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Research Paper

Can a Small City Become Smarter? An evaluation of Viana do Castelo based on a stakeholder perspective

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ABSTRACT

Purpose: Using the city of Viana do Castelo as a case study, the aim of this paper is to analyse the capacity of a city to transform itself into a Smart City. The specific objectives are: (i) to analyse the perception of the concept of Smart Cities by the different stakeholders; and (ii) to analyse the potential of Viana do Castelo to become a Smart City, considering the economic, human, living, governance, environmental and mobility dimensions.

Methodology: A qualitative methodology was used. Primary data was collected from a wide range of stakeholders in the city, such as the local authority, a higher education institution, private companies, business associations and residents. A total of 15 stakeholders were interviewed between August and September 2022.

Results: The results show that the city of Viana do Castelo is still in the early stages of its transformation into a smart city, despite the potential perceived by stakeholders in some dimensions. The development that has taken place in terms of the environment and quality of life is positive. However, in order to become a smart city, major investments are still needed in the areas of mobility and people. The economic dimension, despite the progress made in recent years, still needs significant improvement if it is to fulfil its potential as a Smart City.

Research limitations: Primary data is collected through stakeholders' perceptions as actors in cities. Despite the advantages it offers, this is also recognized as a limitation.

Practical implications: The results have important practical implications for different actors in a city, such as local governments, citizens, companies and other kind of organizations, who can use the knowledge to inform their decision-making. In addition, the results could be important for policy makers in the development of public policies.

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Originality: The paper explores the issue of smart cities in the context of small and medium sized cities.

Keywords: *Urban planning; City management; Smart cities; Stakeholders, Viana do Castelo.*

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1. Introduction

The topic of smart city is relatively new, having emerged mainly in the 1990s (Giffinger et al., 2007). The concept is closely linked to the development of the cities, their growth and subsequent redevelopment and urban planning. Indeed, the abandonment of rural areas and increasing urbanization have created enormous pressures on the development of urban centers, which have manifested themselves in problems such as imbalances and inequalities among urban populations, situations of violence or lack of security, waste management, and many others.

The term smart city consists of a new approach to solving urban problems, anchored in a multidimensional perspective seeking sustainable and efficient development based on different actions (Bernardino & Freitas Santos, 2017).

Despite the relevance of the topic, there are still few studies that seek to explore urban development based on the multidimensional perspective that the smart city concept entails, as opposed to the technological dimension on which most works are based. Furthermore, some studies have been applied to large cities at an international level. To the best of our knowledge, there is still little research focusing on small cities and how they involve different actors in developing new responses to the socio-economic challenges that cities are facing today.

This research aims to analyse the potential for transforming Viana do Castelo into a smart city from the perspective of different local stakeholders. Viana do Castelo is a coastal city located in the north of Portugal, more specifically in Alto Minho that has ancient traditions (folklore, hand embroidery, pottery). Nevertheless, taking advantage of technological developments and the challenges posed by urban growth and tourism, Viana do Castelo has initiated a strategy to transform itself into a smart city.

The paper is structured as follows. First, the theoretical framework is presented through a literature review of the main challenges related to urbanization and the smart city concept as a new approach to the study of cities. Section 2 describes the methodology used in the empirical study. Section 3 presents the results obtained through a content analysis of the interviews conducted with different stakeholders in Viana do Castelo. Finally, the conclusions are outlined.

2. Theoretical background

2.1. Smart city: a new approach to urban research

The concept of the smart city emerged in the 1990s as a new approach to urban planning, with the aim of facing the problems arising from the rapid pace of urbanization (Fernandes, 2016). After its emergence in the United States, the concept has rapidly spread to Europe and Asia and is now present in a significant number of countries around the world.

The smart city concept refers to the balance between technology, people and businesses, through the integration of institutional organizations with democratic participation based on information technologies (Lefaita, 2015).

In its genesis, it stems from the emergence and application of information and communication technologies (ICT) in the management and development of cities. Meanwhile, since 2005, the concept has evolved with the management of complex systems and information based on the planning, development, and management of urban operations.

For the European Parliament (2014), a smart city is a city that seeks to address public issues through solutions based on information and communication technologies, anchored in a multi-sectoral and municipal partnership aimed at solving problems of common interest. According to the European Commission (2015), a smart city is a place where traditional networks and services are made more efficient through the use of digital and telecommunication technologies, for the benefit of its inhabitants and businesses. On the other hand, according to Cosseta and Palumbo (2014), a city can be considered smart when there is investment in human and social capital and in traditional (transport) and modern information and communication technologies (ICT) infrastructures that promote

sustainable economic development and a high quality of life, through careful management of natural resources and through forms of participatory governance.

More recently, the smart city concept has also been linked to issues such as security, environment and energy (Giffinger et al., 2007). As such, the smart city concept aims to change conditions and modes of action to promote efficiency, sustainability and urban quality of life (Bernardino & Freitas Santos, 2017).

