Scientific production on smart cities in Brazil: bibliometric mapping of BDTD doctoral dissertations (2013 to 2023)

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Produção científica sobre cidades inteligentes no Brasil: mapeamento bibliométrico de teses da BDTD (2013 a 2023)

RESUMO

Objetivo - Este estudo visa delinear a constituição do campo científico sobre "cidades inteligentes" no Brasil.

Metodologia - Análise bibliométrica de 40 teses defendidas entre 2013 e 2023, focalizando variáveis como: a) evolução temporal; b) distribuição geográfica e institucional; c) tópicos mais abordados.

Originalidade/relevância - A pesquisa oferece uma visão abrangente e inédita sobre o desenvolvimento acadêmico do tema cidades inteligentes no Brasil.

Resultados - Os resultados indicam um crescimento significativo na produção acadêmica sobre cidades inteligentes e a diversidade temática com ênfase nos programas de pós-graduação em Administração, Engenharia Elétrica e da Computação.

Contribuições teóricas/metodológicas – A análise bibliométrica de teses brasileiras oferece uma ferramenta eficaz para mapear tendências de pesquisa e identificar lacunas científicas.

Contribuições sociais e ambientais – O estudo demonstra que tópicos de cidades inteligentes como segurança pública, privacidade, participação social ativa, sustentabilidade e impactos econômicos ainda poderiam ser mais explorados.

PALAVRAS-CHAVE: Cidades Inteligentes. Comunicação científica. Brasil.

Scientific production on smart cities in Brazil: bibliometric mapping of BDTD dissertations (2013 to 2023)

SUMMARY

Objective – This study aims to outline the constitution of the scientific field on "smart cities" in Brazil,

Methodology – Bibliometric analysis of 40 dissertations defended between 2013 and 2023. A comprehensive bibliometric mapping was carried out, focusing on variables such as: a) temporal evolution; b) geographical and institutional distribution; c) most covered topics.

Originality/Relevance – The study provides a broad and unprecedented perspective on the academic development of the smart cities theme in Brazil.

Results – The findings indicate a significant growth in academic production on smart cities during the analysed period, along with thematic concentration in postgraduate programmes in Administration, Electrical Engineering, and Computer Engineering.

Theoretical/Methodological Contributions – The bibliometric analysis applied to the Brazilian context offers an effective tool to map research trends and identify scientific gaps.

Social and Environmental Contributions – The study highlights the need for deeper exploration of topics such as public safety, privacy, active social participation, sustainability, and economic impacts, which are crucial for developing more inclusive and resilient smart cities.

KEYWORDS: Smart cities. Scientific Communications. Brazil.

Producción científica sobre ciudades inteligentes en Brasil: mapeo bibliométrico de las tesis doctorales de la BDTD (2013 a 2023)

RESUMEN

Objetivo – Este estudio tiene como objetivo delinear la constitución del campo científico sobre "ciudades inteligentes" en Brasil.

Metodología – Análisis bibliométrico de 40 tesis doctorales defendidas entre 2013 y 2023. Se llevó a cabo un mapeo bibliométrico integral, centrado en variables como: a) evolución temporal; b) distribución geográfica e institucional; c) temas principales.

Originalidad/Relevancia – El estudio ofrece una perspectiva amplia e inédita sobre el desarrollo académico del tema

de las ciudades inteligentes en Brasil.

Resultados – Los hallazgos indican un crecimiento significativo en la producción académica sobre ciudades inteligentes durante el período analizado, junto con una concentración temática en programas de posgrado en Administración, Ingeniería Eléctrica e Ingeniería Informática.

Contribuciones Teóricas/Metodológicas – El análisis bibliométrico aplicado al contexto brasileño ofrece una herramienta eficaz para mapear tendencias de investigación e identificar vacíos científicos.

Contribuciones Sociales y Ambientales – El estudio resalta la necesidad de una exploración más profunda de temas como la seguridad pública, la privacidad, la participación social activa, la sostenibilidad y los impactos económicos.

PALABRAS CLAVE: Ciudades inteligentes. Comunicación científica. Brasil.

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1 INTRODUCTION

In the digital age, urban planning is a 'work in progress', with old challenges requiring effective solutions and new problems such as pandemics, disasters and security issues continuing to emerge (Kourtit, 2021). In this context, initiatives aimed at modernising urban infrastructure and services have been key in creating improved environmental, social and economic conditions, and in increasing the attractiveness and competitiveness of cities. These actions have led to the development of new urban concepts (Jong et al., 2015). Terms such as 'sustainable cities', 'smart cities', 'creative cities', 'resilient cities' and 'low-carbon cities' have been adopted in academic research and political discourse among urban planners.

