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Mechanisms of the Smart City: A Case Study of Smart City Búzios, Brazil

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The concept of the smart city is emerging as a topic of interest. Since the implementation of technology in urban space it is becoming the present reality in many cities globally. This study investigates how the smart city project, known as The *Smart City Búzios*, in Brazil affects everyday life in terms of habits in, and relationships with, urban public spaces. The *Smart City Búzios* project involves the implementation of a smart grid infrastructure which purports to achieve energy efficiency for the city. The study also explores the different 'smart' mechanisms used in this city, and attempts to understand the process of implementing the Internet of Things (IoT) infrastructures. This exploration includes the identification of both the groups of actors who were involved in the project, and the societal groups who benefited from it. To do this, a case study approach has been applied to investigate how the technological platforms that are used in the *Smart City Búzios* project could be considered as a process of 'smartness', and consider if these tools have the potential to change the urban sector. The analysis searches traits of changes in the living spaces and in the lifestyles with the inception of new technologies. The focus is on the project's results since its implementation, explaining how these results are articulated in relation to the urban image portrayed in the project's marketing strategies, based on extracts of media news and interviews. The analyses showed that that the strategies of marketing surrounding the project played a key role in the consolidation process. This study thus holds that urban intelligence must simultaneously be a process and a purpose, and that organizations from the public, private and voluntary sectors that are directly affected by the project should be partnered with and brought into inclusive processes of dialogues.

Keywords: smart city, internet of things, smart grid, Búzios.

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Cities, technologies and associated concepts

The interaction between cities and technologies is not a recent phenomenon. Ellul (1980) explains that technology has always been present in all parts of the world, however the main difference now is that current society can be considered a 'technological society'. Within this societal framework, the city is the centre stage of all human actions and interactions (Mumford, 1937), which are linked by technological networks. In this context, technological revolutions such as the Information and Communication Technology (ICTs) revolution impact both the city and the configuration of urban space. Whilst the urban space shapes - at various levels - human actions and interaction (Willis, 2008), we cannot disassociate the influences of technology on the city.

Graham (2010) argues that the growth of cities is connected to an increased need for technologies, in order to satisfy larger distribution demands for water, energy and food. This requires that trains, railways, ports, airports, and roads are set up in an endless technological circle. In the last few decades the proliferation of satellites, televisions, and telephones, has meant that new ICTs have a strong influence on the economic, social and cultural growth of cities around the world. At the same time, several urban concepts were developed, such as: 'Cyber Cities' (Graham & Marvin, 1999), 'Digital Cities' (Ishida et al., 1999), 'Smart Cities' (Nam & Pardo, 2011) and 'smart urbanism' (Wigg, 2013). These terms have in common references to the intensive use of ICTs as a basis for all the processes, strategies, plans and development modes in cities. Reinforcing this idea, Graham (2001) affirms that the world is increasingly connected and informational, and that networks of ICT and connections to the internet play a key role in this. The internet age – which emerged in the 1990s – brought a revolution in information and communication, which has impacted many areas of the city, including the nature of urban planning. Web 2.0 – as the new age of the internet is known – uses three bases: technology, institutions and human capital.

Glaeser (2011) supports this argument stating that human capital has a direct influence on technological development, but that in the twentieth century the rise of the internet changed this. Thus, the role of communication on societal relations and processes is reinforced, and other related concepts begin to emerge – such as the Internet of Things (IoT). For INFSO (2008), the IoT means a global network of interconnected objects-things through codes and protocols that significantly changes the interaction between man and technology. However, there are some complex problems relating to the indiscriminate use of technologies. Several authors have been critical of its unregulated use highlighting some important implications in terms of privacy and jurisdiction. Lyon (1994) argues that one of the many issues surrounding the use of technology is focused on surveillance and control. Gandy (1993) argues that the use of technology in this way is classificatory and discriminatory, because it uses databases to segregate social groups – not by race or beliefs, but for financial reasons. Graham (2001) also raises the issue of technological segregation through a critique of urban infrastructure, and argues that technology is used to build selective and discriminatory infrastructures. The authors argue that smart systems should be public and open access, as opposed to private and available only to a select group. The authors also highlight how technological infrastructures could be used as a type of bargaining tool within the capitalist system.

In the last five years, the 'smart city' concept has gained attention amongst researchers, in public policies and in the business sector. In a smart city, urban systems are supported by technological processes and the city becomes a mechanism for technological data and information flow. One of the most widely used definitions of smart cities is proposed by

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Vienna University of Technology (TUVIEN, 2015), which outlines six key pillars for building a smart city:

- a smart economy, generating competitiveness and innovation meanings;
- a smart governance, that provides efficient management and services to citizens, ensuring transparency and public participation in decision-making;
- a smart environment, which generates attractive, environmentally healthy and intelligent management features;
- intelligent citizens who embrace ethnic and social pluralism, cultural openness and active participation in public life;
- a smart mobility, which allows accessibility for all and a sustainable transport infrastructure; and, finally,
- a smart life, which allows social cohesion through the provision of quality services and institutions.