Another relevant contribution to a holistic view of the smart city concept was made by Caragliu et al. (2011), who emphasized the central role of people's quality of life, for which information and communication technologies should be made available.

A city will become smart if it is able to develop and integrate projects that contribute to the objective of economic development, taking into account the above premises and promoting the participation of all relevant stakeholders, so that the projects to be developed are relevant to cities, both in terms of neutralizing existing urban problems and exploiting the opportunities that the city has to offer (Centreforcities, 2014). It can also be understood as a hybrid model combining open and democratized innovation, but supported, coordinated and monitored by the city's own governance structures.

In summary, the smart city concept highlights the role that ICT can play in improving the competitive profile of a given city and the quality of life and well-being of its citizens.

Giffinger et al. (2007) argue that the concept of a smart city is complex and multidimensional, with six main dimensions: smart people, smart economy, smart living, smart environment, smart mobility and smart governance. In this sense, a smart city is seen not only by the availability of information and communication technologies at its disposal, but by the set of characteristics that constitute an intelligent combination of resources, activities and citizens. According to Giffinger et al. (2007), the better a city ranks in each of these dimensions, the more it qualifies as a smart city.

Smart people

People are seen as the key to the development of the city. Besides considering the education and skills of each citizen, it is important to emphasize the ability to cooperate and help each other to overcome obstacles, to be proactive, to share common goals and to actively participate in social life. People and their attitudes and thoughts are also the

result of different factors, such as past experiences or upbringing, and therefore produce different results in communities.

It is essential to create initiatives and projects that inform, educate and encourage the participation of citizens and involve them in urban management decisions (Chourabi et al., 2012). To this end, it is important to create workshops, courses and programs that make use of social capital (Toppeta, 2010). Therefore, the competitiveness and development of cities are strengthened, ensuring a comparative advantage over other cities. Smart cities are also key for higher education and better educated people, which has a direct impact on economic development and social tolerance (Wahab et al., 2022). However, this more human dimension has been neglected in the face of technological aspects, such as the use of ICT. According to Shapiro (2006), regions with more educated citizens will have the conditions for a better quality of life, as better educated and informed people will generate more growth and will have more influence on the political process. In this sense, we highlight the fundamental role of technologies that revolutionize the sectors in which they operate within cities, and of better educated and informed people that together generate a greater capacity to launch new ideas, products, services, define strategies and theories. In other words, people and technologies create together better working and development conditions, facilitate processes and improve the efficiency of systems (Komninos, 2009).

In this way, people are essential for the development of entrepreneurial activity and are drivers of innovation, becoming an influential and attractive factor in a city. At the same time, the introduction of information and communication technologies and innovation creates a lifelong learning environment for people (Wahab et al., 2022).

This dimension is relevant because it improves livelihoods, enhances the value of human capital, increases the human development index and ensures that people are highly flexible, sensitive and resilient to change (Wahab et al. 2022).

Smart economy

The definition of a smart economy encompasses factors directly related to economic competitiveness, such as entrepreneurial capacity, labor market flexibility, productivity, innovation and national and international market integration (Giffinger et al., 2007).

Cities that manage ICT to develop new and technologically intelligent processes and integrate them in the smart economy concept create a favorableand fertile environment

for new business opportunities. Moreover, enterprises can be considered as central systems in cities, as they include services, citizens, institutions, businesses, communications, transports, water and energy systems (Dirks & Keeling, 2009).

The development of smart cities is usually associated with the creation of new businesses, which consequently generate new jobs, human capital improvement and growth, and increased productivity (Chourabi et al., 2012).

In addition, entrepreneurship and innovation are important drivers in the development of new products and services, promoting an increase in productivity, which in turn influences economic growth in terms of increased competitiveness. In this sense, the factors contributing to the smart economy are innovation, entrepreneurship, economic image and brands, productivity, labor market flexibility and international integration. Thus, this dimension can be seen as the smart city itself as an engine of production and innovation that influence the growth of the economy (Wahab et al., 2022).

Smart living

The quality of life in a city depends on factors such as the cultural life of the city, the conditions of access to health, education, security and housing, social cohesion and the attractiveness of the city in terms of tourism (Giffinger et al., 2007). This dimension also includes improving individual and collective quality of life, personal safety, environmental quality and availability of cultural facilities and tourist attractions in urban areas (Bernardino et al., 2018).

The focus is on improving the quality of life of citizens. This is possible by increasing social cohesion, where community members are willing to contribute and help each other, preserving culture and heritage, having social equity, maintaining livelihoods, and providing people with housing, education, and health facilities.

Smart mobility

Smart mobility includes transport infrastructure and management, and the integration of information and communication technologies in systems (Wahab et al., 2022). Mobility could be increased by integrating a public transport system that is efficient and sustainable, both in terms of energy and price, in a complete itinerary through the city, moving between the points of the city (European Commission, 2011). also requires good

accessibility to regional and international networks and the existence of efficient infrastructures (Giffinger et al., 2007).