Palmisano et al. (2023) argue that labeling cities as *smart* and *sustainable* stems from the need to raise quality-of-life standards amid growing urban challenges. In this context, Masiero et al. (2023) emphasize the importance of *resilience* and *urban sustainability* concepts to set goals ensuring future well-being and safety, particularly for the most vulnerable populations. On the other hand, the *smart city* concept stands out due to its strategic use of Information and Communication Technologies (ICTs) as tools for urban transformation.

Although there is no single model or definition to characterise a smart city, the most common definitions emphasise technology, human resources and governance. In this sense, Gil-Garcia, Pardo and Nam (2015) identified the following common points: (i) the use of ICTs in the city; (ii) the presence of cyber and physical infrastructures; (iii) better provision of services to the population; (iv) the combination, integration and interconnection of systems and infrastructures to enable social, cultural, economic and environmental development; and (v) the vision of a better future.

In the Brazilian context, Leite and Awad (2012) argue that research into smart cities could use technology to optimise informal territories, providing them with more appropriate infrastructure. In addition to the dissemination of ICTs, smart city initiatives should also include investments in human capital, with the aim of promoting the city's capacity for learning and innovation. These investments should support and encourage the education and development of the local population, improving their quality of life and growth potential (Neirotti *et al.* 2014). Despite being considered in the idealisation of smart cities, the social plan ends up being the most difficult to identify and measure. Salgado (2019) points out that the future agenda for cities must pave the way for the creation of better environments for people's lives, emphasising that the social dimension of sustainability can bring 'intelligence' to cities.

The complexity of strategic planning for smart cities cannot be ignored. Angelidou (2014) notes that this process is still considered an abstract idea, partly due to the lack of widespread exploration of the topic and the existence of conflicting interests between stakeholders such as local governments, research institutions and technology providers. This fragmentation makes it difficult to consolidate practices and policies in line with the social, economic and environmental demands of cities.

Understanding the role of scientific communication as an essential tool for sharing and consolidating new ideas and technologies, by enabling the dissemination of research results and fostering discussions. Measuring scientific activity makes it possible to better target research, maximise the efforts devoted to this activity and contribute to the discussion about its evolution

and quality. In this context, bibliometrics has emerged as a methodology that analyses scientific or technical activity through quantitative studies of publications (Silva et al. 2011). To do this, it analyses scientific production, citations and content produced in the light of elements of the socio-historical context in which scientific activity is produced (Araújo, 2006).

Based on this methodology, the research conducted by Guo et al. (2019) evaluated global research trends in publications on smart cities from 1986 to 2019 using the Web of Science platform as a database. It found that the topic of smart cities has been a field of extensive research over the last 20 years, especially the production of publications on smart cities has increased exponentially since 2010. By analysing keywords, this research showed that the main areas of research in the field of smart cities at international level were: (a) smart development; (b) telecommunications and computer science; (c) smart strategy for sustainable development; (d) public administration.

Fernandes et al. (2019) indicate that Latin American scientific production on smart cities has a small number of publications when compared to world production, around 5%. In a review of smart cities and the Internet of Things as a research topic, João et al. (2019) observed that the relationship between smart cities (SCCs), the Internet of Things (IoT) and innovation has received little attention in the context of developed countries and even less in comparison with developing countries. They also point out that recent studies on ICs and IoT, especially qualitative ones, tend to focus on 'global success stories', such as Singapore, Seoul, San Francisco and Barcelona, or on specific examples of typical smart city applications, such as solutions for mobility, clean energy, smart buildings, waste management, citizen participation, government digitisation, education and the development of business ecosystems. Godoy and Benini (2024) also reinforce the need to investigate the impacts of new technologies and forms of urban space production (such as digital manufacturing and the sharing economy) on the morphology of contemporary cities.

In a study published in 2022, Reis et al. identified four topics as the most relevant for the development of smart cities: (1) smart city dimensions; (2) digital transformation; (3) sustainability; and (4) resilience. The research also draws attention to the polarisation of studies in this field, showing that most research has focused on megacities in developed countries. In this context, the authors emphasise the need to expand efforts to carry out scientific research into small and medium-sized cities, especially in developing countries.

According to Dermeval et al. (2020), new forms of review have emerged to meet different demands for scientific evidence, such as Systematic Literature Mapping, also known as scoping review. This method is used when the aim is not to delve into specific issues, but rather to provide a broad overview of a particular area, as opposed to more detailed approaches such as bibliometrics.