In reviewing all the developments involving smart cities and the IoT, the energy sector is a key area. The 'Smart Grid' is an emerging approach found in the intersection between smart city and IoT in the energy sector. According to Boccuzzi (2012), the smart grid is a network of technological mechanisms that seeks to improve energy services, using systems of sensors for measuring, monitoring and transmitting information. In this context, technology and its established relations constitute a paradox. This paper intends – by means of a case study – to understand the technological mechanisms underlying the electricity infrastructure of a smart city project in Brazil. The city of Búzios was selected for this research because it was considered one of the top ten projects of urban infrastructure in the Infrastructure 100 World Market Report by KPMG (2012). The project was initiated in 2011 with a public-private investment of over 40 million Reais (about 12 million Euros), and it was developed by the Brazilian Agency of Energy (ANEEL - Agência Nacional de Energia Elétrica). It is considered one of the most innovative projects in the world within the energy sector (Cidade Inteligente Búzios, 2013).

This study investigates how the technological platforms used in the *Smart City Búzios* project could be considered as a process of 'smartness' and how these tools have the potential to change urban sectors, as well as governance, the natural environment and physical infrastructure. Not only could all these sectors be affected by technological systems, consumption could also be transformed. In the case of Búzios Smart City, the implemented technological system consists of smart and automatic infrastructures of energy efficiency.

In order to effectively analyze the project, the paper takes the following approach. First, we present an analysis of how 'smart' mechanisms are used in the city; and this is then contextualized with a study of the implementation of IoT processes in Smart City Búzios. We then identify which social groups were involved in smart energy implementation, and which social groups are benefited in this process. Finally, we review what results have been achieved since the project's implementation; and if the project actually achieved the proposed aims of optimization of urban resources, sustainability and energy efficiency. It is important to note, that we studied the *Smart City Búzios* project at a particular point during the process of implementation, when only one of the phases had actually been realized. Therefore, this analysis discusses the project in terms of its aims, and the possibilities for the city; by identifying the leading points and attempting to understand how the next steps of the project might be realized. Clearly, the outcomes of the initiative could only be studied following the full implementation of the project.

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This paper first introduces a brief discussion in relation to the concept of smart cities and its relationship with the concept of the IoT. This association guided the choice of research methodology, presented in the second section. The third section describes the Búzios project, highlighting the eight main principles of the initiative, the project investments, and a consideration of which social groups might be involved. The fourth section is a discussion about which smart tools are already implemented in the city, referring to interviews that were undertaken in order to answer the aims of the research. Finally, the paper presents a brief summary of the main points, as well as an overview of the conclusions and final considerations.

Smart Cities and the Internet of Things

The concept of smart city is often associated with an idea of a futuristic city, permeated by automation and high technologies. This concept derives from the emergence of terms such as cyber cities and digital cities, which were introduced in the 1990s and 2000s as a response to the advent of the internet. However, in the last decade the smart city concept has emerged as a new way to define the relationship between cities and technology (Kitchin, 2014). Authors such as Hollands (2008), Nam and Pardo (2011), Giffinger and Gudrun (2010) and Greenfield (2013), among others, argue that the multifaceted and complex nature of the smart city means that critical analysis is urgently needed in order to understand the implications of this emerging area. For Calzada and Cobo (2015), it is important to deconstruct the idea of a smart city and present it simply as a range of ICTs capable of promoting change. Kitchin (2014) outlines how smart cities are configured as high-density urban networks, where ICTs enable monitoring and management mechanisms, and automated regulation. He argues that

A smart city is not a vision of a future city, as often depicted in the media; it already exists in practice through the millions of interconnected, digital socio-technical assemblages embedded into the fabric of cities that frame how people travel, communicate, manage, play, consume, work, and so on (Kitchin, 2014, p.12).

So, the smart city can be understood as a convergence of several mechanisms which intend to solve increasingly complex urban problems. The smart grid is one of the components in the set of initiatives that are characterized as the smart city, and it is important to the understanding of this research. The concept has been increasingly used around the world, since the energy sector is an important part of an increasingly technological society (Erol-Kantarci & Mouftah, 2015). According to Castañeda (EBC na Rede, 2013), a smart grid system consists of smart technologies applied to a smart network. According to Bulkeler *et al.* (2016), a smart city focused on intelligent energy systems is one of the key concepts of a smarter urban system. Kumblar *et al.* (2012) understand the concept of smart grid as a simplified nomenclature of a very complex process, in which energy systems use modern ICTs of transmission and control. The purpose of these systems, according to Amin & Wollenberg (2005), is to reduce emissions and pollutants, translating this process into reliability relationships.

However, physical and digital space (created with digital technologies and WiFi) are both often described as opposites, overlapping and non-unified. This makes it necessary to rethink the way we think and design urban structures (Willis, 2008). Thus, it is essential to understand what the real role of technology in urban activities is; do they exist only as means to serve as a support for decisions or do they contribute to helping to decide and shape urban practices? Among the many possibilities is the role of automation processes within decision-making in the city. In this context, the IoT is an important concept. Ashton (2009)

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first introduced the concept of the internet of 'Things'; and proposed that when IoT connects objects or things to people they start to set up a new relationship with them. According to Veja-Barbas *et al.* (2012) the IoT is a new communication model, which changes the relationship between physical and virtual objects, and can be considered as a new informational paradigm. Lemos (2013) argues that the IoT expands the ability of information-communication objects, making them 'alive' and susceptible to decision-making, behavior changes and adaptation without, necessarily, human control. In other words, all objects have a communication characteristic, but in the IoT objects answer to algorithms, demands, mediations and stabilizations. The IoT is also used for building control networks in machine-machine interaction. According to Atzori *et al.* (2010), the IoT is a paradigm that establishes a new relationship between physical objects, sensors, systems and data.

