



ISSN: 2230-9926

Available online at <http://www.journalijdr.com>

IJDR

International Journal of Development Research

Vol. 11, Issue, 05, pp. 46621-46624, May, 2021

<https://doi.org/10.37118/ijdr.21685.05.2021>



RESEARCH ARTICLE

OPEN ACCESS

SMART AND SUSTAINABLE CITIES: DEFINITIONS, CONCEPT IN CONTEMPORANEITY

***Anderson Saccol Ferreira**

Department of Architecture and Urbanism Unoesc

ARTICLE INFO

Article History:

Received 03rd February, 2021
Received in revised form
11th March, 2021
Accepted 26th April, 2021
Published online 14th May, 2021

Key Words:

Smart cities. Sustainable cities.
Contemporaneity. ICT. Literature revision.

*Corresponding author:

Anderson Saccol Ferreira,

ABSTRACT

The research aims to understand the concepts in the literature about smart cities and sustainable cities. The study provides a comprehensive overview of the concepts that characterize smart and sustainable cities today. For this study, 32 scientific articles related to the concepts and practices of smart cities were analyzed. The study showed a grouping of fifteen possible divisions that characterize smart cities as: quality of life, infrastructure, services, information and communication technology - ICT, intelligence, citizen, society, environment, sustainability, governance, management, economy, finance and mobility. A strong link between ICTs was perceived as a guiding element for the design of smart and sustainable cities. A conceptualization was proposed about the concepts found in the smart city literature and its relationship with sustainability in contemporary times.

Copyright © 2021, Anderson Saccol Ferreira. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Anderson Saccol Ferreira. 2021. "Smart and sustainable cities: definitions, concept in contemporaneity", *International Journal of Development Research*, 11, (05), 46621-46624.

INTRODUÇÃO

Contemporary cities face several challenges in the existing built. The environmental environment is already associated with numerous degradation factors that are related to the social, economic impact and the unsustainable use of energy and gas emissions. This comes as an accelerator for the increase in air and water pollution, which makes land use unsuitable for urban design. Also, the disruption of mobility and ineffectiveness of accessibility, which causes disruptions in transport and traffic congestion, decreased safety and health in cities. Cities occupy less than 2% of the land mass, urban residents consume more than three quarters of the world's natural resources and are the main responsible for greenhouse gases - GHG (NAM; PARDO, 2011). This disordered growth increases a variety of problems that compromise the environmental, economic and collective sustainability of contemporary cities (NEIROTTI, *et al.*, 2014). In this scenario, the acceleration of urbanization has generated numerous challenges associated with the intensity of consumption, endemic congestion, saturation of transport networks, overcoming of air, water, depletion of resources, social inequality and people's vulnerability (BIBRI; KROGSTIE, 2017a). the dynamic grouping of buildings, infrastructure, people and resources, the pressure of urbanization of urban systems, emphasizing urban life in operational functions and services (BIBRI, 2013). Thus, several concepts emerged related to the quality of life of people in cities. Some concepts like garden cities, modern cities and later sustainable cities. Currently, the concept that gains strength is that of smart and sustainable cities. This concept of Smart Sustainable Cities (SSC), is gaining more and more attention worldwide, mainly in response to

the future potential of environmental challenges and the increase in the population living in cities (NASRAWI, ADAMS, EL-ZAART, 2015). In this thought, Townsend (2013), highlights that the challenge is to ensure that cities can offer their citizens better living conditions for current and future generations. Nam and Pardo, (2011a) point out that the concept of smart and sustainable cities has stood out attracting many researchers in the search for ways to promote urban development. But after all, what is the relationship between sustainability and intelligence? What are the key concepts for becoming a smart and sustainable city?

