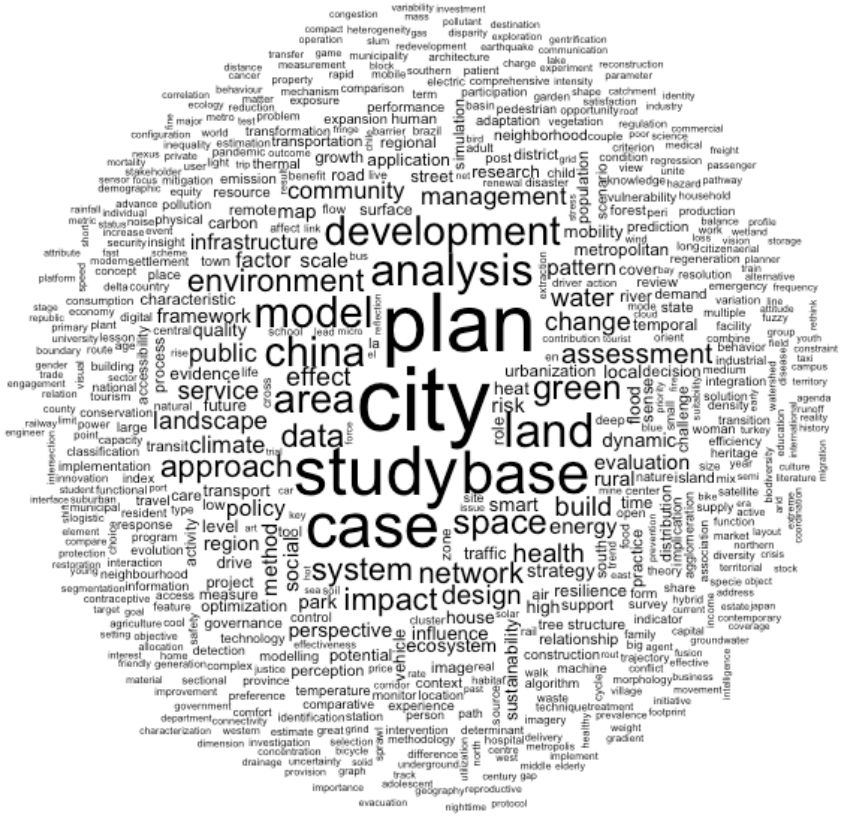

Fig.5 Word cloud of the selected urban planning articles indexed in the Scopus database from 2014-2024

The word cloud in Fig.5 shows the relevance of the words extracted for the current analysis. The size of the text is proportional to the frequency of words in the titles. From the cloud, the most frequents words in the selected text are: *city*, *plan*, *study, case*, *base*, *land*, *analysis*, *model, China* and *development*. These main ten words further underlined some aspects of both the centrality in this discipline of the technician tools and spatial dimension. Furthermore, it emerged from the above data related to the high interest in urban planning from the Chinese scientific community in theoretical and practical studies. To better understand the results obtained, it was decided to divide the words into three subsets based on tematic, technical and localization aspects. The three main subgroups of words were identified according to the leading parts on which scientific study and research activities focus to understand the results better and acquire more information on the evolution of the discipline. The subgroups of words were identified by analysing the words included in the 65,368 selected titles of papers. The three subgroups were named as follows: *Research topics*; *Methods and techniques*; and *Spatial dimensions and places*. A limitation of this thematic analysis of the words is that not all the words were included in the three macro groups because some could be included in other possible thematic subgroups, the identification of which could be the subject of future research.

4.1 Research topics

This group comprises the words related to specific topics of research or arguments of interest in urban planning, thereby providing an overview of the leading topics in urban planning research during the last decade. Table 3 details the 20 most commonly used words in the selected titles from 2014-2024 in this group, and it also lists the order of the words according to how frequently they are used in the group (Group rank) and the order of the words according to how frequently they are used in the entire sample (General rank).