In Brazil, universities play a central role in national scientific production and are responsible for a large part of the knowledge generated in the country (Silva et al., 2011). In this context, understanding that doctoral theses are a valuable source of data for scientific studies, as they represent research of high academic density, with the aim of delving into complex issues and contributing to the advancement of various areas of knowledge, we used theses produced in the last 10 years in the country as a sample. These academic productions reflect not only the

state of the art in certain fields, but also the strategic research directions prioritised by higher education institutions.
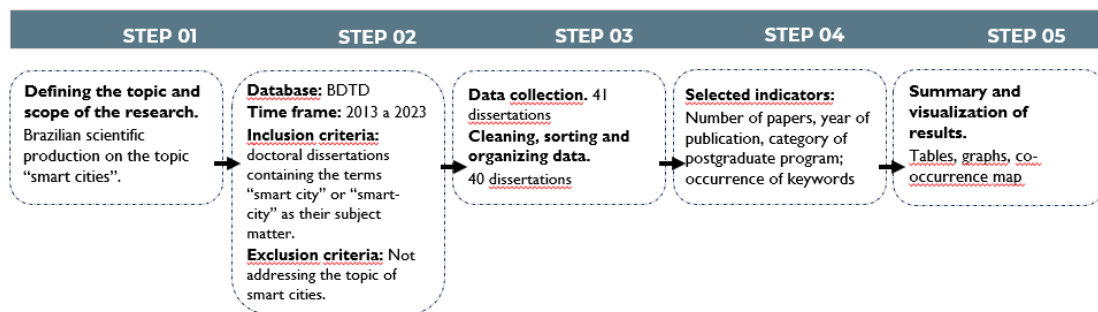
2 OBJECTIVE

This article focuses on analysing knowledge by surveying and characterising national scientific production using bibliometric techniques. The aim of this article is to analyse studies on smart cities in the Brazilian academic production of master's and doctoral degrees over the last ten years. The online collection of the Brazilian Digital Library of Theses and Dissertations (BDTD - https://bdtd.ibict.br/vufind/) of the Brazilian Institute of Information in Science and Technology (IBCTI) served as the primary source of data.

3 METHODOLOGY

Figure 1 describes the methodology that underpins this study. In the first stage, the research topic and its scope were defined. Then, for data collection, the indicators to be used were established.

Figure 1 – Research steps - "*smart city*" and "cidade inteligente"

STEP 01	STEP 02	STEP 03	STEP 04	STEP 05
Defining the topic and scope of the research. Brazilian scientific production on the topic "smart cities".	**Database:** BDTD **Time frame:** 2013 a 2023 **Inclusion criteria:** doctoral dissertations containing the terms "smart city" or "smart-city" as their subject matter. **Exclusion criteria:** Not addressing the topic of smart cities.	**Data collection.** 41 dissertations **Cleaning, sorting and organizing data.** 40 dissertations	**Selected indicators:** Number of papers, year of publication, category of postgraduate program; occurrence of keywords	**Summary and visualization of results.** Tables, graphs, co-occurrence map

Source: Authors, 2024.

In this second step, an advanced search was used to retrieve the data, adding the terms '*cidade inteligente*', smart cities and smart city in the subject field and selecting the search term 'titles' (Figure 1). We chose to search only titles because the BDTD does not have keyword search facility. This resulted in the expression: (Subject: 'cidade inteligente' OR Subject: 'smart city' OR Subject: 'smart cities').

The term 'cidades inteligentes' in Portuguese was not used in the plural, as the singular term also retrieves the plural words in this language. The filters 'dissertations' and dates from 2013 to 2023 were applied. The interval between 2013 and 2023 was used to cover 10 full years before the start of the research. The choice of 'doctoral dissertations' rather than 'theses' is justified as doctoral research is original work with greater theoretical density and methodological maturity. No language filter was applied.

The third step involves exporting the sample. A spreadsheet was created to collect and record the data in '.csv' format using Excel software. This format made it possible to create co-occurrence maps of the keywords, allowing them to be visualised in clusters, thus helping to

understand their distribution in the network. VOSviewer software was used to generate network maps based on data extracted from the scientific production.

The following fields were considered for the research: author, title of the work, year of defence, teaching institution, postgraduate programme, region of the country, supervisor and keywords. Stage 4 consisted of checking the indicators: a) evolution over time; b) geographical and institutional distribution; and c) use of keywords.

Finally, we have step 5, which involves organising topic logically and summarising the results. Tables and graphs were used as presentation tools. During the processing of the co-occurrence maps, it was found that some terms needed to be standardised due to variations in plurality or different forms of registration. To solve this problem, a thesaurus was created to disambiguate the keywords.

4 RESULTS

During the data collection phase of the research, 41 dissertations records were initially found. However, one of these records was excluded because it was duplicated, resulting in a final sample of 40 valid dissertations.