This study covers the concepts that describe smart and sustainable cities. Adopt as a methodological procedure the literature review where 32 scientific studies were published. For the analysis, criteria were adopted related to focus, characteristic, chaining, quality, theoretical framework and unit of analysis. After the articles were tabulated, extracting the good concepts in the literature. As results of the research we find the following groups: quality of life, infrastructure, information and communication technology - ICT, intelligence, citizen, society, environment, sustainability, governance, management, economy, finance and mobility. The review demonstrated several concepts that the literature uses to define smart and sustainable cities, and shows that there is no consensus between the definitions, but that the use of information technologies can help in the development of management and quality of life in cities. Finally, the article points to a brief definition highlighting aspect related to the intelligence and sustainability of cities. In addition to this introduction, the article presents the methodological procedures, results and discussions, ending with the final considerations of the study.

METHODOLOGICAL PROCEDURES

The research consists of a literature review with the purpose of identifying which are the concepts of smart and sustainable cities. Thus, the analysis was from the database of the Scielo journals, Science Direct (Elsevier), Scopus, Web of Science. The period of selected articles was between 2011 and 2021, with documents of the type, article, review article, article in press, research article. The purpose of this analysis was to verify the scientific production that deals with practices of smart and sustainable cities. For the search, the following keywords were used: "smart and sustainable cities" or "sustainable urban development" or "ICT and smart cities" or "smart governance" or "smart city technology and efficiency" of "smart city concepts" or "characteristics of smart cities." In table 1. I present the criteria for selecting research articles.

Table 1. Quality assessment Criteria

Criterion	Inclusion Criteria	Exclusion Criteria
Focus	Address the theme, relating sustainability and intelligence in the context of smart cities.	Referring to the theme, relating sustainability and intelligence in the urban context in a generic way.
Feature	Deal directly with characteristics of the sustainability or intelligence chain in the context of cities, their specificities and ways of making them operational.	Do not directly address characteristics of sustainability and intelligence in the context of cities or their specificities in the organization.
Access	Locate the document file in its entirety online and free of charge. Be written in English or Portuguese.	Not having access to work, not being written in English or Portuguese.
Quality	Scientific journal with peer review.	Scientific periodical without peer review, newspapers, current magazines, conferences, books and websites.
Analysis Unit	Linking: quality of life, infrastructure, information and communication technology - ICT, citizen, society, environment, sustainability, governance, economy and mobility.	Dealing with sustainability or intelligence chaining in other contexts other than those listed.

In the first stage, 85 scientific articles were selected, of which 53 were excluded because they did not meet the criteria for improving the quality of table 1. 32 articles were analyzed, most of them from the Science Direct platform (Elsevier). The selected studies were tabulated in the following order: author, year, study objective, main variables, concept of smart and sustainable cities used as a guideline and or reference in the study, smart city practices, benefits of adopting smart cities, theoretical contribution of the study limitations, research limitations and recommendations for future studies. After tabulation of the data, an analysis was started to identify the main concepts that describe the smart and sustainable city and recorded in table 2, in the same way, identifying a structure of the main groupings in which the keywords relate to smart cities and sustainable.

RESULTS ACHIEVED

When analyzing the literature, 335 occurrences were found, and in many cases, they were structured in the following groups: (1) quality of life, (2) infrastructure and services, (3) information and communication technology - ICT, intelligence, (4) citizen and society, (5) environment and sustainability, (6) governance and management, (7) economy and finance, (8) mobility. ICT and intelligence lead with more than 25% of commercial articles, followed by environment and sustainability with 20%, infrastructure and services with 18%, governance, management with 12%, economy and society 5%, economy and finance 8%, quality citizens of life 6% and mobility 4%. Together, the eight motivators characterize a smart and sustainable city structure, where each of them represents a dimension that organizes a city. This same view is shared by Nam and Pardo (2011a), who describe a smart city as: (1) Technology, (2) People, (3) Institutions. Even so, it can be defined as the harmonious integration of physical, computer, social, human and business infrastructures, which assist in obtaining collective intelligence and with the appropriate use of all available interconnected information, in order to improve the understanding of operations and optimize resource limits (HARRISON, et al., 2010). Another theoretical line points out that smart cities can help in reducing the effects of greenhouse gas emissions and in the rational use of renewable energies (MITCHELL, 2000; GESI, 2020). These cities can improve

