



ORIGINAL ARTICLE

## Manizales City: A Smart City?

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*The use in the cities of Information and Communications Technologies (ICT) has increased, due to the political and economical control, that has favored their development. This new type of city (system) holds different names: Connected city, Digital City and Smart City. The Smart City is a self-sustaining city. In the most innovative-technological dimension, there are included the factors for sustainable development. The Smart City uses the ICT, with the purpose of providing an infrastructure, that can guarantee: a sustainable development, a better life quality for its population, a higher efficiency when using the resources that are available and, a more active participation of the citizens. The focus of Smart City, is more popular among projects that imply transformation for this kind of cities. However, in researches that measure and classify some of the smart cities, there have been presented ideal models, where the main characteristics are based in the subsystems of these cities. The factor that allows establishing the level of intelligence that a city has achieved, is the analysis of a real city and then, comparing it to the features of a Smart City. This measurement model, can be adopted by the municipal government of the city, in order to carry out special improvement activities in their development plans. The case in this paper is the city of Manizales, which is considered to be the ICT city of Colombia. Therefore, this label is not based in a measurement that comprises all of the factors that define this type of cities. The project that is presented in this paper aims to set an assessment model, in order to measure the intelligence of Manizales as a Smart City.*

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### 1. Introduction.

This paper presents the previous study of a measurement model, that will allow structuring the proposal, for the Masters Program of Information Systems Management, which purpose is to carry out an analysis, of the different types of measurement models of a Smart City. Also, the future analysis will pretend to observe and identify, the characteristics of the city of Manizales (Colombia), as a motive to set a measurement model, that could be used for the city.

The use in the cities of Information and Communications Technologies (ICT) has taken hold, due to the increase of the political and economical control, that is taking over their development. This new type of city (system) holds different names: Digital City, which procedures, communications and information have been digitalized. Smart City -Digital City, that has a layer of intelligence, from which high-level decisions can be made. And Smart City, which is a city where the usage of technologies are focused in a practical use, and in the experience of the user (Yin, et al., 2015). The common factor in these definitions is not only the use of ICT, but the fact that the cities cannot renounce to them.

Besides, the Smart City is a sustainable city: a social community, in which at the most innovative-technological dimension are added sustainable development elements (Hoon, Gong, & Hu, 2014). Its final purpose is to achieve an efficient management, in all of the areas of the city, as well as to fulfill the needs of the city and of its citizens (Enerlis, Young, & Network, 2012). The Smart City uses the ICT, with the purpose of providing an infrastructure that could guarantee a sustainable development, a higher efficiency of the resources that are available, and a more active participation of its population. A Smart City is a cybernetic system<sup>i</sup> that improves the behavior and city capabilities. It supplies functions based on ICT, through the study of the phenomena and social problems as systems. Therefore, it is an economically, socially and environmentally sustainable city (Endesa, 2014).

The Ibero-American Corporation of Public and Corporate Affairs CIAPE (2016), notes that the fundamental axis of a Smart City, revolves around having a smart economy, smart roads, smart population, smart life and a smart government. These axes are connected with the theories of urban and development planning, that provide life quality to the population, according to the proper usage of natural resources and a participatory governance.

From the aforementioned characteristics, there have been defined and exercised some measurements, for the intelligence level of the Smart City. These measurements establish a high relation, between the role of the social capital and the urban development (CIAPE, 2016). For instance, in Southampton (England) there are activities developed for the social inclusion: they use smart cards for the service in libraries, city buses, schools, hotels and stores; these services are based in a computer system of open structure, that involves all of the citizens (IT Innovation, 2008). However, the current measurement systems cannot be considered as a final model, for all of the smart cities. Though these cities are systems that share some general features (elements, relations and purposes), the quantity, quality and coverage of these characteristics is different, according to their peculiarities.

Manizales city is the case that will be assessed in this paper. The FINDETER (Financiera del Desarrollo Territorial S.A.) developed in 2012, a research of sustainable cities in Colombia<sup>ii</sup>, and based on its results, the Ministry of Information Technologies and Communication of Colombia (MinTIC) established some strategies, to carry out projects of digital inclusion, that use the technological component (BID, 2013). Thus, in 2013, Manizales was labeled as a "Smart City", because of using ICT products in the utilities, power supply and transportation (MinTIC, 2013). Nevertheless, this smart city label, is not supported by a measurement of the intelligence level of the city.

