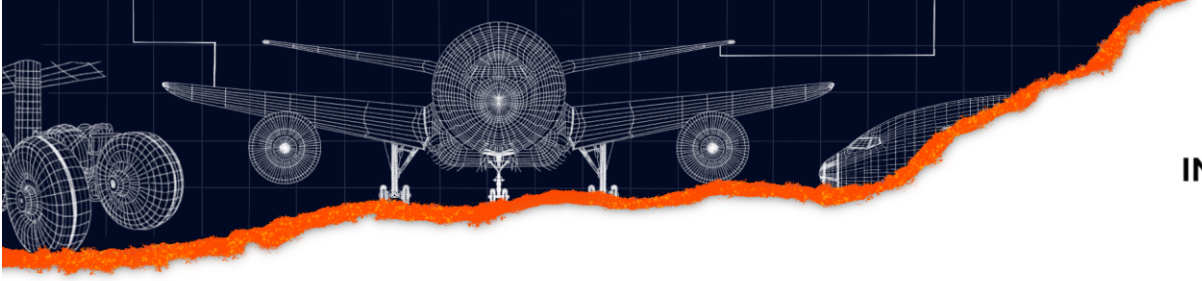

IMPACTO CIENTÍFICO
EDITORA

THE CHALLENGES FOR IMPLEMENTING SMART CITIES IN EMERGING COUNTRIES

OS DESAFIOS PARA IMPLANTAÇÃO DAS CIDADES INTELIGENTES EM PAÍSES EMERGENTES

LOS DESAFÍOS DE LA IMPLEMENTACIÓN DE CIUDADES INTELIGENTES EN PAÍSES EMERGENTES

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ABSTRACT

This article addresses the main challenges for the implementation of smart cities in emerging countries, focusing on the Brazilian context. Based on a bibliographic, applied, descriptive, and qualitative research approach to identify, describe, and interpret critical factors on the topic, the study examines historical aspects of cities, the right to the city, the evolution of the internet in the country, and concepts of smart cities. The study identifies that the adoption of digital technologies can improve the quality of life, increase the efficiency of public services, and strengthen economic development. However, urban transformation faces significant barriers, such as high infrastructure investment costs, technological limitations, low data integration, government budgetary constraints, and social inequality. The results also highlight the importance of governance models that encourage public-private partnerships, sustainability, and citizen participation. It is concluded that emerging countries, although having the potential to advance, are still moving slowly in the implementation of these solutions, making it essential to strengthen public policies and financing strategies that make cities smarter, more inclusive, and sustainable.

Keywords: Smart Cities. Emerging Countries. Urban Transformation. Technology and Innovation.

RESUMO

O artigo aborda os principais desafios para a implantação de cidades inteligentes em países emergentes, com foco no contexto brasileiro. A partir de uma pesquisa bibliográfica, aplicada, descritiva e qualitativa para identificar, descrever e interpretar fatores críticos sobre o tema. O trabalho resgata aspectos históricos das cidades, o direito à cidade, a evolução da internet no país e conceitos de smarts cities, o estudo identifica que a adoção de tecnologias digitais pode melhorar a qualidade de vida, aumentar a eficiência dos serviços públicos e fortalecer o desenvolvimento econômico. No entanto, a transformação urbana enfrenta barreiras significativas, como altos custos de investimento em infraestrutura, limitações tecnológicas, baixa integração de dados, restrições orçamentárias dos governos e desigualdade social.

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Os resultados destacam ainda a importância de modelos de governança que incentivem parcerias público-privadas, sustentabilidade e participação cidadã. Conclui-se que países emergentes, embora tenham potencial para avançar, ainda caminham lentamente na implementação dessas soluções, sendo essencial o fortalecimento de políticas públicas e estratégias de financiamento que tornem as cidades mais inteligentes, inclusivas e sustentáveis.

Palavras-chave: Cidades Inteligentes. Países Emergentes. Transformação Urbana. Tecnologia e Inovação.

RESUMEN

Este artículo aborda los principales desafíos para la implementación de ciudades inteligentes en países emergentes, con especial atención al contexto brasileño. A partir de una investigación bibliográfica, aplicada, descriptiva y cualitativa para identificar, describir e interpretar los factores críticos del tema, el trabajo revisa aspectos históricos de las ciudades, el derecho a la ciudad, la evolución de internet en el país y los conceptos de ciudades inteligentes. El estudio identifica que la adopción de tecnologías digitales puede mejorar la calidad de vida, aumentar la eficiencia de los servicios públicos y fortalecer el desarrollo económico. Sin embargo, la transformación urbana enfrenta importantes barreras, como los elevados costos de inversión en infraestructura, las limitaciones tecnológicas, la baja integración de datos, las restricciones presupuestarias gubernamentales y la desigualdad social. Los resultados también resaltan la importancia de modelos de gobernanza que fomenten las alianzas público-privadas, la sostenibilidad y la participación ciudadana. Se concluye que los países emergentes, si bien tienen el potencial para avanzar, aún se encuentran en un lento proceso de implementación de estas soluciones, lo que hace esencial fortalecer las políticas públicas y las estrategias de financiamiento que permitan crear ciudades más inteligentes, inclusivas y sostenibles.