Rank	Word	General rank	Frequency
1	*land*	6	5,431
2	*development*	10	4,498
3	*green*	14	3,595
4	*environment*	16	3,223
5	*sustainable*	20	2,833
6	*health*	25	2,419
7	*public*	27	2,384
8	*water*	28	2,359
9	*service*	29	2,347
10	*landscape*	30	2,258
11	*climate*	33	2,108
12	*policy*	34	1,968
13	*energy*	37	1,835
14	*infrastructure*	38	1,820
15	*social*	42	1,727
16	*risk*	43	1,714
17	*rural*	46	1,631
18	*smart*	54	1,489
19	*ecological*	57	1,416
20	*ecosystem*	58	1,391

Tab.3 The words used most frequently in articles' titles in the Scopus database from 2014-2024

The word *land* was the most frequently used word in this group but was sixth in the inter-group of words obtained from the titles, thereby indicating that studies on land were common in urban planning. Other

frequently occurring words included *environment*, *sustainability*, and *green,* suggesting that studies on environmental issues were significant in urban planning. Furthermore, several words were related to social issues, such as *health*, *public*, and *service*. The word *climate* was also used frequently, suggesting that urban planning is increasingly focused on addressing the challenges of climate change. These results highlights that urban planning studies concern cities' and their citizens' physical, social, and economic well-being.