Manizales was considered in 2016 by FEDESARROLLO (Foundation for Higher Education and Development), as a part of the research: "How smart are Colombian cities?" The purpose of this research, is to measure the level of intelligence of some cities in the country. Manizales was classified as the city with the lowest usage rate of ICT, in the different components of urban intelligence. In fact, the research points at some proposals in this city, about urban renewal, and production of smart innovation areas, that promote the ICT venture, and that are not working yet (Carlos & Vicepresidente, 2016).

In order to develop the topics that we are considering in this paper, we have divide them into four sections: in the first, there is a conceptualization of the Smart City and the Sociocybernetics; in the second, there is a revision of measuring models of the Smart City; in the third, there is an assessment of Manizales as a Smart City; and in the fourth, there are some previous conclusions about the revision of assessment models for a smart city.

## 2. Smart City and Sociocybernetics

This part of the paper sets the relationship between the concept of Smart City and Sociocybernetics, based on the main features that define them.

The process of urbanization, has caused cities to have more political and economical power, over their own development. Thus, they are allowed to seize opportunities and guarantee a sustainable growth<sup>iii</sup>; therefore, the cities must learn to be intelligent (IBM, 2009). With the fast increase of population, the cities will face challenges related to growth, performance, competitiveness and overpopulation (McKinsey & Company, 2013). The new governments must design new policies, that allow improving the efficiency and sustainability of the city. In order to make this possible, one option could be that the city becomes a Smart City.

Hollands (2008) notes that being a Smart City, does not only imply the usage of technology, even though this type of cities cannot function without it. In fact, the Smart City is a sustainable city, it is a social community, where to the most innovative-technological dimension, are added some of the factors of the sustainable development. The economical efficiency criteria, as well as the social and environmental equity, are principles and guidelines of a pleasant, safe and smart city. It is worth noting that, Hollands considers the label of Smart City, to be more a marketing strategy, than an engine of development.

In 2011, it was published the report: "2020 Forecast: A Planet of Civic Laboratories", in which it is noted that, if cities really want to become Smart Cities, they must provide inclusion and development. The solutions given by big ICT companies are not enough, though they have some advantages, and "The future will not only be a flow, between the north and the south of the planet, but a complex web system of agile experiments and new ideas, that will conform the frame to create common designs and projects, markets and governance kinds, that are suitable for the citizens, webs of citizens, institutions and cityscapes" (Towsend, Maguire, Liebhold, & Crawford, 2011).

In other definitions, the Smart City is described as the city that uses ICT, with the purpose of providing an infrastructure for it, that could guarantee a sustainable development, the increase of life quality of its citizens, a higher efficiency of the resources available, and an active participation of its population. These cities are economically, socially and environmentally sustainable (Endesa, 2014). According to Marina (1993), a Smart City is the city that is in the best conditions, to be a place that represents happiness for its citizens.

The "White book of Smart Cities" (Cebrián, et al., 2012) notes that the final purpose of a Smart City, is to achieve an efficient management, in all of the areas of the city, as well as to fulfill the necessities of the city and its citizens (urbanism, infrastructures, transportation, utilities, education, healthcare, public security, power). Its purpose is also to find the balance, between the wellbeing of the citizens and the protection of the environment.

Generally, there could be considered as Smart Cities, those cities that aim to achieve innovation in four levels: infrastructure (utilities), economical and human sustainable development (natural resources), quality of life (respectful and efficient) and the relation towards and among its citizens (citizen participation). Hence, if the goal of governments is to improve the relationship that cities have with their citizens, besides being the most innovative, technological and eco-efficient; the governments should also be the most society-focused, participative and interconnected. Otherwise, they could lose their main purpose: the wellbeing of all of their population (Stalman, 2016).

But ¿What is the contribution of the sociocybernetics focus, in the definition of Smart City? Although, the main goal of the Smart City is to use the ICT, in order to improve the wellbeing and quality of life of its citizens, the sociocybernetics also studies society, through the concept of system.

Heinz Von Foerster, establishes an important difference, between first and second order cybernetics. The first one, is the research of observed systems and the second one, is the research of observing systems (Ciencias & Complejidad, 2016). The society is an observing system, that allows introducing variations in itself and its environment. In this system, all of the processes are interrelated, in order

to understand society and social factors, in such way, that is possible to differentiate the current issues and to reconsider them.

The Smart City is a system, that may and must be supervised, during its conformation and posterior management and evaluation. In this sense, it is related to the sociocybernetics of the first class/ first type. The assessment of the conditions and impact of the Smart City, is an important issue for its population; becoming thus, the supervisors into supervised (second class/ second type cybernetics). It is also worth noting that, there are different types of evaluations of the Smart City, that are carried out by alien organizations, with the purpose of comparing it with other cities, and establishing the position it has, in a ranking that is focused on intelligence.