Some solutions that contribute to this dimension are the use of a single interface as a platform offering different transport services to the public, the adoption of sustainable travel behavior, the use of clean energy transport, i.e. favoring non-polluting modes such as cycling or public transport over private transport, and traffic management to reduce traffic concentration (Wahab et al,. 2022).

This allows traffic to be moved away from the city and enables the provision of intelligent services. It also improves the user experience. An example of this is public transport timetable monitoring applications, which allow citizens to find out about timetables, routes and travel times, among other things (Wahab et al., 2022).

Smart environment

The environment has been one of the most problematic issues over the years. With urbanization and the settlement of populations in these areas, negative impacts on the environment have increased, such as waste, congestion of private transport, air pollution, lack of green spaces, and natural disasters such as floods, tsunamis, melting ice, among others (Silva et al., 2014).

To be smarter, cities must take into account initiatives that have a significant impact on the environmental sustainability and liability of the city, specifically the protection of natural resources and the management of public infrastructure such as sewers, watercourses and green spaces (Chourabi et al., 2012). It is also important to explore the field of energy management and sustainable buildings, such as solar or wind energy (Lefaita, 2015).

The core of a smart environment represents the way to preserve and manage the natural resources of the city, which can be described by attractive natural conditions, reduced pollution rates, environmental protection and sustainable resource management. To achieve this, it is important to include the use of renewable energy, the implementation of smart grids, pollution control management and green spaces in urbanization plans (Wahab et al., 2022).

Smart governance

Smart governance is the basis for a smart, open, and participated engagement platform that supports collaboration between government, stakeholders and citizens (Wahab et al., 2022). It also requires a structure that coordinates and guides the different dimensions of a smart city, the so-called government.

The growth of cities into smart cities generates challenges that are different from the usual ones, so it is necessary to act in an innovative way to respond to them. This is why the use of information and communication technologies is increasingly recurrent for governments, in order to provide public services and implement public policies (Rodríguez-Bolívar, 2015). Thus, for several authors, governance is at the core of smart city projects (Giffinger et al., 2007).

A smart city requires an interconnection between technological, political and institutional components (Chourabi et al., 2012) that is perceived as a network of multiple systems aimed at satisfying human needs. This leads to greater institutional integration in terms of planning and monitoring (Rodríguez-Bolívar, 2015). It is also important that there is coordination between the different actors in the network, such as schools, local authorities, local transport, businesses, housing cooperatives, among others. Urban governance should manage the actions and results of the different actors (Rodríguez-Bolívar, 2015).

In this way, there must be an interconnection between government departments to implement an integrated and structured strategy that links the different urban policies, such as the economy, the environment, mobility, social cohesion, tourism, culture, health, education, among others. In addition, the laws or policies that are created and approved serve as guidelines for social relations, legal instruments and norms (Wahab et al., 2022).

Smart governance has the function of promoting the power of citizens, the participation of all stakeholders and the innovative use of social capital (European Commission, 2011). Therefore, citizens must have a participatory role in political and strategic decisions for the development and growth of cities. Government must also have a long-term vision, sound knowledge, understanding of strengths and weaknesses, such as diversity and entrepreneurial base, social capital, financial capital, among others, so that they can be properly assessed, and future growth can be structured and appropriate (European Commission, 2011). It must also adopt a transparent stance, i.e. act openly and with the knowledge of the citizens regarding the decisions being made (Wahab et al., 2022).

It is also important that governance is carried out on a solid and transparent basis using information and communication technologies (ICT), which are essential for the social, economic and political life of the city (Rodríguez-Bolívar, 2015). ICT-based governance is considered smart governance, which represents a set of technologies, people, policies, interactions, practices, resources, social norms and information that interact with each other and support the activities of government in the city (Giffinger et al., 2007). In addition, the use of ICT enables the removal of legal and regulatory barriers (Chourabi et al., 2012). This use needs to be tailored to the needs of the city and its citizens, and to the resources available.

Assessing the smartness of a city

A smart city is not only seen in terms of the high availability and use of ICT, but also through a set of characteristics that create an intelligent combination of resources, activities and citizens.

Table 1 systematizes, for each of the dimensions proposed by Giffinger et al. (2007), the different factors that contribute to transforming a city into a smart city, as well as examples of indicators that can be used to measure them.