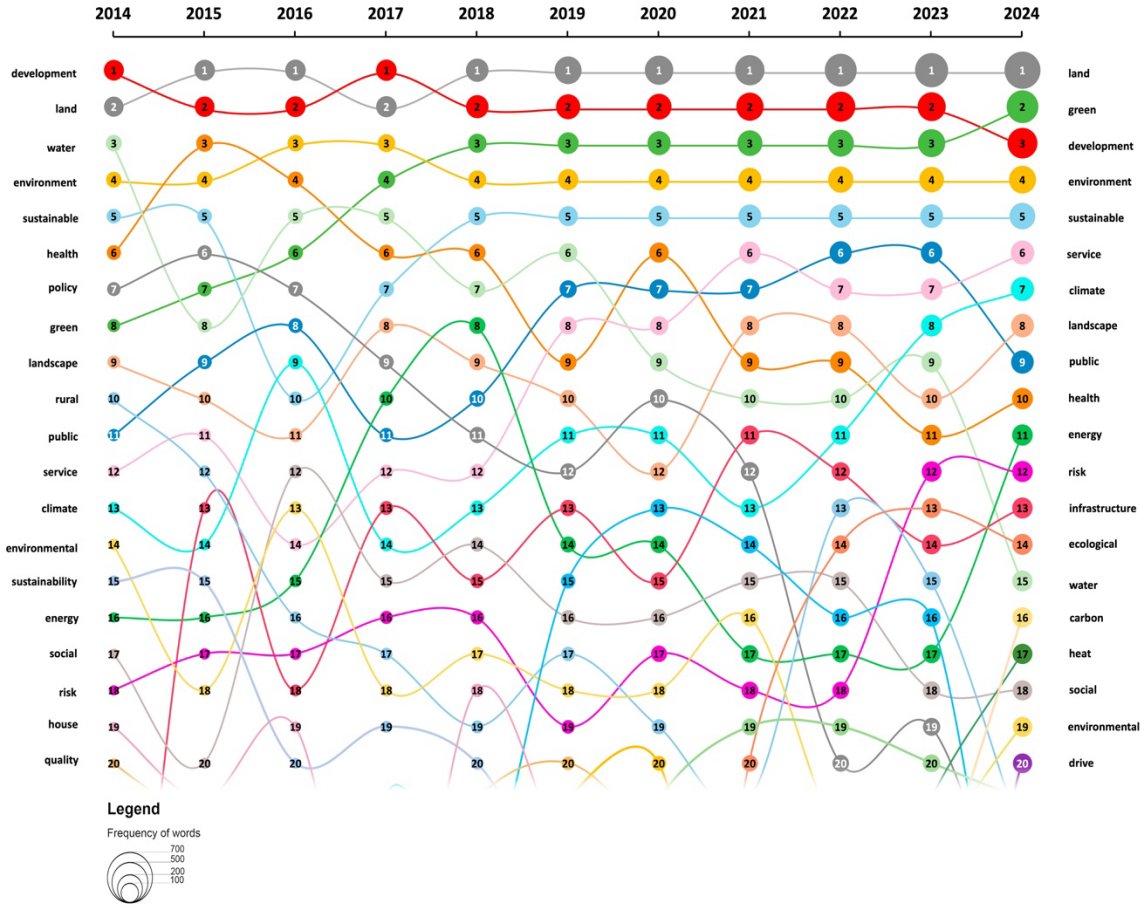

Fig.6 The Variation in rank and frequency (dimension of point) of words in the research topics group per year

Considering the words included in this group, some subgroups can be determined: The first subgroup conteins words related to the discipline's identity arguments, such as *development*, *policy,* and *risk*; the second sub-group relates to environmental issues, encompassing the words *green, environment*, *sustainable*, *ecological, ecosystem* and amongst others; and the third denotes socioeconomic issues, indicated by the words *health*, *public*, *service*, *social*, and the like. Fig.6 is a bump chart that details the frequency variation per year from 2014-2024. The variation in word frequency was used to identify the evolution of key concepts and issues discussed in urban planning research, which can help understand new focus, ideas, and solutions in future urban planning studies. Three main groups of variations can be delineated according to the frequency variation per year: The first group of words is very stable, the second group has a moderate variation level, and the third group has high variation during the years of observation. In details, the words *development, environment,* and *land* had the highest frequency values in all years, with some position variation between them and a constant frequency increase. Alternatively, the use of the word *green* progressively increased, moving from the 8th position in 2014 to the 2nd position in 2024. In addition, the word *social* stayed in the 17th position in 2022 and in the 18th in last years of analysis but, over the ten years, its position varied. Furthermore, the use of the words *environmental, sustainability* and *policy* over the years significantly decreased, and the words *service*, *climate* and *risk* increased in frequency in the later years of the time span analysed. These results suggests that some concepts innovative technologies and approaches as well as cities' abilities to withstand

shocks and stresses are becoming increasingly important issues in urban planning. Overall, urban planning research increasingly focused on the topics of cities' physical, environmental, and economic sustainability. The highest frequency words reflect these topics and provide a basis for understanding the future development of the discipline.

4.2 Methods and Techniques

This group includes words related to approaches, techniques, data, and instruments that were popular in urban planning between 2014 and 2024. Tab.4 lists the 20 words used most frequently in the titles of the papers belonging to this group. The table also lists the order of the words in the group (Group rank) and the order of the words in the total words analysed (General rank).

Group rank	Words	General rank	Frequency
1	*plan*	2	10,147
2	*analysis*	7	5,033
3	*model*	8	4,832
4	*spatial*	12	4,422
5	*assessment*	21	2,686
6	*management*	31	2,238
7	*multi*	35	1,906
8	*method*	40	1,784
9	*evaluation*	44	1,676
10	*framework*	49	1,577
11	*dynamic*	50	1,545
12	*optimization*	94	1,001
13	*process*	97	967
14	*simulation*	102	952
15	*perception*	108	926
16	*remote*	115	888
17	*GIS*	118	876
18	*tool*	121	850
19	*scenario*	122	834
20	*prediction*	139	738

Tab.4 Most frequently used words in the methods and techniques group from 2012-2022

Tab.4 highlights that only *plan, analysis* and *model* ranked within the top-most used words in the General rank of this group. At the same time, *spatial* was the twelfth most-used word (eleventh position in General rank), also confirming its significance in the discipline studies. In support of this, there is also the word *GIS*, which is the most frequent for this group. The words of this group can be categorised into the sub-group of methods and approaches, indicating the widespread discussion of this topic in urban planning phenomena and processes, exemplified by the words *model*, *assessment*, *multi*, *method* and more. The second subgroup included the words that refer to various techniques that support applying quantitative and qualitative methodologies to analyse urban planning phenomena, such as *analysis*, *spatial*, *management*, *evaluation*, *framework*, and more.