The sociocybernetics incorporates the first and second order systems, through models that are designed based on sociology and complex problems of society (hunger, poverty, environmental problems). The aim of these models is, to give feedback to heterogeneous problems seized by society, in order to find the accomplishment of their goals (Ciencias & Complejidad, 2016).

The social inclusion is a common axis of the Smart City and Sociocybernetics. As the Smart City, the Sociocybernetics aims to diminish the social phenomena and problems basing on the complexity of the cities, in order to generate citizen participation and inclusion, through the models that integrate technologies, thus allowing the community, the chance to advance intellectually and to adapt to its environment to innovate.

On the other hand, the Sociocybernetics is an approach that allows the assessors of the Smart City, considering the elements and heterogeneous relations, that characterize this type of city as a complex system.

### **3. Measurement models of the Smart City**

The current cities are a scenario for constant and numerous changes, from a social, economical and environmental view. The capability that these cities have to improve, to promote and to protect these changes, are being blocked by the lack of communication and integration, between the physical and technological infrastructures.

The objective of a Smart City is to create a balance between the ICT and the human capital, by guaranteeing the quality of life of its citizens. An example of this, could be the situation in Southampton (England), where they use smart cards for entering to libraries, city buses, schools, hotels, stores and other services. Thus, they involve all of the citizens, in a single computer system of open architecture (IT Innovation, 2008).

The sustainability is also a strategic component, basic for Smart Cities, since it helps to integrate areas for participation and education, with the purpose of creating less consumerist lifestyles (e.g. replacement of the usage of fuels, by the usage of renewable energies) (CIAPE, 2016).

The International Telecommunications Union (ITU), annually performs the measuring of the information society (MIS). This measuring gathers data about the usage of ICT products, and also introduces reference tools, that are used to carry out the assessment of the Smart City. The last report of 2015 "Facilitating communications in the smart cities", aims to find IT solutions, as well as experiences in spectrum management, planning, performance and optimization of webs. This type of reports generate an objective assessment, of the performance of the countries regarding ICT, and it also highlights, the factors that need to be improved by the governments of the smart cities (ITU, 2016).

The Ibero-American Corporation of Public and Corporate Affairs CIAPE (2016) notes that the fundamental axis of a Smart City, revolves around having a smart economy, smart roads, smart population, smart life and a smart government. These axes are connected, with the theories of urban

and development planning, that provide life quality to the citizens, according to the proper usage of natural resources and a participatory governance.

Based on the aforementioned characteristics, the measurements of the intelligence level of a Smart City have been defined and performed. These measurements are highly related, to the role that plays the social capital in the urban development (CIAPE, 2016).

From the revision of literature, we have found measurements of the level of intelligence of smart cities, performed in Amsterdam (Holland), Cairo (Egypt), Dubai (Arab Emirates), Malaga (Spain), Singapore (Singapore), Paris (France) and London (England) among others. These cities are widely recognized by their ecological, touristic and infrastructure projects, in order to develop a smart environment. Although their characteristics, organization and development programs are different, all of them aim to become a Smart City (CIAPE, 2016).

Other measuring models are focused on stating, how do technology and institutional leadership prompt the planning of the urban ecosystem, such as in Montreal, London and Stockholm. These cities have all, a particular characteristic, that could be diminished through the appropriation of the Smart City. For instance, in Montreal, it was identified an ageing of the population, an obsolete public infrastructure and a raise in the companies of IT goods and services. Therefore, its assessment model was focused on smart health, smart webs and smart transportation (Ben Letaifa, 2015).

According to ENDESA (2014), the philosophy of Smart City is being implemented more frequently, in projects that involve the transformation of cities, into smart cities. Nevertheless, some researches that measure and classify some of the smart cities, have been based in ideal models, where one of the main features are their own subsystems. When comparing the analysis of a traditional city, with the features of a Smart City, it could be established the level of development it has achieved. This measuring, could be the basis for the municipal government, to take special improvement actions for their development plans.