The authors affirm that the internet is everywhere, and the popular demands for new technologies made the IoT grow: '[...] providing them with an always higher degree of smartness by enabling their adaptation and autonomous behavior, while guaranteeing trust, privacy, and security' (2010, p. 2788). This new paradigm can be applied in various areas: industrials, hospital use, mobility or intelligent development of systems. This study however dwells on, first, Caragliu *et al.* (2009) who affirm that ICTs and these processes of automatization are the future of the urban spaces, and second, Schaffer *et al.* (2011) who affix that the interaction between artefacts and urban space is not only a technological issue, but also a human, social, cultural, and economic question. In this context, technologies build a territorial system with knowledge and innovation, a collective and cooperative environment.

Methodology

The approach used in this paper is to present the implementation of the Armação dos Búzios city project as a case study. According to Yin (2001), a case study is performed in order to evaluate real and contextualized phenomena, which permits answering questions such as 'how' and 'why' this phenomenon occurs. In considering the Búzios city project as a potential case study choice the following four contextual factors were considered: the temporal dimension of the project; the geographical location of the city; the focus on the implementation of the smart city in terms of energy/smart grid; and the national and international relevance of the project. The methodology is also based on a single case study, which is present below the corpus of this research.

The empirical data was collected through the following main sources:

- Master Plan of the city;
- Two reports about the project, one national and one international;
- 4 Municipal Reports;
- 28 Reports on important Brazilian media vehicles ('G1', 'O Globo', 'Folha de São Paulo');
- Papers about the project, written in 2014 and 2015;
- Interviews with important actors from the project, published on Youtube.

The data was collected between January 2011 (the beginning of the project) to January 2016. This particular period was chosen because all other phases of the project were already completed. Other important aspect is the validity and reliability of the collected data. Paiva and colleagues (2011) argue that these aspects become particularly important in qualitative research and that the researchers' interpretation of the collected data is also relevant in this process. For this study, the validity and reliability of collected data were evaluated based on the source of data. Only the documents hosted on the official websites of Búzios Major, Rio de Janeiro State and other associated institutions were collected. Furthermore, all reports

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and interviews were collected from Brazilian journals and newspapers that have large circulation numbers and daily editions.

Búzios Smart City Project

The city Armação dos Búzios is a coastal area in the state of Rio de Janeiro (Figure 1). It is a tourist resort with about 31,000 habitants, according to the population projection for 2016 made by Brazilian Institute of Geography and Statistic. (Instituto Brasileiro de Geografia e Estatística).

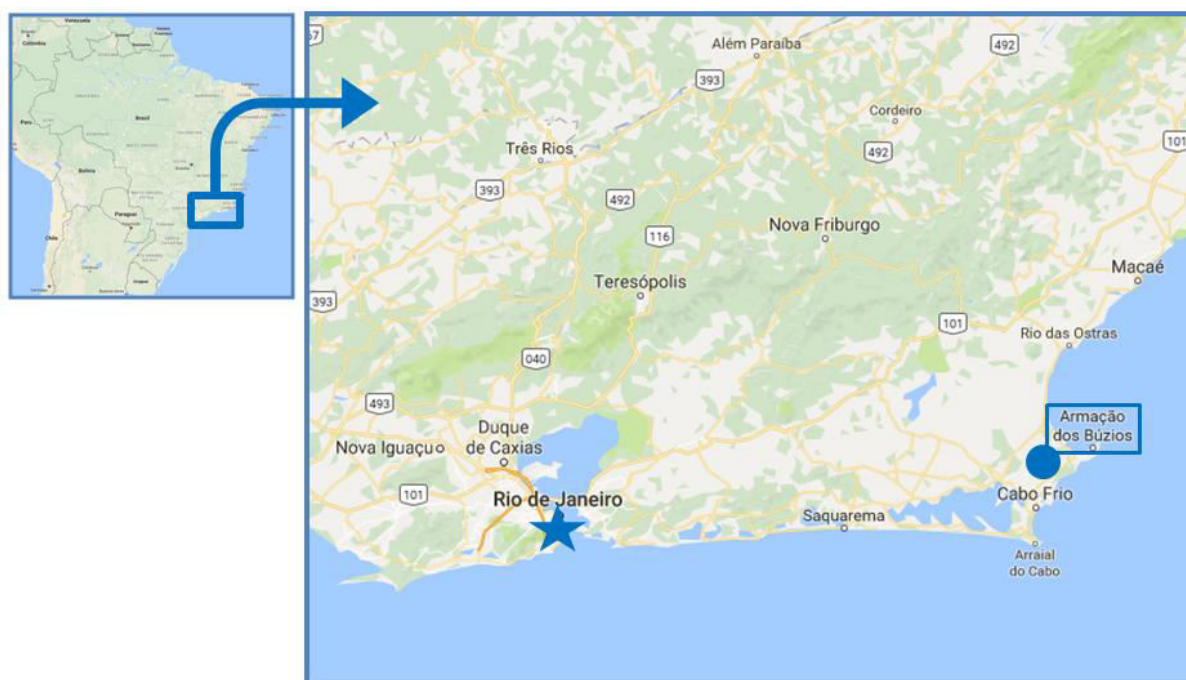


Figure 1. Location of city of Armação dos Búzios. *Source:* Drawn by the authors, based on Google Maps.