the use of public resources, services provided and quality of life, keeping the cost of public operations low (ZANELLA, et al., 2014), in addition to transportation within cities, reducing traffic congestion (VANOLO, 2013). In the literature we have several concepts that define smart and sustainable cities, and from the groupings we have as definitions such as: (1) quality of life, (2) ICT, (3) infrastructure, (4) people, (5) environment, (6) economy and, (7) governance. For the classification of sustainable cities, the three aspects were used as guidelines: environmental, economic and social. The addresses in table 2 are subdivided into author, theme, classification and defined in the literature that conceptualize smart and sustainable cities. Literature publishers for smart and sustainable cities gain impulses that attract clear attention on their development path, directing the direction of the future. Despite many considerations associated with smart and sustainable cities, there are discrepancies, which Bibri and Krogstie (2017a) describe as a weak

connection between the concepts of intelligence and environmental sustainability, and technologies are not always used in or do not contribute to the sustainability. The authors point out that sustainable cities address the concepts and principles they ignore as smart solutions, and focus on modern information, communication and efficient solutions, allowing them to consider or ignore aspects of design, that is, sustainable cities to leverage their landscape. Information and smart cities, focused on the physical and landscape and aligned with the vision of sustainability (BIBRI, KROGSTIE, 2017a). Therefore, there is no clear definition of smart and sustainable cities, nor do they establish a sustainable development definition line, but the definitions about them become crucial for their purpose, especially where an intelligence should be used and how it should be evaluated, as seen that their systems contribute to the objectives of sustainable development (Höjer; Wangel, 2014).

DISCUSSION OF RESULTS

The vast majority of texts point to a bias towards smart cities, mainly towards a relationship with ICTs and quality of life, ICTs and people, ICTs and governance and ICTs with sustainability. Several factors that designate sustainability, such as environmental, economic, political, institutional, are present in smart cities, in order to be guided by information and communication technologies. To a relationship that city intelligence could better and make progress in areas such as energy production, mobility and transport, ICTs, and create several interdisciplinary opportunities to improve services and, at the same time, reduce energy and compel greenhouse gases (GHG) (Fletcher, Potts, 2007; Chaigneau, Brown, 2016). In this way, smart cities can be seen as a solution for sustainable urban development and the conurbations that lead to improved urbanization. Based on the analysis, it can be defined that a sustainable and intelligent city is one that takes advantage of information and communication technology systems in an adaptable, reliable, scalable and secure model to improve the quality of life, infrastructure, services, the environment, governance and management. It guarantees economic growth in a tangible way, offering higher standards of living with opportunities for work and income for people, without forgetting to improve well-being, health, safety and education.