Table I: Indicators for a smart city – Example

Dimension	Factor	Indicator
Smart economy	Innovative spirit	Expenditure on R&D activities as a % of GDP Employment rate in knowledge-intensive sectors Patent applications per inhabitant
	Entrepreneurship	Self-employment rate New companies registered
	Economic image & trademarks	Importance as a center for decision-making
	Productivity	GDP per employed worker
	Flexibility of labor market	Unemployment rate Proportion in part-time employment Companies with headquarters in the city that are listed on the stock exchange Transport of passengers by air
	International embeddedness	Air freight transport
Smart People	Level of qualification	Importance as a knowledge center (top research centers, top universities, etc.) Population with higher education Knowledge of foreign languages
	Affinity to lifelong learning	Number of book loans per inhabitant Rate of participation in lifelong learning Participation in language courses Rate of foreigners

	Social and ethnic plurality	Rate of nationals born abroad
	Flexibility	Perception of getting a new job
	Creativity	Rate of population working in creative industries
	Participation in public life	Voter turnout in city elections Voter turnout in European elections Participation in voluntary work
Smart governance	Participation in decision-making	City representatives per resident Political activity of residents Importance of politics to residents Rate of female city representatives
	Public and social services	Municipal spending on public spaces per inhabitant Rate of children in day-care centers Satisfaction with the quality of schools
	Transparent governance	Satisfaction with the transparency of bureaucracy Satisfaction with the fight against corruption
Smart mobility	Local accessibility	Public transport network per inhabitant Satisfaction with ease of access to public transport Satisfaction with the quality of public transport
	(Inter-)national accessibility	International accessibility
	Availability of ICT infrastructure Sustainability, innovation and safety of transport systems	Computers per household Access to broadband internet per household
	Sustainable, innovative and safe transport systems	Green mobility rate (individual non-motorized traffic) Traffic safety Use of hybrid cars
Smart environment	Attractivity of natural conditions	Hours of sunshine Green spaces
	Pollution	Incidence of ultraviolet rays Particular problems Fatal respiratory diseases per inhabitant
	Environmental protection	Individual efforts to protect the environment Opinions about environmental protection
	Sustainable resource management	Efficient use of water (in relation to GDP) Efficient use of electricity (in relation to GDP)
Smart living	Cultural facilities	Frequency of cinema visits per inhabitant Visits to museums per inhabitant Frequency of theatre visits per inhabitant
	Health conditions	Average life expectancy Hospital beds per inhabitant Doctors per inhabitant Satisfaction with the quality of the health system

	Individual safety	Crime rate Homicide rate per robbery Satisfaction with individual security
	Housing quality	Rate of dwellings meeting minimum quality standards Average living space per inhabitant Satisfaction with the quality of personal housing Importance as a tourist destination
	Touristic attractivity	Annual overnight stays per inhabitant Perception of personal risk of poverty
	Social cohesion	Poverty rate

Source: Giffinger et al. (2007)

3. Methodology

The aim of this research is to evaluate the capacity of a city to become a smart city, using the city of Viana do Castelo as a case study. In order to achieve this goal, the following specific objectives were defined: (i) to understand the perception of the concept of smart City by the different stakeholders; and (ii) to evaluate the potential of Viana do Castelo to become a smarter city, taking into account the economic, human, living, governance, environmental and mobility dimensions.

The city of Viana do Castelo was chosen primarily because of its geographical location and population. In terms of location, Viana do Castelo is the northern most Atlantic city in Portugal, located about 60 kilometres from an airport in Porto and about 70 kilometres from an airport in Vigo, Spain. In terms of population, according to the Viana do Castelo City Council website, the city has around 40,000 inhabitants and the municipality around 91,000 inhabitants and can be considered a medium-sized city in Portugal and a small city in Europe. It is a coastal city that has grown in recent years in terms of tourists and visitors, and is considered the capital of Portuguese folklore, festivals and pilgrimages, where handicrafts, especially hand embroidery and pottery, play an important role (Câmara Municipal Viana do Castelo, 2022).

A qualitative methodology has been chosen for a deeper understanding of the research subject (Martins, 2004) and for a more detailed exploration of the different dimensions of the city (economy, population, quality of life, governance, environment, and mobility). Primary data was collected from a wide range of actors in the city, such as the municipality, a higher education institution, private companies, business associations and citizens. The sample also included residents of the city who were employees of the

companies included in the study. To ensure the anonymity of the participants, their names were not identified in the study.

Table II summarizes the main characteristics of the sample.

Table II: Summary of analysis units

Name	**Activity sector/characteristics**	**Location**
Viana do Castelo City Council	Public sector	Centre of the city
Polytechnic Institute of Viana do Castelo- higher education school	Education sector	Centre of the city
Business Association of Viana do Castelo	Business sector, in the area of consultancy	Centre of the city
Company A	Business sector, in the area of consultancy and accounting; Micro-enterprise	City surroundings
Company B	Business sector, in the automotive area; Multinational	Business park
Company C	Business sector, banking	City surroundings
Company D	Business sector, coworking space and research centre; Micro-enterprise	Centre of the city
Cmpany E	Business sector, in the automotive area; Micro-enterprise	City surroundings
Company F	Business sector, real estate	Centre of the city
Company G	Business sector, in the area of night entertainment Micro-enterprise	Centre of the city
Resident A	Male, 24 years old	
Resident B	Male, 28 years old	
Resident C	Female, 45 years old	
Resident D	Female, 22 years old, student	
Resident E	Female, 32 years old	

Source: Own elaboration.