Fig.7 is a bump chart detailing the results obtained from analysing the frequent evolution of words over ten years for this group. Generally, the frequency of all words increased annually alongside the growing number of articles published on urban planning. Three main groups of words were identified from this analysis: The first group (at the top of the chart) includes words that remained stable over time, the second group shows a moderate variation in their positions, and the third group (at the bottom of the chart) consists of words that

frequently shifted their positions, especially during the first part of the decade. The first group includes five words (plan, model, analysis, spatial and assessment) that did not vary over the ten years of analysis to confirm the centrality of these words for the scientific debate. The second group of words showed moderate variation in this period (*management*, *evaluation*, *framework*, *dynamic* and *method*). The third group of words, from the word *dynamic*, varied significantly during the ten years of observation. The words *GIS*, *tool*, and *process* have shown a progressive reduction in their frequency in the debate compared to other words that have seen greater success over the years, such as *remote*, *prediction* and *optimisation*. The progressive decline of *GIS* and *tool* may indicate a shift from traditional mapping techniques toward integrated digital platforms and real-time analytics. The rise of *remote*, *prediction* and *optimisation* words suggests a growing reliance on data-driven and AI-based approaches in urban planning discipline. Some words, such as *perception, simulation*, and *scenario*, did not change rank between the first and last year, but their positions changed significantly in the intervening years.