Table 2. Definitions and concepts of smart and sustainable cities

Authors	Definitions	Classification	Concept
Nam e Pardo (2011a)	People; ICT; Quality of life; Governance.	Smart cities Sustainable cities	It is considered a smart city when it invests in human, social capital and ICT infrastructure that feed sustainable growth and improve the quality of life, through participatory governance.
Caragliu, Del Bo, C., Nijkamp (2011)	People; Governance; ICT; Environmental Infrastructure.	Smart cities Sustainable cities	Smart cities offer a mode of governance in which social equality and environmental protection can be achieved in parallel with digitally catalyzed economic growth. A smart city with its efficient digital media and integrated infrastructure is positioned as a facilitator of sustainable development, aligning the objectives of the environment with protection, social equity and economic development.
Lee et al. (2013)	ICT; Economy.	Smart cities Sustainable cities	The smart and sustainable city can be achieved through the adoption of a public, private, partner and effective system, shaping value-added business models and incorporating emerging technologies into smart city systems.
Lee, Hancock e Hu (2014)	People; ICT; Governance; Infrastructure.	Smart cities	It cites five definitions: (1) service innovation, (2) forming partnerships, (3) pro-effective urbanization, (4) integration of the smart city infrastructure, (5) smart city and governance.
Angelidou (2015)	ICT; Economy.	Smart cities	A smart city is based on four main frameworks: (1) urban futures, (2) knowledge, (3) economy and innovation, (4) impulse of technology.
Jong, et al. (2015)	Governance; Infrastructure; ICT.	Smart cities	The creation of smart cities and the guarantee of their sustainability from the beginning, which can help to solve urbanization problems and lead cities to sustainable development.
Joshi, Saxena e Godbole (2016)	People; Governance; ICT.	Sustainable cities	Six important concepts are identified for the development of a smart city structure: (1) social, (2) management, (3) economical, (5) juridical, (6) technology, (7) sustainability.
March (2016)	Economy.	Sustainable cities	Sustainable development could be further facilitated by the imperative of smart city development, from economic growth to decline. This change would be a harbinger of the emergence of post-capitalist and digitally mediated urban economies, where open source and digital fabrication play a central role in the city's economy and in the lives of its residents.
Meijer, Bolivar (2016)	People; ICT Governance.	Smart cities	The smart city must be related to smart people (with a focus on human resources); collaborate (governance) and techniques (with technology).
Ahvenniemi, et al. (2017)	ICT, Quality of life; Environmental.	Smart cities	Smart cities do not have a clear and consistent meaning, but there are indications that the use of several modern technologies makes it possible to achieve a better quality of life and a reduction in the environmental impact.
Fernandez-Anez et al. (2018)	Governance.	Smart cities	Smart city as an integrated and multidimensional system such as: (1) the key role of governance and stakeholder involvement, (2) the importance of showing a comprehensive view of smart city projects and dimensions, (3) the understanding of the smart city as a tool to face urban challenges.
Yigitcanlar, et al. (2018)	People; ICT; Governance; Economy.	Smart cities	three drivers for smart cities: community, technology and politics. They are linked to six outcomes: (1) productivity, (2) sustainability, (3) accessibility, (4) welfare, (5) habitability, (6) governance. Together, they build a smart city structure, where each represents a different dimension of the notion of smart cities.
Martin, Evans, Karvonen (2018)	Environmental; People; Quality of life;	Smart cities	It is important to design smart city projects and programs in ways that address broad environmental and social issues. It can be done by involving a wider range of parts designed in project design and by extending monitoring and evaluation to include broader measures of social and environmental performance.
Ismagilova, et al. (2019)	ICT, Quality of Life; Environmental; Governance.	Smart cities Sustainable cities	Approach centered on the information system, for the intelligent use of interaction, sustainability, citizenship and quality of life, within an interactive infrastructure for advanced and innovative services to citizens, with an impact on the quality of life and the sustainable management of natural resources.
Antwi-Afari, et al. (2021)	People; Quality of life; infrastructure; Environmental; Governance; Economy.	Smart cities Sustainable cities	Six dimensions to conceptualize the urban structure of smart cities: (1) life, (2) people, (3) mobility, (4) economics, (5) governance, (6) environment.
Csukás, Szabo (2021)	Environmental; ICT People; Governance.	Smart cities	Four models of smart cities: (1) the green city, with objectives related to the environment, (2) app city in the development and implementation of ICT platforms and applications to provide quality of life and improvements directly to citizens, (3) the socially sensitive city, (4) the participatory city, focus on the citizen.

The smart and sustainable city meets today needs without compromising the needs of the next generations, guaranteeing the environment, both economically and socially. In this way, the smart and sustainable city can be characterized as: innovative, adaptable, safe, uses information and communication technologies (ICTs) to improve the quality of life, increase job opportunities and its local governance system, it is characterized by involvement and inclusion of citizens, in order to guarantee the needs of present and future generations respecting social, economic and environmental aspects. The combination of several aspects creates a smart and sustainable city structure, where each one represents a different dimension of the notion that characterizes and conceptualizes smart and sustainable cities.

CONCLUSION

The article offers a comprehensive overview of smart and sustainable cities and seeks to characterize the determinant concepts of these cities. Through a literature review, he sought to understand the main concepts that describe smart and sustainable cities. The results of the literature review allow us to establish a panoramic view of the concepts concepts in the literature on the development of smart and sustainable cities. Information and communication technology systems - ICTs are present in most of the literature as a way to assist innovation and make the city adaptable and safe. The review points out that smart and sustainable cities have similar characteristics aimed at quality of life, infrastructure, people, information systems, governance and the environment.