Palabras clave: Ciudades Inteligentes. Países Emergentes. Transformación Urbana. Tecnología e Innovación.

1 INTRODUCTION

This theme addresses the issue of the challenges for the implementation of smart cities in emerging countries, in Brazil, for example, for Quinteri et al. (2018) a challenging aspect is the issue of the migration of Brazilians from rural areas to urban cities. This migration is based on the incorporation of technology and its results reflect on agricultural production processes, resulting in a reduction in the demand for labor. Consequently, the demand for urban services increases, which for Silva et al. (2016) is just one of the traits of the precarious Brazilian reality, among many other challenges such as urban violence, unemployment, precariousness of education and health services, lack of housing, sanitation, among others.

Objectively, for Intelbras (2022), a smart city is characterized by using technological resources to provide a better quality of life for the population.

Taking into account the points raised, the general objective of this work is to identify and describe the challenges for the implementation of smart cities in emerging countries. The specific objectives are: a) How much does it cost to become a smart city? b) What are the benefits of a smart city? and c) Requirements and difficulties to become a smart city?

The methodology used will be qualitative research to help answer the problem raised: what are the challenges to make a smart city in an emerging country?

2 THEORETICAL REVIEW

2.1 HISTORY OF CITIES

For Mumford (2004), in order to understand the history of the city, one must ask oneself: What is the city? How did its existence begin? What processes does it promote? What functions are performed? What is its purpose? Answering such questions in isolation will not be enough to help in the perception and definition of a well-defined, broad and complex concept of city.

Still for Mumford (2004) an important part that must be taken into account when talking about the history of the creation of the concept of city is the movement and rest of human life. However, the greatest and significant contributions come from our animal past, as fish gathered in schools for reproduction and the care of their offspring, birds connect to the same nest and nomads are fixed by protected areas for reproduction.

According to the aforementioned author, the city emerged as an emerging in the Paleoneolithic community, in this sense, introducing a new factor that not only increases the mass that exists, but also produces a transformation in general with a new configuration and that alters its property.

When talking about lowland cities, the writer Mumford (2004) believes that there are some difficulties because some ancient cities have not been completely unearthed, which could reveal many things, and their existence still continues as a place for housing and with no plans to be explored.

Researcher Mumford (2004) in another excerpt from the book addresses that the physical structure of the city was not a product of entirely sudden growth because the discovery of a fully walled city was made, possessing a sanctuary and typically subtle traces of art in the lower layers of Jericho when only if the ruins of Babylon were visible.

Among the influences on the city is the Baroque court in relation to aspects of life and considered the mother of many institutions that were later recognized.

However, what really led the march towards civilization was the movement to increase arable land, improve techniques for improving agriculture, demographic diffusion, and others. Countries in general will have the amount of urban population greater than the rural population, in which they will conflict.

2.2 RIGHT TO THE CITY

The Right to the City is provided for in the City Statute, Law No. 10,257/2001, in article 2, items I and II, as follows:

> Art. 2 The urban policy aims to order the full development of the social functions of the city and urban property, through the following general guidelines:
> I – guarantee of the right to sustainable cities, understood as the right to urban land, housing, environmental sanitation, urban infrastructure, transportation and public services, work and leisure, for present and future generations;
> II – democratic management through the participation of the population and associations representing the various segments of the community in the formulation, execution and monitoring of urban development plans, programs and projects (PLANALTO, 2001);

For Amanajás and Klug (2018) in the statute, the right to a sustainable city is understood as "the right to urban territory, environmental sanitation, housing, urban infrastructure, public services, means of transport, work and leisure for future and current generations. Having the right to have access to the city is understood as a diffuse and collective right for the entire population.

Also for Amanajás and Klug (2018), due to the existence of the statute, the importance of master plans as the main instrument to combat social inequalities was reinforced, subdivisions, buildings and compulsory uses were created.