Among these 40 dissertations, 17 were found using the term 'smart city' in English, and the other 23 used the term 'smart city' in Portuguese. Despite the 17 records for the term 'smart city' only eight of the dissertations were written in English, which indicates that the term continues to be used in its English form even in Portuguese-language academic literature.

When analysing the distribution of these dissertations over the period from 2013 to 2023, it was observed that in 2013 and 2014 there were no works on this topic. From 2015 onwards, the growth vector begins until 2019, when the highest number of doctoral dissertations defended was recorded, with a total of 8 (Figure 2). Furthermore, there was a very significant increase in the number of doctoral dissertations on smart cities between 2017 and 2019, indicating an increase in interest and academic production on this topic during this period. On the other hand, there was a decrease in the number of doctoral dissertations defended in 2022. This decrease can be attributed to the Covid-19 pandemic, which affected the functioning of universities. The pandemic led to the extension of the deadlines for defending dissertations, the suspension of academic activities and delays in the end of the academic year, which probably contributed to the decrease in the number of doctoral dissertations defended in that year.

Figure 2 – Number of doctoral dissertations defended per year (2013-2023)
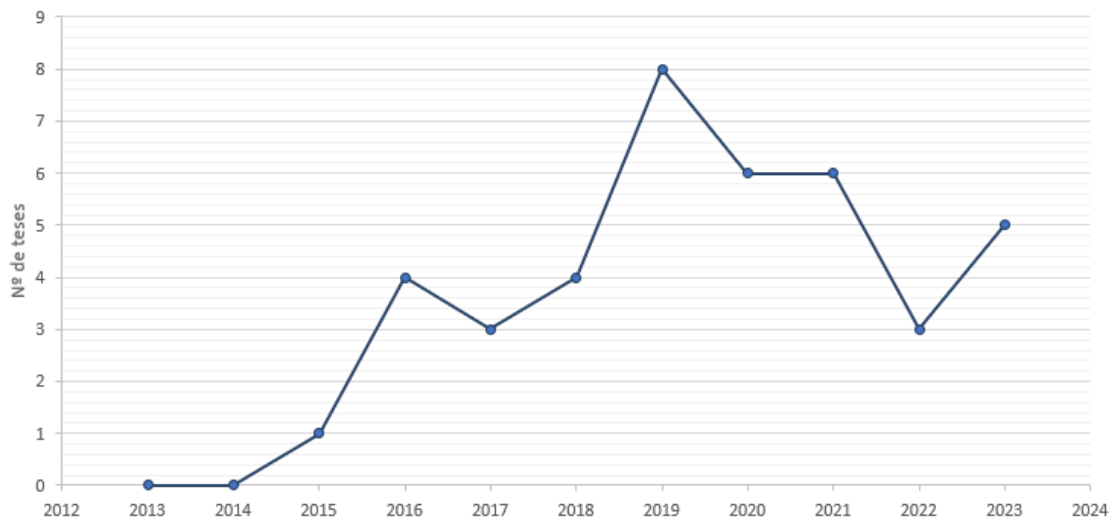
Source: Authors, 2024.

With regard to the dissertations presented in English, which represent 20% of the corpus analysed, it is important to note the researchers' intention to internationalise their work, as English is widely recognised and used in academic publications around the world. Publishing in English increases the visibility and impact of research on the global scale.

In total, the dissertations were produced by researchers from 16 different institutions. A total of 37 supervisors were identified, indicating a high number of supervisors with only one dissertation on this topic, which also demonstrates the dispersion of research in the area. Only two supervisors supervised more than one dissertation: One from FGV with two doctoral dissertations, and one from UFRN, with three doctoral dissertations.

Table 1 - Educational institutions and number of dissertations.

Institution	No. of dissertations
Universidade de São Paulo (USP)	08
Universidade Federal do Rio Grande do Norte (UFRN)	05
Universidade de Campinas (Unicamp)	04
Fundação Getúlio Vargas (FGV)	04
PUC-RJ	02
PUC-RS	02
PUC-SP	02
Universidade Federal do Rio Grande do Sul (UFRS)	02
Universidade Federal de São Carlos (UFSCAR)	02
Universidade Federal de Santa Catarina (UFSC)	02
Universidade Federal de Pernambuco (UFPE)	02
Universidade Federal de Uberlândia (UFU)	02
Fundação Educacional Inaciana (FEI)	01
Universidade do Vale do Rio dos Sinos (UNISINOS)	01
Universidade Estadual Paulista (UNESP)	01
Universidade Tecnológica Federal do Paraná (UTFPR)	01
Total	**40**

Source: Authors, 2024.