The *Búzios Smart City* is a current project being developed by the multinational group ENEL, and funded by ANEEL (National Agency for Electric Energy), in partnership with the electricity company Ampla. The project seeks an optimization of the energy resources in an energy-processing model where each citizen is made responsible for the control of their own energy use (Cidade Inteligente Búzios, 2013). The construction of a new electrical infrastructure involved the installation of 67km of medium voltage lines to supply 10,000 clients and with annual capacity consumption of 55GWh.

The different features of the project included the use of renewable energy sources, the control of individual energy consumption in real-time, the construction of a new electrical infrastructure to optimize energy resources, a system for the remote control of energy network, the implementation of a more economic public lighting system, and the introduction of different cost rates for the supply of electricity. One of the main goal of the project is the constitution of a Smart Grid, which combine the following eight initiatives:

- Smart energy management – which is associated with the energy consumption preferences of the customer with the potential to adopt different tariffs throughout the day, which are priced according to peak times and the possibility of remote management. Persons who consume energy from 10pm to 5pm could pay a cheaper tariff (about 220 reais/MWh) - on

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the other hand, the tariffs become more expensive between 6pm and 9pm (about 660 reais/MWH).

- An energy storage system - for use in consumption peaks;
- Smart energy generation – with the use of renewable resources;
- Smart vehicles – incorporating a pilot project of electric vehicles with charging points throughout the city;
- Smart public lighting – replacing light bulbs for lower-consumption lamps, and the ability to control brightness according to the movement of people in the streets;
- Smart buildings – with technological solutions for the control and measurement of energy consumption;
- Telecommunications, control and internet – with automatic answering possibilities in case of failure of the electricity supply system; and
- Conscious and informed citizens – to promote engagement from participation in workshops and discussions.

At the beginning of this research, the *Smart City Búzios* project was in a phase of implementing energy measurement mechanisms in more than 2000 houses. At that stage, some solar panels and wind generators had been installed, as well as making electric bikes available to rent and use on the streets and electric cars for the Municipal Guard. The replacement of 70 street light bulbs saved 69% of electric energy, compared to previous rates (Correia, 2013). In this phase of the project, these initiatives were not implemented throughout the entire city, but favoured coastal neighbourhoods like *Alto de Búzios*, *Tartaruga e Manguinhos*. In order to better analyze the advances and demands of the project it is necessary to identify the different groups of actors involved in and responsible for the project, as well as to consider the potential social groups that may have benefited from the initiatives. It is important to pay attention to the role, demands and responsibilities of each group. It was established that four groups were essential in triggering the initial deployment process: the government (public sphere), responsible for the initiative, financing, bureaucracy and process control; the industrial secondary sector, responsible for producing the necessary technological infrastructure; the tertiary sector, which conducts the supply and distribution of this infrastructure in the form of customer service; and finally, a social sphere, the group of beneficiaries (Figure 2).

These groups or 'pieces' are both independent and interdependent at the same time, because each one has autonomy in the process, although they may not be solely responsible for it. The relationship between these four groups cannot be disjointed or operate only according to economic interests, under penalty of invalidating or hindering the progress of the project as developers improve the quality of life. The actors connect more or less according to self-provisions, and according to the local share of actions and situations. Some factors that influence the internal cohesion of social groups include similarities, approaches and compatibility (Netto, 2014).

Figure 2 shows a link between several social groups around the same project that aims to transform urban space. The Ampla company appears simultaneously in the secondary sector, producing infrastructure, and in the tertiary sector, offering the energy service. Klauser et al. (2014) argue that the relationship between public and industrial actors can cause transformations in urban space, based on specific interests of particular companies and warn that this could be a risk factor. Kitchin (2014) also warns of the potential problems associated with this process, which the author calls 'smart city commercialization', and describes a process in which the city begins to relate in a more specific and more intimate way with economic interests.



Figure 2. Relevant groups and institutions identified in Smart City Búzios project. *Source:* Authors.

This process of the 'disposal' or 'commercial negotiation' of urban space is what Harvey (2005) calls 'entrepreneur city'. In his text, Harvey explains this model of the city equates to a business model of free competition, based on: a) public-private partnerships, b) speculation, which is a natural process in entrepreneurship, and which exposes urban environments to risks and uncertainties, and c) political economy, placed in greater prominence than territorial constraints. Kumbhar et al. (2012) affirms that smart grid projects tend to be closely related to this type of process. In their paper, they argue that although there is a focus on well-being, it is common to have intense competition related to the sale of these projects between companies.

(Not so) smart tools?