According to Amanajás and Klug (2018), in Brazil and in developing countries, populations face realities such as illegality, exclusion, segregation, and informality, which leads some researchers to understand that in Brazil there is a "city deficit" (Rolnik, 2015) and/or that the country needs "city distribution" (Maricato, 2016).

2.3 INTERNET IN BRAZIL

According to Agência Brasil (2021), in mid-1987 the telephone company called Embratel dominated telecommunications in Brazil. At the same time, researchers from the country traveled to countries such as Europe and North America, where they had their first contacts with new communication options, which at the time were e-mails and discussion forums on computer networks. In turn, Brasil Escola adds that the internet arrived in the country in 1988, due to the first steps taken by the academic community of São Paulo, together with the Foundation for Research Support of the State of São Paulo - FAPESP, the Federal University of Rio de Janeiro - UFRJ and the National Laboratory of Scientific Computing - LNCC.

The years of partnership and connectivity between these Brazilian institutions with the Chicago particle physics laboratory, the Fermi National Accelerator Laboratory – FERMILAB, passed, and in 1990, also according to Agência Brasil (2021), FERMILAB, which previously opened the doors of the world of technology to FAPESP, sought greater operational capacity, then, it would migrate from Bitnet to the internet (TCP/IP) and so FAPESP followed the same steps.

According to the reference mentioned above, in 1994 the commercialization of the internet was carried out by Embratel when it launched the commercial internet service on an experimental basis with five thousand users chosen to test the service. In 2007, an auction of frequency bands for the use of 3G connection was held and this technology was soon expanded to the national territory; In 2013, the 4G connection began to be implemented in the country's capitals that would host World Cup games in 2014; and in 2021 negotiations for the implementation of 5G technology in Brazil are being made.

2.4 SMART CITIES

For Zanella (2014) the main objective of a smart city is to promote the use of public resources in the best possible way, seeking to achieve an increase in the quality of the services that are offered to the population, and still managing to reduce operating costs for the public administration's coffers.

In the view of Caragliu et al. (2011) a smart city should invest in human and social capital, transportation, drive sustainable economic growth, quality of life and governance.

In a survey by IESE Business School (2019) carried out with 174 cities and 96 different indicators, nine approaches were analyzed to indicate the level of intelligence of a city, such as: human capital, social cohesion, economy, governance, environment, mobility and transport, urban planning, international dissemination and technology. In this survey, leading the top 10 of the ranking was the city of London taking 1st place, followed by New York, Amsterdam, Paris, Reykjavik, Tokyo, Singapore, Copenhagen, Berlin and Vienna. Brazilian capitals such as Rio de Janeiro appear in 128th position, Brasília in 130th, São Paulo in 132nd, Curitiba in 140th, Salvador in 146th and Belo Horizonte in 151st.

In 2020, a survey by IESE Business School was carried out again with 174 cities, taking into account the same approaches, in the top 10 of the ranking remains in 1st place the city of London, followed by New York, Paris, Tokyo, Reykjavik, Copenhagen, Berlin and Amsterdam.

Cities in Brazil such as São Paulo appear in 123rd position, Rio de Janeiro in 132nd, Brasília in 135th, Curitiba 138th, Belo Horizonte in 156th and Salvador in 157th place.

According to Quinteri et al. (2018), a smart city has five aspects for its maintenance and development, which are: 1 – a large digital information infrastructure that can be consulted whenever you want and from wherever users are; 2 – accessible, fast and effective services according to the needs of its users; 3 – intelligent physical structure that enables its users to use as much data as possible, strategically investing in the city and the community; 4 – willingness to learn new skills, experiment with new techniques and work models and 5 – transparency in the disclosure of results and performances.

A smart city according to McKinsey & Company (2018) has three layers that work together to make it work properly. The first is the core technology, which includes a critical mass of smartphones and other sensors connected by high-speed communication networks, as well as open data portals. The sensors take constant readings of variables such as traffic flow, energy consumption, air quality and many other aspects of daily life and put the information within reach of those who need it; The second layer consists of translating raw data into alerts, insights, and action requires the right tools, and this is where technology providers and developer applications come in, to develop multiple domains: security, mobility, health, energy, water, waste, economic development, housing, engagement, and community.

2.5 EMERGING COUNTRIES

Emerging countries for Benachenhou (2013) consolidate the new social and economic geography of the world, occupying a place that is constantly growing in terms of international transactions of goods, services, technologies and capital. China has had a share of global trade in emerging countries in its exports since 1992, this year with Brazil this share in percentages was 0.9% and in 2010 it went to 14%. The specific goods to be marketed by the country in agriculture are: sugar, soybeans, coffee, meat; in minerals, iron predominates; with regard to energy, it is biofuels and offshore technologies, in the area of transport and aeronautics, it is airplanes; and finally in the area of Telecom, Modulation and Coding Scheme - MCS technology (Benachenhou, 2013).