The south-eastern region of Brazil leads the way in dissertations production, accounting for 66 per cent of the total. Institutions such as the University of São Paulo (USP), the Getúlio Vargas Foundation (FGV) and the State University of Campinas (Unicamp) stand out. In the Northeast, the Federal University of Rio Grande do Norte (UFRN) also stands out, contributing five dissertations analysed. Among these institutions, USP deserves special mention, being responsible for eight dissertations in the area of smart cities, which corresponds to 20% of the sample (Table 2).

Finally, 151 different terms were identified that were used as keywords in 40 dissertations analysed. The keywords were extracted directly from the dissertations, keeping the terms in English when available. However, the bibliometric counting algorithm, was not designed to deal with the textual nuances of terms such as 'Internet of Things', 'IoT', and 'Internet das Coisas', resulting in separate lists for keywords that are, in practice, identical. To ensure the clarity, readability and interpretability of the network of connected keywords, it became imperative to standardise the terms (see Chart 1).

Chart 1 - Standardized terms for keywords.

Standardized term	Terms retrieved
"Internet das coisas"	"Internet of things", "IoT" e "Internet-das-coisas – Brasil"
"Ontologia"	"Ontologias (Sistema de recuperação da informação)"; "Ontologias"
"Planejamento urbano"	"Cidades – Planejamento"; "Planejamento e Gestão urbana"
"Desenvolvimento sustentável"	"Desenvolvimento urbano sustentável"
"Mobilidade"	"Mobilidades" e "Mobilidade urbana"
"Tecnologia da informação e comunicação"	"Tecnologias-da-informação-e-comunicação "; "TICs"; "Information and communication technology"
"Inovação"	"Inovações tecnológicas – Brasil"
"Turismo"	"Turismo Inteligente"

Source: Authors, 2024.

In order to assess the mutual connections between keywords - i.e. where two or more keywords are used simultaneously - we opted for a network representation, where the graph below groups the keywords into clusters using VOSviewer (Figure 3). In addition, the postgraduate programme of each dissertation was associated with the corresponding keywords, allowing us to see the most researched topics in each knowledge area. To distinguish the postgraduate programmes from the keywords, an asterisk (*) was added in front of the name of each programme. The size of the circles represents the frequency of the keywords. The larger the circle, the more often the keyword was co-selected in publications on smart cities. Circles of the same colour indicate that these terms are related to similar topics in the publications.

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Figure 3 – Keyword networks with the most occurrences (2013-2023)