An analysis of the collected material allows us to identify nuances of greater or lesser use of smart tools. It is not always clear which spaces or initiatives are actually becoming 'smart', but is possible to make some analytic measurements based on the collected material. From this analysis, it is possible to return to the main question of this research, forming a response based on an analysis of the data. The question is how technological platforms that are used in the *Smart City Búzios* project could be considered as a 'smartness' process, and consider whether these tools have the potential to change urban sectors such as governance, urban

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infrastructures and the natural environment. In this sense, the first change that can be summarized is about the implementation of the technological system itself. It is possible to observe that in this project there is a potential and gradual application of the IoT concept, particularly in relation to the introduction of processes of automation. In this case, a citizen is able to control remotely the energy consumption of their home, using a range of technologies. In the street, the street lamp bulbs are programmed to increase and decrease luminosity according to the flow of people. This automatic function, established between an electric device (bulb) and a remote command, is enabled by communication between objects. In other words, they are dialogues established between programs and computers, an informational network that depends on human action only for supervision, and not directly. The human action still exists, but is not required for each request; it is determined by previous decisions that determine which objects will behave in what way.

These observations take us to another facet of this research: a discussion about how smart are the mechanisms used in the city. This discussion may be a little subjective, because each person may have a slightly different view of what is considered to be smart. But it is possible to observe that there is no one turning the bulbs on or off in the same periods; and previous studies of urban behavior defined a smart function as a standard demand, which is internally programmed. This is what Lemos (2013, p. 268) calls 'acquired info-communicational capability'. The author affirms that in this process, the relationship between the object and the environment and between the human and not-human is changed.

A third intention of this research was to identify which groups were involved in smart energy processes. The previous section showed one of the possibilities of articulation among the sectors responsible for the project. Besides that, the collected data enables the identification of some views - positives or not – from these different groups. One of the positive arguments is of the Brazilian Association of social housing sector ABC (in Portuguese, ABC refers to Associação Brasileira de Cohabs e Agentes Públicos de Habitação). According to ABC (Habitação. 2016, p. 2), this project:

Is one of the ten best urban infrastructure projects [...] that can make cities livable and sustainable. [...] The report shows how pioneering projects in the area of infrastructure can make a difference, contributing to the emergence of cities of future [...]. Considered one of the ten most important in the world, the Búzios Smart City project was included in the urban energy infrastructure category, and, according to the publication, responds to one of the greatest challenges of the 21st century, which is the development of sustainable urban infrastructure.

According to the technical coordinator of the project, another positive aspect is the relation established between population and energy infrastructures:

Our main motivation factor is the integration of these technologies with society, giving people access to the equipment that we only see on television, so everyone can see it working and happen in their city (O Globo, 2012, p.1).

The installation of infrastructure to reduce consumption is also seen as an urban enrichment and an opportunity for integration between urban sectors, as affirmed by the president of one of the companies involved:

They say it's hard to add beauty to intelligence, but in Búzios we managed it (O Globo, 2012, p.1).

Búzios is a lab where the energy becomes a spark to create an integrative and shared process (Distretto delle energie rinnovabili, 2014, p.1).

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Vilaca *et al.* (2014, p. 21) affirm that the project could be a good opportunity for the city, in terms of national recognition:

This project will have benefits as well as diverse opportunities; we can cite the positioning of the Region of Búzios as a national reference in demonstration of renewable energy sources, as well as how to boost industrial development and areas of research and development, with a view to participation of several universities in this project, and other institutions.

Contrary to these 'success stories' there were questions about the actual role of the citizen in the project, as well as the amount paid for the energy that was being produced. For example, there is a section of the local population that did not have access to all this technological evolution, and these urban areas are susceptible to energy falls and blackouts. One case was reported in Vila Verde community (a Búzios neighborhood) where there were successive energy blackouts, which culminated in protests against the energy company. According to a local newspaper (Folha de Búzios, 2015, p.1), this situation culminated in a protest carried out by the residents. One of them affirms:

The reason for the protest is: that the street has been without power since yesterday 2:00 pm. We are already tired of calling the company Ampla! About fifty people called them and they did nothing. We were not served!

Freitas (2014), in his dissertation research, interviewed fifteen residents of Búzios (randomly selected) in order to understand the citizens' perception of the project. The author asked:

- Have you heard about the 'Smart City' project? What did you hear?
- How did you hear about the project?
- Do you feel benefited by the initiative?
- Do you know who is responsible for the project?
- Why do you think Búzios was the chosen city?

Through the application of this questionnaire, the author concluded that only two of those interviewed had a complete understanding of what the project was about. Many of those interviewed could not identify what it was that was being transformed. However, it is interesting to note that the author identified that residents do have a list of aspects that would make the city smarter, although they cannot conceptualize what is a smart city. Thus, the desire for a smart city is not visible, because the concept is not fully known.

An informal survey conducted by Lab404 (2015) with tour operators, receptionists and drivers showed that there is a lack of knowledge and awareness regarding the installation of energy meters. However, the installation of free WiFi points seems to be better understood. However, research by Freitas (2014) showed that although at these points the signal is intense, data transmission does not work as expected. The author noticed during the interview process that there appeared to be little involvement of the population in the project, which makes it difficult to fully implement and take ownership of, because the initiatives depend directly on the participation of the population. One of the interviewees, for example, said that despite having seen advertisements for the project, she found them to be of insufficient use and did not feel that the general population was engaged in the initiative.