The study's findings are important for urban planning and the development of cities and establish motivators that characterize an intelligent and sustainable urban structure, so that each of them represents a dimension that organizes cities. Future studies investigate the advantages and discrepancies between the concepts of smart and sustainable cities, as well as measure the elements that characterize these cities. Even so, it is possible to investigate in relation to ICTs as an integration tool between intelligence and sustainability, and if this relationship occurs in practice, and how it interacts between models of sustainable cities such as ecocity, compact city, green city. This study is limited to an analysis of the theoretical literature review that is based on theoretical models and concepts of smart and sustainable cities.

REFERENCES

- Ahvenniemi, h.; huovila. A.; pinto-seppä, I. Airaksinen, M.: What are the differences between sustainable and smart cities? *Cities*, v. 60, pp. 234-245, 2017. DOI: <https://doi.org/10.1016/j.cities.2016.09.009>
- Angelidou, M. Smart cities: A conjuncture of four forces. *Cities*, v. 47, pp. 95–106, 2015. DOI: <https://doi.org/10.1016/j.cities.2015.05.004>
- Bibri, S. E. ICT for sustainable urban development in the European Information Society: A discursive investigation of energy efficiency technology, *Master Thesis School of Culture and Society*, Malmö University. 2013.
- Bibri, S. E.; KROGSTIE, J. On the social shaping dimensions of smart sustainable cities: A study in science, technology, and society. *Sustainable Cities and Society*, v. 29, pp.219-246, 2017a. DOI: [10.1016/j.scs.2016.11.004](https://doi.org/10.1016/j.scs.2016.11.004)
- Bibri, S. E.; Krogstie, J. Smart sustainable cities of the future: An extensive interdisciplinary literature review. *Sustainable Cities and Society*.v.31, pp. 183–212, 2017b. DOI: <http://dx.doi.org/10.1016/j.scs.2017.02.016>
- Caragliu, A., Del Bo, C., Nijkamp, P. Smart cities in Europe. *J. Urban Technol.* v. 18, pp. 65–82, 2011. DOI: <http://dx.doi.org/10.1080/10630732.2011.601117>
- Chaigneau, T.; Brown, K. Challenging the win-win discourse on conservation and development: analyzing support for marine protected areas, *Ecology and Society*. v.21, n. 1, 2016. DOI: <http://dx.doi.org/10.5751/ES-08204-210136>
- Fernandez-Anez, V., Fernández-Güell, J. M., Giffinger, R. Smart City implementation and discourses: An integrated conceptual model. The case of Vienna. *Cities*, 78, pp. 4-16, 2018. DOI: <https://doi.org/10.1016/j.cities.2017.12.004>
- Fletcher, S.; Potts, J. Ocean citizenship: an emergent geographical concept, *Coastal Management*. v.35, n. 4, pp. 511–524, 2007. <https://doi.org/10.1080/08920750701525818>.
- Gesi, S. *Enabling the Low Carbon Economy in the Information Age*, London, UK. 2020.
- Harrison, C.; Eckman, B.; Hamilton, R.; Hartswick, P.; Kalaganam, J.; Paraszczak, J.; Williams, P. Foundations for smarter cities, *IBM*. v. 54, pp. 1-16, 2010. DOI: [10.1147/JRD.2010.2048257](https://doi.org/10.1147/JRD.2010.2048257)
- Höjer, M.; Wangel, S. *Smart sustainable cities: Definition and challenges*. In L. Hilty; B. Aebischer (Eds.), *ICT innovations for sustainability*. Berlin: Springer-verlag. pp.333-349. 2014. DOI: [10.1007/978-3-319-09228-7_20](https://doi.org/10.1007/978-3-319-09228-7_20)