Source: Authors, 2024.
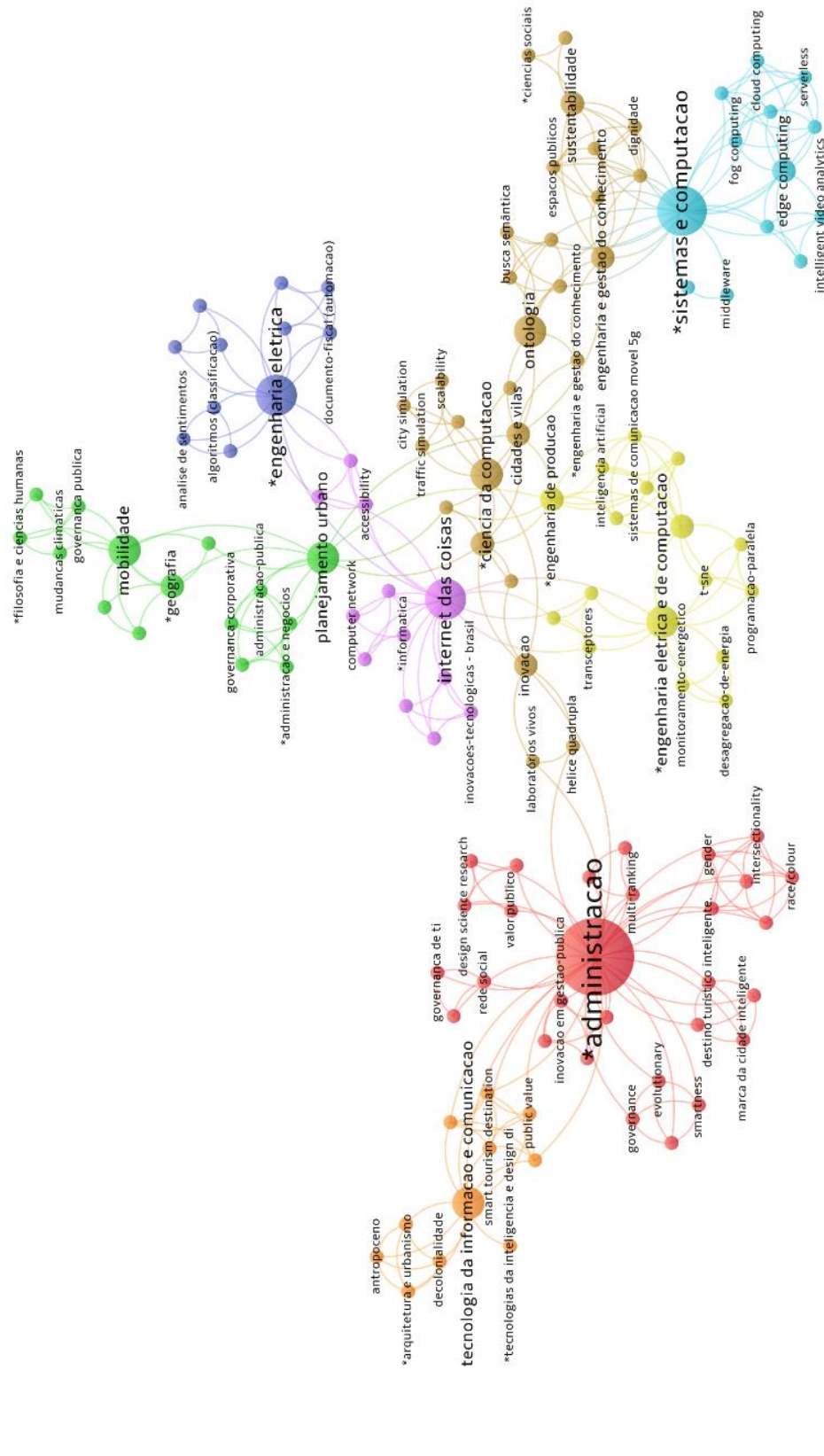
Eight clusters were formed with few relationships between them. In general, what can be seen is a dispersed constellation of terms, mostly related to technical issues. Few terms stood out in the mapping of keywords (internet of things, information and communication technology, mobility, urban planning, edge computing, ontology and mobility). It can be seen that many of the terms used as keywords are not connected and are located on the edges of the map, which may represent the specificity of the keywords used by the authors and the diversification of the themes that make up research into smart cities.

On the left-hand side of the map, there are red and orange clusters (Cluster 01) associated with postgraduate programmes in *Business Administration, *Information Administration, *Architecture and Urban Design and *Intelligence Technologies and Digital Design, *Technology and Society, *Social Sciences and *Computer Systems. The term 'information and communication technology' stands out, associated with research of various approaches. Studies encompassed in this cluster are associated with the dimension of governance, proposing theoretical models and frameworks to guide the development of smart cities, proposing models to measure, evaluate and manage the intelligence of cities, applied technology for the development of tourism, social networks as a stimulus for urban creativity (Chart 2).

Chart 2 – Dissertations Cluster 01

Author	Title	Postgraduate programme	Institution	Year
CAMBOIM, Guilherme F.	Analyzing smart city development through an evolutionary approach	Business Administration	UFRGS	2023
CAVALHEIRO, Mariana B.	Understanding smart tourism destination: evidence from a smart city project implementation in an international tourism destination	Business Administration	FGV	2017
ESASHIKA, Daniel S.	Living labs contributions to smart cities from a quadruple-helix perspective	Business Administration	USP	2020
MACAYA, Javiera F. M.	Smart cities for whom? Intersectionality and women`s safety perception and violence experience	Business Administration	FGV	2023
MARTINHO, Leila T.	Marcas de Cidades Inteligentes: um estudo sobre o turismo em cidades da América Latina	Business Administration	PUC-Rio	2023
PORTO, Josiane B.	Smart cities methodology (Scml): uma metodologia em smart cities baseada em valor público	Business Administration	PUCRS	2018
SILVA, Kelly M. P.	A rede social de inteligência coletiva e a criatividade na cidade: implicações teóricas e proposição de framework para cidades inteligentes e criativas	Business Administration	UFPE	2022
WEISS, Marcos C.	Cidades inteligentes: proposição de um modelo avaliativo de prontidão das tecnologias de informação e comunicação aplicáveis à gestão das cidades	Business Administration	FEI	2016
GUIMARÃES, José G.	Cidades inteligentes: proposta de um modelo brasileiro multi-ranking de classificação	Business Administration	USP	2018
PRZEYBILOVICZ, Érico	Governando iniciativas de cidade inteligente: compreendendo os arranjos de governança sócio-técnica	Management Information Systems	FGV	2019
HIROKI, Stella M. Y.	Parâmetros para identificação dos estágios de desenvolvimento das cidades inteligentes no Brasil	Intelligence Technologies and Digital Design	PUC-SP	2019
ALONSO, André Deak	Morte e vida de cidades inteligentes: tecnologia, colonialismo e antropoceno	Architecture and Urban Design	USP	2023