Some technical and operational aspects of the project were tested by Fortes *et al.* (2015, p.4). The authors analyzed some components of the energy systems, making measurements of device consumption and performance, and found that:

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The power quality of energy produced by the small renewable distributed generation technology installed in Smart City Búzios can be improved. Although the obtained results are not so critical, some improvements should be considered especially regarding the current implementation. Another important aspect is the proper sizing of the distributed generation system. As highlighted by the wind generation system, the oversizing of the equipment brought considerable power quality problems for low velocity conditions. This is not a huge limitation in pilot projects where the technological evaluation is the one of the main objectives. However, in future scenarios considering the installation of a fleet of wind generation systems in a microgrid, the huge number of harmonic sources can compromise the power quality indexes of the distribution grid as a whole.

The analysis of these excerpts and statements allows the identification of a relative segmentation between the positive (corporate) vision and the vision of the people directly affected by the project (a neutral or negative view). This is not an extensive set of studies, but the analysis showed that there seems to be a dichotomy between the part of the project that is reported by project partners and the way that the project is actually experienced by the city's residents. The interviews and surveys show that there is a difficulty in differentiating the smart grid' aspects, which is a core aspect of the *Smart City Búzios* project, and the broader marketing concepts of the 'smart city'. It is also possible to observe that the smart city concept is, in part, a marketing strategy. In this case study of the *Smart City Búzios* project it was found that there was little involvement of the population in the project, which raises difficult questions regarding the appropriateness of the project's implementation, since such initiatives depend directly on the participation of the population.

A large-scale project like this is naturally susceptible to technical issues, due to its complexity, novelty and scope. An important aspect to consider, then, is the dialogue that must exist between the service provider and the beneficiary, to make the process transparent and to improve the flow of information. This dialogue should always consider the complexities between the interests of each group, urban demands and what is desired for the city. Therefore, in a project like this, it is important that public communication strategies facilitate the understanding and engagement of all groups involved. In the advent of computer technology, Johnson (2001) outlined how everybody is able to perceive changes that are gradual or very subtle; and that to fully understand the techno-culture it is necessary to understand how the side effects happen. In this sense, another point to be addressed is related to urban marketing and the form of disclosure and broadcasting initiatives.

This affirmation leads us to the fourth aim of this research, which was to review the results in order to see what has been achieved since the project's implementation. However, it should be highlighted that projects like these require a long-term observation following the implementation of infrastructures. In this sense, this research cannot make inferences about a closed situation. However, it is possible to draw initial conclusions from what can already be perceived from within the city itself, as has already been discussed.

A project of this type, with large-scale coverage and robustness is naturally susceptible to controversies, as authors like Graham (2011), Lyon (1994) and Gandy (1993) call the collateral of underexplored effects of technologies. Firstly, it is possible to identify that the energy metering in domestic housing produces highly accurate data that is controlled centrally through the project. This is part of a process aimed at implementing more energy efficient processes. However, this has implications for citizens in relation to a relative loss of privacy. In this sense, it is important that these processes are transparent and regulated. Moreover, it is possible to note that the urban marketing activities associated with the project were focused predominantly on promoting the urban efficiency aspects of the project - in

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terms of preserving the environment and in terms of the beneficial aspects for the citizens. The academic community must observe how the actual urban demands respond to these aspirations. There is a need for clearer governance at all stages of the process, through a clearer role for the public sector in overseeing and regulating the project.

Conclusions

The concept of the smart city is often characterized by utopian language and aspirations. Even in academia, the smart city concept is often treated as a form of technological city, where the role of technology is stimulated and urban innovation encouraged. It is not only as a marketing strategy – where the term ‘smart’ is associated with concepts such as optimization and efficiency – but also because the smart concept is still in an abstract collective imaginary.

This study sought to analyze different dimensions of a smart city project currently in progress in Brazil. It was discussed that this project shows the potential for the gradual application of the IoT concept, particularly in relation to the automation of infrastructures. It was also discussed that this process could change the relationship between what is human and what is non-human. The excerpts analyzed permitted the identification of a relative segmentation between positive and negative views about the project, according to the specific interests of those involved (corporate, social, economic). Another observation is that this project needs to be considered on a more long-term basis as it does not concern exclusively the technical aspects of energy provision. As it was implemented, the project could raise other social, cultural and economic issues that are not only immediately observable, but may unfold over the years, as the social structure and understanding of those infrastructures are expected to vary over time.

In contrast to the futuristic promises of the *Smart City Búzios* project, in our case study we found that there is an inherent difficulty in identifying examples of the real impact of the technological apparatus in cities. The project is an attempt to integrate public and private sector actors, which is one of the challenges we can observe in the implementation of any smart city project. In addition to this it is worth noting the involvement of research centers from the energy sector, who aim to apply academic knowledge into urban space practices, effectively transforming the city into an outdoor laboratory (or living lab). Another positive aspect identified was the automation and smart process of objects that assumes the role of humans. This paper sought to outline the nature of the multifaceted demands on implementing a smart city agenda, as well as raising new questions about this subject. The case study of the *Smart City Búzios* project reflects the complexity of the topic, due to the number of actors involved, the multiple public and private interests and the differing urban needs. Our analysis of the various phases of implementation of the project gives us the possibility of being more accurate and critical, in relation to the integration of new technologies in cities. In this sense, we note an assumption that reveals a relative dichotomy: it is important that these urban transformation processes are - at the same time - innovative and naturally adaptable to each reality, and the demands and resources of each location. It is also important to recognize that urban intelligence as a purpose, but also as a process, is looking for consistent and conscious articulation of the sectors involved.