Data collection was based on a semi-structured script developed by the authors based on the literature review and the research objectives. The script was adapted to each type of stakeholder analysed.

The first interview, which was exploratory in nature, was conducted with an official from the Viana do Castelo city council, given the council's important role in the definition of local public policies and the design of the strategy to transform Viana do Castelo into a smarter city. Interviews were then conducted with the different stakeholders, using the pre-established script as a reference.

In order to carry out the interviews, the institutions were contacted by email and telephone to present the research project and schedule the interviews. The interviews took place between August and September 2022 and lasted between 30 and 45 minutes. The interviews were conducted face-to-face, except for one case where the interview was conducted online using Microsoft Teams. All interviews were recorded for transcription, with the prior consent of the participants and used in the content analysis. To ensure the anonymity of the participants, the interviewees were randomly coded from 1 to 11 (I01 to I11)

4. Analysis of the results

4.1. *Stakeholders' perceptions of the concept of smart cities*

The analysis began with an attempt to understand how the various actors in the city perceive the concept of smart city.

The analysis of the interviews shows that, in the perception of its actors, the concept of smart city is inextricably linked to the digital transition and the use of ICT for the development of the city itself (I01, I02, I03, I05, I06, I07). The concept also includes the use of technology (sensors) and the internet of things (I03). As one of the interviewees (I07) pointed out, to talk about smart cities is to talk about the development of digital solutions in response to the problems affecting the city at a given moment. Therefore, according to the same interviewee (I07), the concept of smart city should include technologies that can contribute to solve problems identified in other areas, such as the economy, health, well-being or social life. The purpose of using technologies in the context of smart cities should be "to improve and optimize the quality of life of its citizens and to stimulate economic growth by investing in sustainable and innovative solutions in different areas, from the environment to mobility and citizen participation" (I01). Similarly, according to another interviewee (I04), a smart city is "a city that has the ability to read and respond to the different needs of the city itself, i.e. respond to the needs of those who live there, whether in terms of resources, people, infrastructure or access". As interviewee 06 points out, in the context of smart cities, technology makes people's everyday lives easier.

More succinctly, for one interviewee (I02), a smart city is one that makes people's lives easier, or "a city that can read and respond to the different needs of the city itself, in other

words, it can respond to the needs of those who use it or invest in it" (I04). According to the respondents, the concept of a smart city also includes the issue of energy, green and ecological transition (I01, I02, I08), which makes it possible to create new sustainable dynamics in the face of the city's growth (I02).

The connection between the different actors in the city is also seen as relevant to the concept of smart city. For interviewee I02, building a smart city means creating a fully connected city, where both entrepreneurs and residents have access to platforms and services that connect them to each other and to services provided by other entities, such as companies, municipalities or public institutions. Talking about smart cities also implies generating faster and more accessible information (I03, I08), creating databases that are then monitored more efficiently (I05), and a whole process of continuous improvement (I04).

According to the interviewees, the smart city concept involves innovation and social change (I06), although they believe that its implementation may involve resistance to change and therefore requires the participation and education of the population. For another participant in the study (I01), the transformation into a smart city is an ongoing process based on a balance between improving the quality of life of citizens and the sustainable development of the urban ecosystem.

4.2. *Viana do Castelo's potential as a smart city*

The empirical study aimed to evaluate the potential of Viana do Castelo as a Smart City, as perceived by different stakeholders.

From the analysis of the interviews, it is clear that the city is still at an early stage in its transformation into a smart city, especially when compared to other national and international cities (I02). According to interviewee I01, the city is currently in a diagnostic phase to understand and strengthen the strategy to transform Viana do Castelo into a smarter city.

In their assessment of Viana do Castelo's potential as a smart city, the interviewees highlight positively its location (I01, I04, I06), mainly by its proximity to the seaport, the port of Leixões, and two airports (Porto and Vigo), as well as the proximity to the region of Galicia in Spain. The interviewees also highlighted the natural features of the city,

namely the maritime environment, the river and the mountains, which are specific to the city's landscape. This opinion is shared by various stakeholders, including the city's residents. The proximity to industrial and academic centers, not only local but also regional, is also highlighted as positive, particularly for the development of talent and the retention of people (I04). The city's specific characteristics are also seen as attractive for retaining foreign talent, including digital nomads (I06).

The city's natural and endogenous resources, especially its heritage (culture) and the sea, are also identified as important for ensuring the actions needed to change the city's profile (I01). Similarly, the territorial cohesion of the whole municipality is highlighted as relevant to the city's development potential (I01).

The role of the municipality in developing the city's profile and strategy is also underscored by some interviewees (I06, I07), as well as the business sector (I08) and tourism, especially senior tourism (I06).