For Tiago Reis in an article for the company SUNO (2019), what characterizes an emerging country is that it does not demonstrate a high level of economic development when compared to rich countries. However, they are considered increasingly important in the world scenario when evaluating macroeconomic indicators, as today emerging countries have a lot of influence on global economic growth. Brazil, Russia, India and China are the main emerging countries in the world and make up a group called BRICS that emerged in 2001, years later South Africa joined the group. These countries have agreed on basic principles such as non-interference, equality and mutual benefit.

3 MATERIAL AND METHODS

The methodology used will be that of bibliographic research, for Silva (2017) consists of explanations and discussions of certain subjects that have been published in magazines, annals, periodicals, scientific articles and books. In addition to bibliographic research, another research method used is the literature survey, which for Gonçalves (2021) is characterized by locating and obtaining documents that enable the evaluation of the availability of materials that have the function of subsidizing the theme of the work to be researched.

As for its nature, the research applied to the Editora do Senai-SP (2018):

> Applied research is the collection of knowledge necessary for use in practical situations employed in real problems, and may even make use of concepts developed in basic research (EDITORA, 2018, p.24).

From the point of view of its objectives, for Gomes and Gomes (2019) descriptive research is given by the most in-depth level of knowledge on a given subject, the act of describing in a certain way is a fact or phenomenon. On the other hand, the act of observing objects, interesting facts and behaviors are linked to our natural day-to-day capacity and will

serve for different interpretations. Also according to the authors, explanatory research tries to explain the observed patterns of facts or phenomena that will be evaluated, refuted, confirmed or refined, to identify the determining factors for their occurrence.

As for the approach to the problem, the research can be said to be qualitative, according to Minayo (2010), it provides the review and construction of new points of view, conceptualizations and categories, taking into account and respecting the existing diversity.

4 DATA ANALYSIS AND RESULTS

4.1 HOW MUCH DOES IT COST TO BECOME A SMART CITY?

For the Legislative Chamber (2020), one of the first public initiatives in the country focused on the theme was in 1997 with the creation of the High Speed Metropolitan Network (ReMav) project, which provided a connectivity infrastructure to promote digital library services, distance education, geographic information systems, telemedicine, teleconferences, and on-demand videos. About R$200 million were invested in this project, directed by the Ministry of Science and Technology and Education - MCTIC, the National Education and Research Network - RNP and the National Council for Scientific and Technological Development - CNPq, which resulted in the acquisition of a backbone, responsible for a high-speed and high-capacity road. In an article produced by Isto É magazine (2019), a city called Songdo in South Korea is investing an amount of US$35 billion, financed by a partnership between the South Korean government and American companies, to create a smart city 56km from Seoul and will house 65 thousand residents.

With regard to investments, for McKinsey & Company (2018) smart cities are revenue-generating ventures of private sector companies, and private actors can provide about 60% of the initial investment needed to implement the full range of current tools. Also for the magazine Isto É (2019), Mayor Daniela de Cássia Brito (PSB) of the city of Monteiro Lobato estimated a value of R$30 million for the creation of a smart city, of which about R$1.5 million have already been donated by the government of São Paulo.

4.2 WHAT ARE THE BENEFITS OF A SMART CITY?

In a report by McKinsey & Company (2018), smart cities add digital intelligence to their existing urban systems, which makes it possible to do more with less. When connected, applications start to transmit more transparent information and in real-time periodicity, allowing their users to make better choices in their daily lives. It is also noteworthy that this tool can contribute to saving time, helps reduce waste and also helps increase your social connection. Another aspect that can be taken into account is that when cities work efficiently,

they become productive places to do business. The report found that smart cities that use applications with varied infrastructure systems, that these tools contributed to reducing fatalities by 8% to 10%, speeding up emergency response times by 20% to 35%, reducing average commutes by 15% to 20%, and reducing the burden of disease by 8% to 15% and reducing greenhouse gas emissions by 10% to 15%.

For McKinsey & Company (2018), a smart city's main objective is to respond effectively and dynamically to the needs and desires of residents. Because technology serves to optimize infrastructure, resources, and shared spaces. A smart city also seeks to improve outcomes for residents by enlisting their help in shaping the places they call home. When a company sees a revenue-generating opportunity to offer mobility and services, residents of underserved neighborhoods suddenly have new ways to get to work. When a resident analyzes real-time traffic data and decides to leave at a less busy time, they avoid adding another car to the road that would make congestion worse for everyone. Millions of individual decisions and actions add up, making the city as a whole more productive and responsive.