References

ABC Habitação. *Cidade Inteligente Búzios é destaque em ranking internacional de infraestrutura*. Retrieved from <http://abc.habitacao.org.br/cidade-inteligente-buzios-e-destaque-em-ranking-internacional-de-infraestrutura/>

Open Access Journal

- Amin S. M., & B. F. Wollenberg, (2005). Toward a smart grid: Power delivery for the 21st century. *IEEE Power Energy Mag.*, 3(5), 34–41.
- Atzori, L., Iera, A., & Morabito, G. (2010). The Internet of Things: a survey. *Computer Networks*, 54(15), 2787-2805.
- Ashton, K. (2009). That 'Internet of Things' Thing, *RFID Journal*, 22 June 2009.
- Boccuzzi, C.V. (2012). *Tecnologias de Smart Grid no Brasil: avanços regulatórios e institucionais*. V Fórum Latino-Americano de Smart Grid. São Paulo, Brazil.
- Calzada, I. & Cobo, C. (2015). *Unplugging: Deconstructing the Smart City*. *Journal of Urban Technology*, 22(1): 23-43.
- Carigliu, A.; Del Bo, C; Nijkamp, P. (2009). Smart cities in Europe. *Series Research Memoranda*, University Amsterdam.
- Cidade Inteligente Búzios (2013). Retrieved Abril, 2017 from http://www.smartgrid.com.br/eventos/smartgrid2013/apresentacao/weules_correia.pdf
- Correia, W. (2013). *Avanços do projeto Cidade Inteligente Búzios*. AMPLA Energia e Serviços S/A. Apresentação. São Paulo.
- Distretto delle energie rinnovabili. (2014). *Armacao dos Buzios in Brasile, a 200 km da Rio, è diventata una "smart city" con l'uso delle rinnovabili*. Published on March, 24th, 2014. Retrieved from: <http://www.distrettoenergieinnovabili.it/der/s/rinnovabili-territorio/armacao-dos-buzios-in-brasile-a-200-km-da-rio-e-diventata-una-201csmart-city201d-con-l2019uso-delle-rinnovabili>
- EBC na rede. (2013). *Engenheiro fala sobre o projeto de cidade inteligente em Búzios*. Video published on January 29th, 2013. Retrieved on <https://www.youtube.com/watch?v=G4htdmn2f1s>.
- Ellul, J. (1980). *The technological system*. New York: The Continuum Publishing Corporation.
- Erol-Kantarci, M., & Mouftah, H. T. (2015). Energy-Efficient Information and Communication Infrastructures in the Smart Grid: A Survey on Interactions and Open Issues. *IEEE communication surveys & tutorials*, 17(1), 179-196.
- Freitas, J. A. de. (2014). *Cidade Inteligente Búzios: entre paradigmas e percepções*. (Master's dissertation). Programa de pós-graduação em história, política e bens culturais, Fundação Getúlio Vargas, Rio de Janeiro.
- Folha de Búzios (2015). *Moradores de Vila Verde, em Búzios, fazem protesto*. Published on March, 22th, 2015. Retrieved from: <https://pt-br.facebook.com/JornalFolhadebuzios/posts/766862266766638>
- Fortes, M., Ferreira, V., Arariba, L., Weules, C., & Rosa, R. (2015). Power quality analysis for dg in smart city Búzios. In: *Proceedings of 23rd International Conference on Electricity Distribution*. Lyon, 15-18 June 2015. Retrieved from: http://cired.net/publications/cired2015/papers/CIRED2015_1582_final.pdf
- Gandy, O. H. (1993). *The panoptic sort: a political economy of personal information*. Boulder: Westview Press.
- Giffinger, R., & Gudrun, H. (2010). Smarter Cities Ranking: An Effective Instrument for the Positioning of Cities? *ACE: Architecture, City and Environment*, 12: 7-25.
- Glaeser, E. (2011). *Triumph of the City: how our greatest invention makes us richer, smarter, greener, healthier and happier*. New York: Penguin.
- Graham, S. (2001). Information Technologies and reconfiguration or urban space. *International Journal of Urban and Regional Research*, 25 (2): 405-410.
- Graham, S. (2010). *Disrupted city: when infrastructure fails*. London: Routledge.
- Graham, S., & Marvin, S. (1999). The planning cybercities: integrating telecommunication into urban planning. *Town Planning Review*, 70 (1): 89.
- Graham, S., & Marvin, S. (2001). *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition*. London: Routledge.
- Greenfield, A. (2013). *Against the Smart City* (The City is here for You to Use: Book 1). New York: Do Projects.
- Harvey, D. (2005). A produção capitalista do espaço. São Paulo: Annablume.
- Hollands R. G. (2008) Will the real smart city please stand up? Intelligent, progressive or entrepreneurial? *City*, 12 (3): 303–320.
- IBGE – Instituto Brasileiro de Geografia e Estatística. (2017). *IBGE Cidades: Armação dos Búzios*. Retrieved January, 2016, from