Economic dimension

The business fabric of Viana do Castelo is mainly characterized by micro and small enterprises, which tend to be family-owned. As one of the interviewees said, Viana do Castelo has a fairly traditional business fabric (I06). However, the development that has taken place in recent years in terms of the ability to attract business investment is clear from the interviews. As one of the interviewees (I03) pointed out, "8 years ago Viana do Castelo had one industrial park and today it has four (...), almost all of which are occupied". These industrial parks house large national and foreign French, Japanese/French, German or Spanish companies. These parks house companies from sectors such as automotive, shipbuilding and wind energy industries.

The services sector is highly adaptable, as evidenced by its recovery from the 2008 economic crisis. However, according to one of the inhabitants, the economic fabric of Viana is very industrial and there is still a need for more investment in services (I11).

Still in the economic dimension, the role of tourism should be highlighted, as one of the interviewees pointed out its growth in recent years (I03). However, one of the interviewees warns that some businesses, especially traditional and street-based, are currently "geared towards visitors to the city and there are no opportunities for locals".

The sea economy is mentioned by one of the interviewees for its potential for the city of Viana do Castelo (I02), as it currently contributes around 2,000 jobs and a significant amount to Portuguese exports.

The digital transformation of the city's companies is still a distant reality for most of them, which are small and whose entrepreneurs are of a more advanced age. Nevertheless, there are already some cases of companies that are involved in Industry 4.0, albeit few in number (I03).

Regarding the economic dimension, one of the interviewees highlights the role that information technologies have played in the creation of a 100% public e-commerce platform (Viana Market initiative) and the application for digital shopping districts (I03). The digitization of public services is also highlighted as positive, as it allows local government to be more agile and efficient (I02).

The support systems for companies wishing to set up in Viana do Castelo are also mentioned (I03), such as the tax benefits and the ease of acquiring land from the municipality itself. The role played by the municipality in this respect is emphasised by other actors, who value the proactive position adopted by the municipality in the development of projects, including financial support, the ease with which tax benefits are designed in the implementation or development phase of new projects, as well as the culture of proximity and openness (I04). However, one of the interviewees (I05) points to the difficulties faced by established companies in defining their own future and projecting themselves internationally. The more professional culture of some multinationals in the city is seen as positive for its potential as a smart city (I08).

Still in the smart economy dimension, some of the municipality's shortcomings in terms of entrepreneurship were mentioned (I05). In terms of attracting skilled labor, some interviewees (I07) highlighted the positive role played in this area by different actors, such as the municipality, companies and higher education institutions (Polytechnic Institute of Viana do Castelo). However, another interviewee considered that the attraction of labor in different sectors, whether qualified or not, was still a weakness (I04, I03, I06), with significant implications for the costs and development strategy of the companies themselves (I03, I04). However, according to one resident, the existing businesses are still insufficient to create jobs for the available workforce in the city (I15).

The need to develop a more critical spirit among new students and employees, with greater resilience in finding solutions to problems, is identified by one respondent (I02).

The ability to attract young people to the city was also highlighted in the empirical study. Also worthy of mention is the city's housing problem, exacerbated by the luxury property market in the city center and the growth of external demand, which makes it very difficult for young people in particular to afford their own homes, given the wage levels (I08). Another weakness identified by respondents in the economic dimension is the size of the city itself, which makes it economically difficult to attract companies of a certain size or reputation (I07).

Regarding the improvement of the economic dimension, there have been a number of specific projects, such as the creation of the digital job market - "Work in Viana" - a project which has improved the skills and employability of companies in the municipality. Another project under development is DataCoLAB, recognised as a Collaborative Laboratory by the Foundation for Science and Technology, which is the result of a partnership between companies, the municipality and academia (Viana do Castelo Polytechnic Institute). The aim of this project is to use data to redefine the way Viana residents produce, consume and live, based on the development of tools to support decision-making. In addition, this project will develop knowledge to increase the competitiveness of businesses and raise awareness of the need to adapt businesses to the emerging reality of data-driven innovation.

When it comes to transforming the economic dimension of the city into a smart city, the interviewees recognize the financial demands involved due to the high investments required, where funding provided by the European Union is perceived as relevant. However, the interviewees acknowledge that applications to these funding mechanisms are very complex and bureaucratic, which makes access to funding difficult. In addition, all interviewees emphasize the need for monitoring to ensure that the funds are used correctly.

Human dimension

When evaluating the elements related to the human dimension of the city of Viana do Castelo, the increasing number of students attending higher education (I02) is mentioned in a positive way, and in most cases the students are the first generation of their household

to attend higher education. These students have a high propensity to participate in the projects developed by the educational institution.

However, despite the improvements that have taken place in recent years (I03), the need to train a qualified workforce is recognized, as is the need for more investment in training and people's qualifications (I04). As one of the interviewees (I03) pointed out, the new jobs created as a result of industrial parks cannot be fully employed by the local population because they require skills that are difficult to find in the municipality. As a result, according to interviewee 03, around 20 per cent of the new jobs created have to be filled by people from outside the municipality. According to the same interviewee, the Polytechnic Institute of Viana do Castelo has made efforts to adapt the courses it offers to the needs of the economy.