- Jong, M. De.; Joss, S; Schraven, D.; Zhan, C.; Weijnen, M. Sustainable smart–resilient–low carbon–eco–knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization, *Journal of Cleaner Production*, v. 109, p. 25-38, 2015. DOI: <https://doi.org/10.1016/j.jclepro.2015.02.004>
- Joshi, S.; Saxena, S.; Godbole, T. Developing smart cities: An integrated framework. *Procedia Computer Science*, v. 93, pp. 902–909, 2016. DOI: <https://doi.org/10.1016/j.procs.2016.07.258>
- Lee, J. H.; Hancock, M. G.; Hu, M. C. Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco. *Technological Forecasting and Social Change*, v. 89, pp. 80–99, 2014. DOI: <https://doi.org/10.1016/j.techfore.2013.08.033>
- Lee, J. H.; Phaal, R.; Lee, S. H. An integrated service-device-technology roadmap for smart city development, *Technological Forecasting and Social Change*, v. 2, pp. 286–306, 2013. DOI: <https://doi.org/10.1016/j.techfore.2012.09.020>
- March, H. The Smart City and other ICT-led techno-imaginaries: any room for dialogue with degrowth? *Journal of Cleaner Production*.v. 197, pp. 1694-1703, 2016. DOI:<https://doi.org/10.1016/j.jclepro.2016.09.154>
- Meijer, A.; Bolívar, M.P.R. Governing the smart city: a review of the literature on smart urban governance, *International Review of Administrative Sciences*, n. 82, v, 2, pp. 392-408, 2016. DOI: <https://doi.org/10.1177/0020852314564308>
- Mitchell, W.J. E-topia. Urban Life, Jim e but Not as We Know it. *The MIT Press, Cambridge Mass*, 2000. DOI: DOI: <https://doi.org/10.7551/mitpress/2844.001.0001>
- Nam, T.; Pardo, T. Smart city as urban innovation. *Proceedings of the 5th International Conference on Theory and Practice of Electronic Governance - ICEGOV '11*. 2011a. DOI: <https://doi.org/10.1145/2072069.2072100>
- Nam, T.; Pardo. T. Conceptualizing Smart City with Dimensions of Technology, People, and Institutions. *Proceedings of the 12th Annual International Digital Government Research Conference*, pp. 282-291, 2011b. DOI: <https://doi.org/10.1145/2037556.2037602>
- Nasrawi, S.; Adams, C.; El-zaart, A. A conceptual multidimensional model for assessing smart sustainable cities. *JISTEM - Journal of Information Systems and Technology Management*. v. 12, n. 3, 2015. DOI: <https://doi.org/10.4301/S1807-17752015000300003>
- Neirotti, P.; De marco, A.; Cagliano, A. C.; Mangano, G.; Scorrano, F. Current trends in smart city initiatives – some stylized facts. *Cities*, n. 38, pp. 25–36, 2014. DOI: <https://doi.org/10.1016/j.cities.2013.12.010>
- Townsend, A. *Smart Cities - Big Data, Civic Hackers e a busca por um novo Utopia*. Norton & Company, EUA: Nova York, 2013.
- Vanolo, A. Smart mentality: the smart city as disciplinary strategy, *Urban Studies*, v. 51, n. 5, pp. 883-898, 2013. DOI: <https://doi.org/10.1177/0042098013494427>
- Yigitcanlar, T; Kamruzzaman, M.; BuyS, L; Ioppolo, Gi; Sabatinimarques, J; Costa, E. M; Yun, J. J. Understanding ‘smart cities’: Intertwining development drivers with desired outcomes in a multidimensional framework. *Cities*, v. 81, pp. 145-160, 2018. DOI:<https://doi.org/10.1016/j.cities.2018.04.003>
- Zanella, A.; Bui, N.; Castellani, A.; Vangelista, L.; Zorzi, M. Internet of things for smart cities, *IEEE Internet of Things Journal*, v. 1, n. 1, pp. 22-32, 2014. DOI: [10.1109/JIOT.2014.2306328](https://doi.org/10.1109/JIOT.2014.2306328)