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MARTINELLI, Marcos A.	Proposta de gestão local de redes sociotécnicas: estratégia para implantação de cidades inteligentes e humanas	Technology and Society	UFSCar	2019
CÉSAR, Vivian A. B. S.	Cidades inteligentes: polissemias urbanas e pensamento complexo	Social Sciences	PUC-SP	2016
AFONSO, Ricardo A.	Smartcluster: a metamodel of indicators for smart and human cities	Computer Science	UFPE	2017
BLANCK, Mery Rose de M.	Incubação de empresas e desenvolvimento de Smart Cities	Computer Science	UFRGS	2019
ROCHA Neto, A. F.	Edge-distributed stream processing for video analytics in smart cities	Computer Systems	UFRN	2021
SILVA, Jorge Pereira da	SGeoL: uma plataforma para o desenvolvimento de aplicações	Computer Systems	UFRN	2021
ROCHA, B. P. F. D. L	LGeoSIM: um modelo semântico de dados para cidades inteligentes	Computer Systems	UFRN	2020
SANTANA, Eduardo F. Z.	InterSCSimulator: a scalable, open source, smart city simulator	Computer Science	USP	2019
SOUZA, A E Cassio	Sapparchi: a scalable platform for computational smart city environments	Computer Systems	UFRN	2022

Source: Authors, 2024.

In the centre of the map are the purple and green clusters (Cluster 02) associated with postgraduate programmes in *Geography, *Philosophy and Humanities, *Administration and Business, *Media and Technology, *Production Engineering, *Law and *Information Technology. Among the terms that stand out are 'internet of things', 'urban planning', 'mobility' and 'innovation'. These papers addressed guidelines for sustainable mobility; mobility (transfer and sharing) public policies, human rights perspectives on smart cities, technologies to support citizens with disabilities and data architecture for sensors (Chart 3).

Chart 3 – Dissertations Cluster 02

Author	Title	Postgraduate programme	Institution	Year
PEREIRA, Gabriela V.	Contribuição de iniciativas de cidades inteligentes no desenvolvimento humano: uma análise da percepção de agentes de centros de operações municipais no Brasil	Administration and Business	PUCRS	2016
ARAGÃO, Franciely V.	Modelo de maturidade para Smart Cities: uma abordagem multicritério	Production Engineering	UTFPR	2020
NICHI, Jaqueline	Governança climática: uma abordagem multinível para a mobilidade inteligente e de baixo carbono	Philosophy and Humanities	UNICAMP	2023
FREITAS, J. A.	A invenção da cidade inteligente Rio: uma análise do Centro de Operações Rio pela lente das mobilidades	Geography	FGV	2018
SILVA, Fander O.	Cidades inteligentes: planejamento e gestão para a mobilidade urbana	Geography	UFU	2021
MESLIN, Alexandre M.	Musanet: a multitier platform for developing smart-city applications	Information technology	PUC-Rio	2021
FERRARESI, Camilo S.	A ressignificação do Direito à Cidade a partir dos Direitos Humanos: as Smart Cities como espaço para garantir a qualidade de vida das pessoas com deficiência	Law	UNISINOS	2020
BERNARDINI, Gleice	Internet das coisas no Brasil: a comunicação nos processos interativos das cidades inteligentes	Media and Technology	UNESP	2021

Source: Authors, 2024.

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The groupings on the right of the map, in yellow, brown, light blue and dark blue (Cluster 02), are related to postgraduate programmes in *Electrical and Computer Engineering, *Production Engineering, *Computer Science, *Electrical Engineering, *Urban Engineering and *Systems and Communication. The terms 'ontology', 'edge computing', 'sustainability' and 'engineering and knowledge management' stand out. These papers explore the use of algorithms for process optimisation, applications of technologies for predicting electricity demand and prices, tax monitoring systems, integration of urban data with geographical information, knowledge models for monitoring urban transport lines, algorithms for process optimisation and reducing processing time, the relationship between incubation and sustainable urban development (Chart 04).