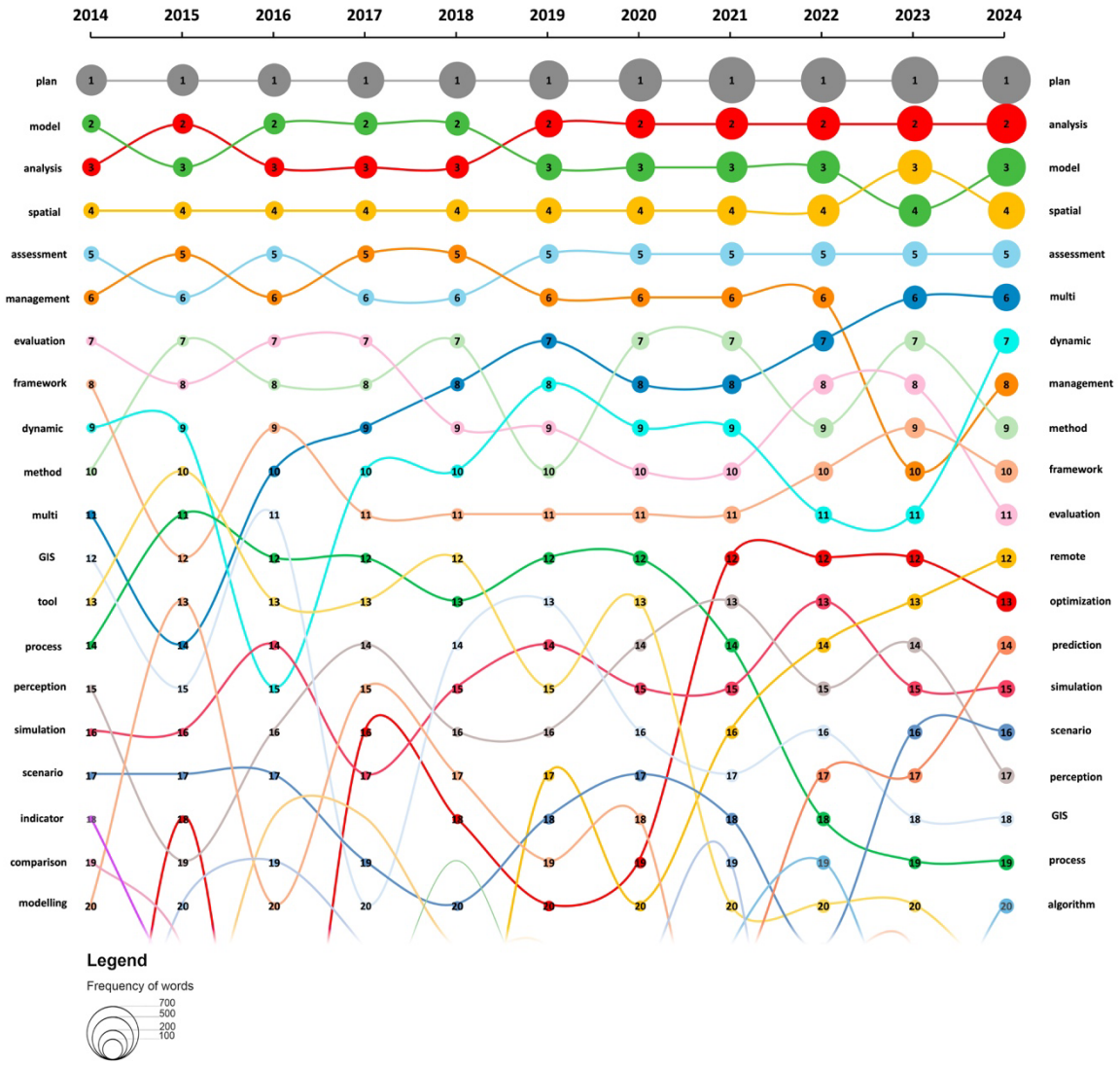

Fig.7 The variation in rank and frequency (dimension of point) of the words in the methods and techniques group per year

4.3 Spatial dimensions and Places

This group contains the words related to the scales of analysis and geographical locations. Tab.5 lists the 20 most frequently used words in this group as well as the order of words in the group (Group rank) and the order of words in the list of total words analysed (General rank). The word *city* was the most frequently used

word in this group as well as all the words analysed in this study. The subgroup of Spatial Dimensions included nine of the twenty words: *city*, *area*, *network*, *region*, *neighbourhood*, *local*, *metropolitan*, *district*, *town* and *costal*. The subgroup of Places contained eight words of the twenty: *China*, *park*, *river*, *India*, *South*, *island*, and *Beijing*.

Group rank	Words	General rank	Frequency
1	*city*	1	11,229
2	*China*	9	4,640
3	*area*	11	4,425
4	*network*	19	2,945
5	*scale*	45	1,639
6	*region*	51	1,544
7	*map*	52	1,538
8	*park*	53	1,506
9	*local*	60	1,337
10	*metropolitan*	73	1,150
11	*river*	88	1,049
12	*India*	95	978
13	*South*	103	949
14	*regional*	104	948
15	*district*	111	914
16	*island*	113	896
17	*neighborhood*	116	886
18	*Beijing*	133	780
19	*town*	144	709
20	*costal*	155	658

Tab.5 Most frequently used words in the spatial dimensions and places group from 2014-2024

Fig.8 delineates the most frequently used words in the Spatial Dimensions and Places group in a bump chart, showing that the frequency of all words increased each year in correlation with the number of articles published on urban planning. These words can be divided into two subgroups: the top of the chart, which includes words with high stability, and the bottom, which indicates increased instability. From the results presented in Fig. 8, the instability increases as the value decreases. This aligns with the results achieved by the other groups. In particular, the rank positions of the first four words (*city, area, China,* and *network*) did not vary significantly during the observation period. The stability of terms such as *city* and *area* reflects their foundational role in urban planning discourse. The results obtained for *China* confirm the analysis proposed in the previous paragraph, which highlights China's significant role in the global urban planning debate. In line with this result, it is notable that the progression of the word *Beijing*. The results also evidence the significant role of another country in the urban planning debate, which is *India*.

The words *region, and park* varied progressively during the ten years of observation. Moreover, *local* varied significantly in each year, progressing from the 6th position in 2014 to the 10th position in 2024, and *metropolitan* progressed from the 8th position in 2014 to the 13th position in 2024.