Open Access Journal

- <http://www.cidades.ibge.gov.br/painel/painel.php?lang=&codmun=330023&search=||info%EDpio1ficos:-dados-gerais-do-munic%EDpio>
- Ishida, T., Akahani, J., Hiramatsu, K., Isbister, K., Lisowski, S., Nakanishi, H., Okamoto, M., Miyazaki, Y., & Tsutsuguchi, K. (1999). *Digital City Kyoto: Towards A Social Information Infrastructure* (pp. 23-35). Cooperative Information Agents III, Lecture Notes in Artificial Intelligence 1652. Springer-Verlag.
- INFSO (2008). *Internet of things in 2020: a roadmap for the future*. European Commission: Information Society and Media. Retrieved January, 2016, from http://www.smart-systems-integration.org/public/documents/publications/Internet-of-Things_in_2020_EC-EPoSS_Workshop_Report_2008_v3.pdf
- Johnson, S. (2001). *Cultura da interface: como o computador transforma nossa maneira de criar e comunicar*. Rio de Janeiro: Zahar.
- Klauser, F., Paasche, T., & Söderström, O. (2014). Michel Foucault and the smart city: power dynamics inherent in contemporary governing through code. *Environment and Planning D*, 32(5), 869-885.
- Kitchin, R. (2014). From a single line of code to an entire city: reframing thinking on code and the city. In *Code and the City workshop*, 3rd-4th September 2014, Programmable City, NIRSA, National University of Ireland Maynooth.
- Kumbhar, M., M., Naverkar, P., R., Nandgaonkar, A., B. & Nalbalwar. (2012) Smart Grid: Advanced Electricity Distribution Network. *Journal of Engineering*, 2(6), 23-29.
- KPMG (2012). *Infrastructure 100: World Cities Edition*. Edited by Nick Chism. p. 1-100.
- Lab 404 (2015). *Cidade Inteligente Búzios*. Published on June, 20th, 2015. Retrieved from: <http://www.lab404.ufba.br/?p=2786>
- Lemos, A. (2013). *A comunicação das coisas: Teoria Ator-Rede e Cibercultura*. São Paulo: Annablume.
- Lyon, D. (1994). *The electronic eye: the rise of surveillance society*. Cambridge: Polity Press.
- Mumford, L. (1937). *What is a city?* New York: Architectural Record.
- Nam, T., & Pardo, T. A. (2011). Conceptualizing smart city with dimensions of technology, people, and institutions. In *Proceedings of the 12th Annual International Digital Government Research Conference: Digital Government Innovation in Challenging Times* (pp.282-291), ACM
- Netto, V. M. (2014). *Cidade e sociedade: as tramas da prática e seus espaços*. Porto Alegre: Sulina.
- O Globo. (2012). *Búzios torna-se primeira cidade inteligente da América Latina*. Published on December, 21th, 2012. Retrieved from: <http://oglobo.globo.com/sociedade/tecnologia/buzios-torna-se-primeira-cidade-inteligente-da-america-latina-6787601#ixzz4fGvP30ds>.
- Paiva, F. G. J., Leão, A. L. M. S., & Mello, S. C. B. (2011). Validade e confiabilidade na pesquisa qualitativa em administração. *Revista de Ciências administrativas*, 13(31): 109-209.
- Schaffers, H., Komninos, M., Pallot, Trousse, B., Nilsson, M., & Oliveira, A. (2011). Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation. *The Future Internet, Lecture Notes in Computer Science*, 6656: 431-446.
- TUVIEN – Technische Universität Wien. (2015). *European Smart Cities 4.0 2015: The smart city model*. 2015. Retrieved November, 2015, from <http://www.smart-cities.eu/?cid=2&ver=4>
- Vega-Barbas, M., Casado-Mansilla, D., Valero, M. A., López-de-Ipina, D., Bravo, J., & Florez, F. (2012). Smart spaces and smart objects interoperability architecture (S3OiA). In *Proceedings of the 6th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing* (pp.725-730). USA, IEEE.
- Vilaca, N. M. C. A. A., Figueiredo, V. N., Oliveira, L. B de., Ferreira, V. H., Fortes, M. Z., Correia, W. F., & Pacheco, O. L. C. (2014). Smart City: Caso da implantação em Búzios – RJ. *SODEBRAS*, 9(98): 16-22.
- Yin, Robert K. (2001). *Estudo de caso: Planejamento e Métodos*. Porto Alegre: Bookman.
- Willis, K. (2008). Places, situations and connections. In: Aurigi, A., De Cindio, F. (Eds). *Augmented Urban Spaces: Articulating the Physical and Electronic City*. Aldershot, UK: Ashgate Press, pp. 9-27.
- Wigg, A. (2013). *The dual focus of smart urbanism: Enabling infrastructural efficiencies and promoting global economic competitiveness* [Workshop paper]. Smart Urbanism - Utopian Vision or False Dawn? (Durham University, 20th-21st June 2013).