Regarding the human dimension, the interviewees also highlighted the pride of the citizens in their roots and their love of praising the city, with cultural traditions and uses, including the deeply rooted religious ones.

On the negative side, the ageing population is mentioned (I06, I08) and some interviewees stress the need to educate the population (I06, I08). In their opinion, the population of Viana is resistant to change, which makes it difficult to implement initiatives that promote a smarter city. In addition, over the years habits have been created that are contrary to the sustainability and mobility policies that the municipality intends to implement. Therefore, a strategy to educate the population of Viana would be important to change the profile of the city (I06).

Another respondent believes that there is a certain lack of awareness among the general population of the benefits of using technology for people, which is detrimental to the development of the city and the appreciation of human labor (I03). Nevertheless, one of the interviewees considers that some of the actions taken to promote digital literacy are positive (I01).

Also, the growing multiculturalism currently observed in the city (I08), with an increase in the number of residents from other origins (Central Europe, America or Canada) who have settled in the city, has encouraged the emergence of new markets, such as luxury markets, as well as the creation of leisure activities in the city that match to this profile of resident.

Living dimension

The way of life in Viana do Castelo is described by respondents as safe, with good food and scenery and pleasant leisure areas. Some of the city's infrastructures, such as hospitals, health centers and pharmacies, as well as shopping centers and street shops, are also positively mentioned as contributing to the quality of life of its residents (I03). Gastronomy and cultural events are also mentioned positively in the interviews (I04).

Respondents highlight the fact that the city center has been redeveloped and that new housing is available, albeit in the luxury property sector. The high prices of these properties make it difficult for people to afford to buy their own homes. However, living conditions are improving and houses are being built in a more sustainable and environmentally friendly way. One of the interviewees (I08) also mentions the role that information technology will play in the construction of new homes, with the hope that home automation will improve people's quality of life.

According to the residents interviewed, Viana do Castelo is a pleasant place to live, with leisure facilities and proximity to different regions of the country, which makes it easier for them to get around. As interviewee 4 sums it up, Viana "is not a big city, but it has quality of life".

Governance dimension

In terms of governance, and although the interviewees recognize that the city is still at an early stage in its transformation into a smart city, some actions that have been developed within this dimension stand out.

These actions include the digitization, dematerialization, simplification and bureaucratization of administrative processes by public services, as well as the implementation of proximity responses to the population (I01).

In terms of governance, some interviewees highlighted the municipality's willingness to work with businesses and create an ecosystem that is more conducive to the development of a smarter city (I03, I04). In the opinion of the City Council, it is important to pay attention to improving the communication strategy with the residents of the municipality, as well as the implementation of proximity strategies with the population.

The council mentions the efforts made to involve citizens more closely in the decision-making process. An example of this is the creation of the "Agenda for Innovation 2030",

a strategic document based on the input of citizens through surveys, forums and thematic focus groups, with the participation of more than 1,500 residents.

From the residents' perspective, there is a distance between the municipality and the citizens, which is reflected in the decision-making process. Residents point to a lack of openness and difficulty in engaging in dialogue with the municipality, sometimes only with groups of the population rather than with the population as a whole, and only at very specific times and in a dispersed manner.

It should be noted that one of the intentions of the municipality is to create a citizens' laboratory in the future, where the opinion of the citizens will be collected and valued in the political decision-making and in the creation of new solutions. The use of digital media to promote transparency between the municipality and citizens, through public institutions that are more active in the digital environment, is also mentioned as relevant to changing the city's profile (I01).

One of the interviewees (I06) pointed out that the four-year term of office of city councils limits their ability to design and implement long-term strategies, which has a negative impact on the efficiency and effectiveness of their actions.

Environmental dimension

Regarding the environmental dimension, the interviews indicate that some of the actions undertaken by the municipality are positive, such as optimizing waste collection, promoting recycling and composting, installing LED lighting throughout the city and most of the municipality, and regulating and reducing public lighting at less busy times through smarter management. On the other hand, the consolidation of the Viana do Castelo Geopark aims to contribute to the valorization of the geological and environmental heritage of the municipality.

The interviews show that the concern for the environment is also visible among other actors, in particular among businesses. As noted by one of the participating companies, this concern is reflected in the sustainability strategy (I04), to which the partnerships developed with the municipality and the companies located in the town are relevant (I04). An example of this interaction can be seen in the case of waste collection and reuse. In the environmental field, some respondents (I03) stress the importance of producing their own energy. Apart from the fact that this can be done individually by each of the interviewees (e.g. I02), the role that the city has played in the creation of the first offshore

wind farm in Portugal (WindFloat), for which the first tests have been carried out and new investments are underway, as well as the creation of renewable energy communities, should be noted positively. Also noteworthy is the location in Viana do Castelo of a green hydrogen production plant in one of the city's business parks. Raising public awareness of less polluting transport options is also one of the strategies mentioned (I01).