Another interesting result is the progression of the word *map*, which moves from the 13th position in 2014 to the 6th position in 2024, indicating the importance of this term suggests an increasing reliance on geospatial technologies and data-driven approaches. In conclusion, these results indicate that urban planning research is shifting towards a more data-driven approach, where spatial analytics and digital mapping will play a key role in addressing the challenges faced by urban environments worldwide.

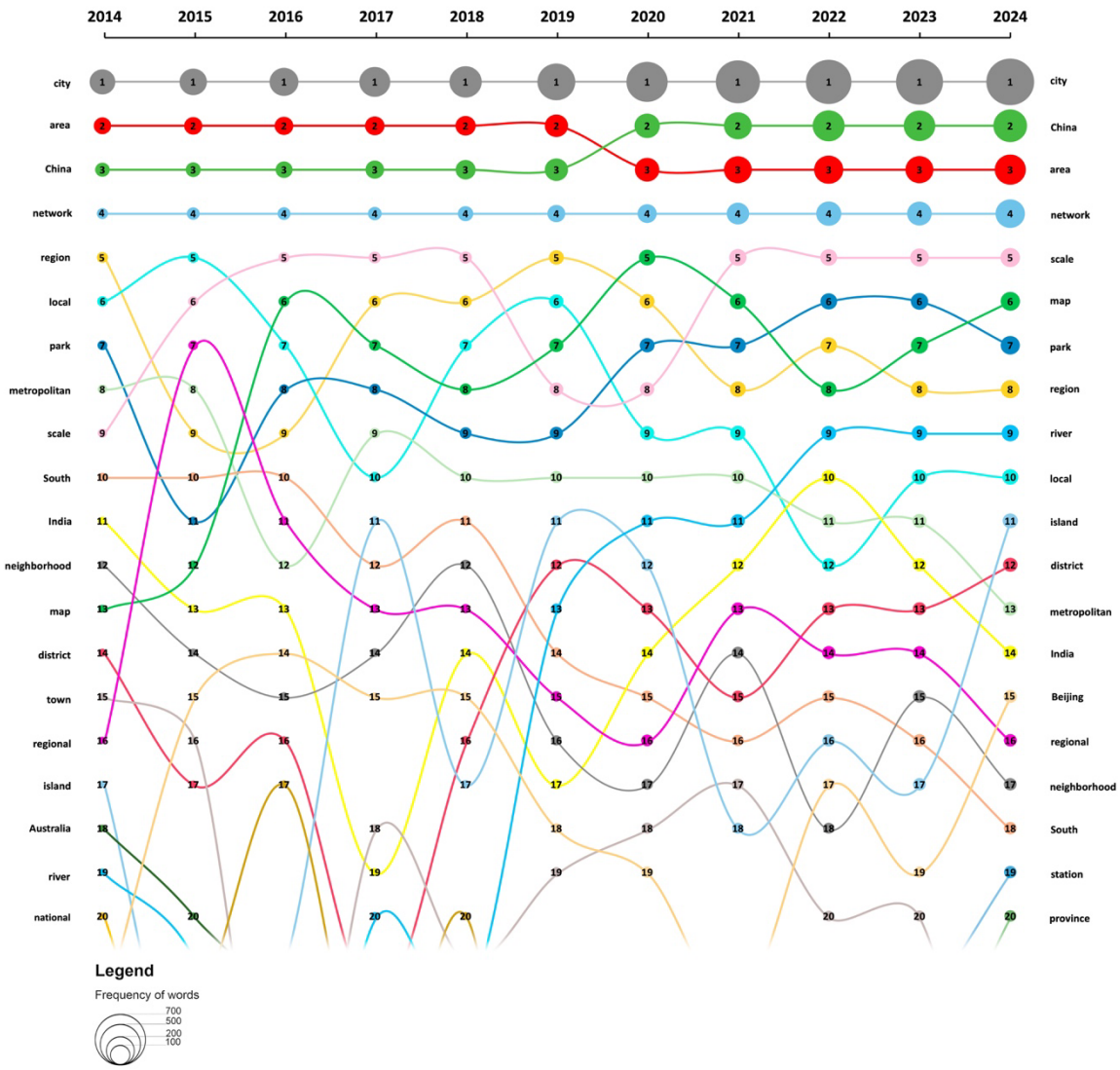

Fig.8 Variations in rank and frequency (dimension of point) of words in the spatial dimensions and places group per year