Chart 4 – Dissertations Cluster 03

Author	Title	Postgraduate programme	Institution	Year
GARBUIO, Maria E. M.	Espaços públicos humanizados e sustentáveis: cocriação e consolidação de um framework para cidades costeiras turísticas	Engineering and Knowledge Management	UFSC	2019
ROCHA NETO, A. F.	Edge-distributed stream processing for video analytics in smart city applications	Systems and Computing	UFRN	2021
SOUZA, A. E. Cassio	Sapparchi: a scalable platform to execute applications on computational smart city environments	Systems and Computing	UFRN	2022
ROCHA, B. P. F. D. L.	LGeoSIM: um modelo semântico de dados para cidades inteligentes	Systems and Computing	UFRN	2020
SILVA, Jorge P. da	SGeoL: uma plataforma para o desenvolvimento de aplicações para cidades inteligentes	Systems and Computing	UFRN	2021
AFONSO, Ricardo A.	Smartcluster: a metamodel of indicators for smart and human cities	Computer Science	UFPE	2017
BLANCK, Mery Rose de M.	Incubação de empresas e desenvolvimento de Smart Cities	Computer Science	UFRGS	2019
SANTANA, Eduardo F. Z.	InterSCSimulator: a scalable, open source, smart city simulator	Computer Science	USP	2019
OLIVEIRA, Gabriel G.	Aplicação de inteligência artificial para melhoria do conceito ITS em busca de uma smart city	Production Engineering	UNICAMP	2022
ANDERLE, Daniel F.	Modelo de conhecimento para representação semântica de smart cities com foco nas pessoas	Engineering and Knowledge Management	UFSC	2017
GALLO, Diego S.	Monitoramento colaborativo para cidades inteligentes	Electrical Engineering	USP	2016
MELO, Vidal A. Z. C.	Sistema autenticador e transmissor (SAT): modelo tecnológico de automação e controle	Electrical Engineering	USP	2015
OLIVEIRA NETO, J. S.	Inclusive smart cities: theory and tools to improve the experience of people with disabilities	Electrical Engineering	USP	2018
ROSSI, Rosa H. P. S.	Análise de sentimentos para o auxílio na gestão das cidades inteligentes	Electrical Engineering	USP	2019
LUZ, Paulo Denis G.	Sistema de comunicação de dados sem fio auto-adaptativo tipo mesh para cidades inteligentes	Electrical and Computer Engineering	UNICAMP	2021
PIRES, Felipe M.	Sistema de monitoramento energético compreensível para aplicação em cidades inteligentes	Electrical and Computer Engineering	UNICAMP	2020
LOPES, Maximiliano A.	Dashboards para desenvolvimento de aplicáveis e visualização de dados para plataformas de cidades inteligentes	Electrical and Computer Engineering	UFRN	2020
LABOISSIERE, Leonel A.	Administração pública municipal: um estudo sobre o nível de aderência do modelo de gestão inteligente	Urban Engineering	UFSCar	2019

Source: Authors, 2024.

5 CONCLUSIONS

The subject of smart cities has emerged from a variety of disciplinary perspectives. A bibliometric analysis and scientific mapping using the VOSviewer tool revealed that the dissertations on the topic of smart cities developed in Brazil follow a multidisciplinary trend. However, the results indicated a clear predominance of studies in the fields of administration (represented by postgraduate programmes in administration and business administration) and computing (represented by postgraduate programmes in computer science, computer systems, electrical and computer engineering).

The sample shows comprehensive coverage of key issues for the development of smart cities, particularly in terms of governance, technology and data integration. However, there are areas that could be further explored, such as public safety, privacy, active social participation, sustainability and economic impact. Further research into these aspects could provide further insight into the gaps in smart city research.

This study aims to assist researchers in identifying interdisciplinary partnerships and patterns, thereby fostering knowledge exchange and promoting integrated strategies to address complex challenges within these domains. Future research could benefit from incorporating articles indexed in authoritative international databases, such as Scopus and Web of Science. As highlighted by João et al. (2019), the recent consolidation of this research field underscores the importance of academic conferences, which play a critical role in enhancing the visibility and dissemination of scientific advancements through the publication of conference proceedings. Integrating these publications into subsequent analyses could provide valuable insights into the evolution and emerging trends within this field. The findings presented herein fulfill the initial objectives of the study and, through systematic analysis, reveal that doctoral-level research on smart cities within the national context still exhibits significant potential for expansion.

6 ACKNOWLEDGEMENTS

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STATEMENTS

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CONFLICT OF INTEREST DISCLOSURE FORM

We, Adrielly Oliveira Carneiro and Marcelo Eduardo Giacaglia, declare that the manuscript entitled **"Scientific production on smart cities in Brazil: bibliometric mapping of BDTD dissertations (2013 to 2023)"**:

1. **Financial ties**: Does not have financial ties that could influence the results or interpretation of the work..
2. **Professional Relationships**: No professional relationships relevant to the content of this manuscript have been established.
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