4.3 REQUIREMENTS AND DIFFICULTIES TO BECOME A SMART CITY?

For an article by Politize! (2020) There are five practical ways to become a smart city: 1 – be a city concerned with sustainable development; 2 – have smart manholes that alert when they are full and activate a team to provide cleaning; 3 – to have a system to coordinate the operations of an integrated health system; 4 – buildings designed and planned for sewage treatment and self-generation using sunlight.

For the Inter-American Development Bank – IDB (2021), there is a methodology used to identify the level of readiness of cities to become smart cities, one of the important aspects is that the level of progress in the transition to a smart city must be known; identify possible areas of opportunity to become even smarter; map future projects to boost cities and facilitate access to financing for these projects. The maturity levels are classified as: level I - Initial (0-1.25), level II - Intentional (1.26 – 2.50), level III - Emerging (2.51 – 3.75) and level IV - Integral (3.76 – 5.00).

This methodology also observes six dimensions that encompass the environment, safety, economy, education, lifestyle and mobility. These are used to evaluate the technologies used in the services provided, local capacities, project creation and service delivery. The technological infrastructure of these cities, whether physical or digital, is also observed, considering the generation and analysis of data to produce useful information that can help in the planning and provision of services (IDB, 2021).

Paraphrasing the IDB (2021) again, what a city needs to have to become a smart city is divided into two groups: one of fortress and the other of challenge. In the fortresses, make cities available as an option for the provision of public services and also for the modernization of the city; The challenge is the lack of resources to develop a project like this and the lack of use of data to carry out an analysis to improve the services provided to the population.

For McKinsey & Company (2018), a smart city can disrupt some sectors, even if they present substantial market opportunities. Customer needs will force a re-evaluation of current products and services to meet the highest expectations for quality, cost, and efficiency in everything from mobility to healthcare. Smart city solutions convey value to both the landscape of cities and value chains. Companies that want to enter the market in these cities will need different skill sets, creative funding models, and a sharper focus on civic engagement.

The concept of "smartness" is not only based on installing digital interfaces in traditional infrastructure or simplifying city operations. It is about using technology and data purposefully to make better decisions and provide a better quality of life for citizens. Quality of life has several dimensions, ranging from the air people breathe to how safe they feel when walking on the streets (McKinsey & Company, 2018).

Still for Mckinsey & Company (2018) even the most advanced cities still have a long way to go in building the fundamentals, implementing all available applications and achieving wide adoption.

5 CONCLUSIONS

The present work was guided by the intention of answering the specific objectives raised above: how much does it cost to become a smart city? What are the benefits of a smart city? Requirements and difficulties to become a smart city? During the process, it was found that with the advent of technology and its evolution over the years, the ways of using the internet to improve the lives of citizens have increasingly diversified. Whether it is as a means of connecting with people from all over the world, great accessibility to imported products or even access to high-tech products that provide a quality of life for its users in the automation of homes, as well as the creation of smart cities, or smart cities as they are called in English.

A smart city is a system that encompasses the use of tools such as materials, energy, service provision and financing that allows goals such as economic development and the search for quality of life to be achieved. In addition, using the internet to solve problems with the help of technology.

To make a city smart, there are requirements to be met that are divided into categories such as: sustainability, population, government, quality of life, and mobility. Among the requirements that involve sustainability are the reduction of pollution, use of alternative transport, among others; In relation to population, education, health and security stand out; for the government it is the promotion of communication and providing more transparency in its acts; Regarding mobility are traffic control, informing schedules/traffic so the population can plan and arrive on time for their appointments.

One of the major challenges that imply the transformation from a "city" to a "smart city" is the issue of the financial investment applied in this initiative, an investment of this magnitude is considered high taking into account the limited budget of these countries to invest in infrastructure. It also involves network connectivity, as it needs to integrate the city with an internet system that enables connectivity that works to meet demands. It is also necessary to standardize the data, to be able to understand the dynamics of how the city works in an "intelligent" way and make the necessary changes to conduct the well-being of the population on a daily basis. The implementation of a data governance policy for the management of information on people, processes and technologies stands out as a challenge. And finally, the issue of slow deadlines is highlighted as a difficulty in the process of creating a smart city.

Among the limitations found for the production of this are the lack of scientific and academic production in Portuguese, due to Brazil still moving at a slow pace to keep up with advances in technology.

As a suggestion to face these challenges, I suggest that all emerging countries adopt public policies and partnerships with American financial institutions to develop a public policy establishing the creation of smart cities in all their capitals.

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