5. Conclusions and research limitations

Over time, the evolution of urban planning research has been studied by a wide range of academics across various points of view and different approaches, considering specific related topics or the discipline in its entirety. This study contributes to a better understanding of the global scientific trends of urban planning research through an SLR of scientific papers indexed on the Scopus database. Using textometric analysis, this study employed word-counting and relation techniques to identify the primary topics and concepts within the scientific literature and track how they evolved over this period. Articles' titles were systematically examined to uncover the predominant words and concepts, providing insights into the evolution of discipline debate and potential future sectors of interest.

This systematic review provides a comprehensive overview of global urban planning research trends from 2014 to 2024, highlighting thematic, methodological, and geographical evolutions. The study offers two main categories of results. The first category includes the outcomes related to the variation of discipline topics, methodologies, tools and areas of experimentation. In particular, the analysis highlighted a significant evolution of the topics investigated in the discipline over this decade, with some new subjects progressively gaining increased prominence. From the results, it is clear that some innovative terms initially exhibited high variation in their rank positions. For examples, the word "green" climbs from eighth to second place. Considering other words that have become more frequent in 2024, such as "climate" and "risk", this could

highlight climate change mitigation and adaptation policies that have been integrated into urban planning processes and are moving toward nature-based solutions. Moreover, during the time interval of observation, some of them became more stable and significant, especially for the words included in the "Methods and Techniques" and "Spatial dimensions and Places" groups. For example, the progressive affirmation of words is strongly related to implementing solutions involving spatial information systems. Indeed, the central role of words like *plan*, *model* and *analysis* alongside the increased frequency of the words *prediction*, *optimization* and *remote* could highlight the growing prominence of data-driven approaches and spatial analytics suggests that future urban planning will increasingly rely on predictive models and integrated digital platforms.

Second, this study revealed that academic communities' interest in the discipline is predominantly focused on advanced countries such as China, the United States, and European countries. Furthermore, the data analysis indicated that most discipline-related debates centred around these countries. Lastly, China's scientific output in urban planning during the observation period is particularly noteworthy, with a steadily increasing number of publications and institutions working on urban planning. This aspect is further highlighted by the results obtained in the paragraph "Spatial dimensions and Places" with words China (4,640 repetitions) and Beijing (780 repetitions).

In conclusion, this work presents an extensive and detailed framework for understanding the evolution of the urban planning discipline worldwide, highlighting how it has increased scientific production in the field in terms of the number of scientific products published and the geographical provenance of researchers. The proposed focus on the decade from 2014 to 2024 offers a deeper analysis of the changes that have occurred over the last decade in terms of topics, tools, and experimentation.

This study offers a detailed framework for examining how urban planning research has evolved and paves the way for future interdisciplinary methods. Its findings can aid the scientific community in recognising established and emerging topics within the field, while also supporting future research initiatives and international collaborations through insights into global themes, approaches, and experiments.

This study had several limitations and offers some suggestions for future research. The findings were influenced by the data collected, which may be subject to change if a different data source or time interval is used. Thus, although the data used in this study were sourced from the Scopus databases, it may be beneficial to expand the scope of data to other databases or specific domains, such as urban planning journals. In addition, the data collected from January 2014 to December 2024 provided an extended list of research topics and factors related to smart cities, but this was not addressed herein. Moreover, as this study only reviewed articles containing the words *urban* and *planning*, its scope was larger, as studies that only contained one of these terms may have been included. This study's outcomes may have also been influenced by the specific keywords used in the databases. Lastly, while this study provides valuable insights into the evolution of international research on urban planning within a specific timeframe, the search for particular keywords on a database may have limited the generalisability of the findings.

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Image Sources

All the figures were edited by the author using Iramuteq.

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