Finally, we should also mention the role that the municipality's education and research can play in the environmental dimension, namely through the implementation of sustainability projects. An example of this is a European project in which the Polytechnic Institute is involved, in which bottles are made from materials other than plastic. Digitalization has also made it possible to contribute to the environment, through dematerialization (I09).

Mobility dimension

When evaluating the city of Viana do Castelo in terms of mobility, the proximity of the city to the airports of Porto and Lisboa (I07) is highlighted, as well as the existence of the long-distance train, which reduces travel time and makes it more comfortable.

Also worthy of note is the commitment to soft mobility, with the construction of a network of cycle paths in the city center. In the future, the intention is to continue the strategy of strengthening cycle paths and ecovias, as well as creating a pedestrian link between the two banks of the River Lima. This effort to create cycle lanes and dedicated parking for bicycles is mentioned by some interviewees (I02, I07).

With regard to public transport, the interviewees felt that it was still underdeveloped, both within the city and between the city and its surroundings (I07), and that it was insufficient to meet the needs of the inhabitants (I07). According to one of the interviewees (I02), mobility in the city is at an early stage of maturity. In this context, the stakeholders interviewed stress the need to invest heavily in mobility solutions in the city. Real-time information could make a significant contribution (I02). In order to improve mobility solutions, one of the interviewees also mentions the need to consensus between the different actors in order to reduce conflicts, in particular between the public and private sectors (I02).

Some interviewees (I03, I04) believe that the development of mobility solutions should be extended to industrial parks, as mobility in these areas is still very poor. This concern is reinforced by the fact that the municipality has four industrial parks, which are far apart

and have a considerable distance between them. As the interviewee pointed out, "when you go to an industrial park, the most you see are cars", which highlights the need to create collective mobility solutions to meet the needs of all those who work in different parts of the city. This need to improve mobility solutions in order to build a smarter city is underlined by respondents 3 and 4, as the use of cars by employees in business parks reduces their installed capacity, as around a third of the land has to be allocated to parking.

Information technologies are recognized as capable of improving the mobility dimension. One of the interviewees (I02) gave some examples, pointing to the creation of applications to identify buses (including electric buses) or to share rides. The city has also developed an application (called “Viana mais acessível”) to identify routes for people with reduced mobility.

For the future, according to interviewee 02, there is still a lot to be done to change people's mobility habits through information technologies, where gamification could make an interesting contribution. Raising people's awareness and changing their mindset towards more sustainable mobility practices is still a work in progress, as several interviewees pointed out.

5. Conclusion

In recent years, cities and their stakeholders have faced major challenges, forcing them to rethink their future development strategy. The concept of the smart city has been progressively applied in some cities, which seek to combine the use of ICT with the way cities are managed, with the aim of improving the quality of life of their residents.

The aim of this research was to evaluate the potential of the city of Viana do Castelo to become a smarter city.

The research carried out shows that the city's stakeholders already have some knowledge of the smart city concept, although sometimes in a rather vague way and with difficulties in interpreting how to operationalize it. When analyzing Viana do Castelo's potential as a smart city, the perspectives of the different stakeholders are generally positive, with the geographical characteristics of the city itself standing out as the most important. However, it is recognized that, despite the potential presented, there is still a long way to go to change the profile of the city. Regarding the potential in relation to each of the smart city

dimensions recommended by Giffinger et al. (2007), there has been a positive development in the economic and human dimensions, by attracting new investments (especially foreign ones) that strengthen the city's business fabric and by improving the skills of the younger generations. However, despite these changes, there are still some limitations. The way of life and environmental dimensions of the city are highly valued by stakeholders, to which the geographical characteristics and size of the city itself contribute significantly. In the area of governance, despite the recognition of the efforts made by the public authorities in actions related to a more participatory management, there is still a lot of room for improvement in the perception of the stakeholders regarding the position that the city can achieve in this area. Finally, the mobility dimension is the one in which Viana do Castelo seems to be least well positioned as a smart city. Despite the moderately positive perceptions that stakeholders attribute to the potential shown in each of the smart city dimensions, it should be noted that the reference to the use of ICT in transforming the dynamics observed in each dimension is very little mentioned by the majority of stakeholders, which suggests that in the future it will still be possible to optimize the impact that they can have on the city's development.

This research has some limitations. The first is that it is based on the perceptions of the stakeholders, which do not always correspond to the reality and actual knowledge of each of the dimensions of the city. The second is that it depends on the type and number of respondents who, being directly involved in the management of the city (e.g. the local authority), are not independent in their assessment of the results obtained. In the future, it is suggested that a quantitative study be carried out, which will make it possible to collect more systematic information from a larger number of participants.

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