Endesa (2014) notes the usage of these measurements, in the following places:

- In Malaga (Spain), the focus of projection for Smart City is the management of power, by integrating renewable sources in the electricity grid, so that the energy control arrives in every home. The purpose is, to have a better power management in the grids, also to have efficient reports of demand and to involve all of the components of the electricity system, from generation to consumption.
- In Barcelona (Spain), the aim is the ICT to become in a basic element, when performing services for the citizens, such as mobility or management. One of the improvement plans includes the electric cars, that has been promoted by this city, creating the first "ENDESA island of energy".
- In Búzios (Brazil), the transformation of the electricity distribution grid, into a smarter grid, is being made by using digital meters and an automation, able to integrate all of the current means, for generation of power, as well as the most recent renewable energies and the electric cars .
- In Santiago de Chile (Chile), there is a project of the district Business City of Santiago, to test the integration of technologies such as: the Smart Metering, the grid automation, the electric cars, the street lighting and the distributed generation; by assessing their economical, technical and social factors .
- Though Montevideo (Uruguay) is one of the smallest cities in all of the region, it stands out for being the city with the greatest quality of life in Latin America. It is also recognized, for being a technology centre, since it has several careers in its universities, that prompt entrepreneurship. These features have the purpose to make of Uruguay, the biggest software exporter per cápita of Latin America.

- Medellín (Colombia) is considered to be, one of the cities with the most number of transformations in the continent. The metro and metro cable structures are the biggest commitments, to integrate the poorest communities with the rest of the city, thus making of Medellín, a world reference for social inclusion and smart transportation.
- Curitiba (Brasil) is considered to be a pioneer, regarding the urban planning and the introduction of new means of transportation, especially in solutions for integrated systems of mass transportation, which allows predicting landslides and warning the communities with previous notice.
- Buenos Aires (Argentina) has implemented its own mass transportation system, known as "Metrobus" and a system of bicycles, which is recognized as one of its greatest accomplishments, in order to fight traffic. Besides that, it is the only city with a ministry, which purpose is exclusively to make of Buenos Aires a Smart City (Modernization Ministry).
- Bogota (Colombia) is recognized for being the first city that has solved, the problem of mass transportation. It is also a pioneer on the implementation of the Bus Rapid Transit - BRT (TransMilenio), which is one of the biggest and used systems worldwide. This city is also recognized, for being the first Latin American city to establish bicycle paths (ciclorutas) and electric taxis.
- Mexico City (Mexico) is one of the cities that promotes the most, the construction of green and smart buildings. This city, has also implemented the shared bikes system, in order to reduce traffic congestion. Mexico City is a pioneer in Latin America, on the introduction of the 'CarShare' system, where there are more than 40 vehicles (some of them are electric) working in this mode.

According to "Sustainability for all" (2014), the smartest cities in the world are:

- Tokyo (Japan): It is a leader in human capital and public management.
- London (England): Though it is recognized for its international and technological projection, it must improve on public management and social cohesion.
- New York (United States): It is the second conurbation of the continent, after Mexico City. It is recognized for being strong in human capital and in world economy.
- Zurich (Germany): It is the financial power and cultural center of the country. It is a strong city on environment, mobility and transportation issues.
- Paris (France): It stands out on international projection, technology, mobility and transportation.

Based on the revision of the literature, about measuring models of the Smart City, it could be concluded that, the design of an assessment for this purpose, could not be considered as a final standard model, for all of the cities labeled as smart. Though these cities are systems that share general features, in quantity, in quality and in power of these characteristics; every city is different, because of their peculiarities. These specific assessment systems, might not consider these peculiarities that some cities have.

Diverse authors propose to measure the Smart city, based on factors such as: economy, energy, environment, community, health, transportation and land planning/territorial planning. Its evaluation is performed by using tools as: the fuzzy logics, the inductive qualitative research, the self-arrangement of maps from a dynamic perspective and the process of multicriterion decision making, among others. There have been used some assessment models in cities as: Lombardy (Italy), Montreal (Canada), London (England), Stockholm (Sweden) and other cities form the European Union.

#### 4. Manizales: A Smart City?

Manizales city is presented and analyzed, as a case study in this paper, based on the concept of Smart City. Consecutively, we will give a brief description of the characteristics and elements of this city, which will be a basis to establish the measuring model according to the city.

Manizales is a city of Colombia, capital of Caldas department, and it currently has a population of 397.488 people (DANE, 2016), therefore, it is a medium size city. The MinTIC in 2013, stated that Manizales would be the centre of technological development in Colombia, due to the growth of entrepreneurship, and to the development of apps [mobile] (La Patria, 2013). This development that the city has had, has positioned it as one of the most competitive cities in the country (MinTIC, 2013).

The national development plan of Colombia "All together for a new country" has as a main strategy, the use of human capital in inclusive territories. The main purpose of this strategy is, to recognize the capacity of carrying out research processes, that could contribute to reconfigure goods, products, methods and methodologies, with a social, cultural, economic and environmental aim, taking into account the application of innovation technologies (Mayor's office of Manizales, 2016). In this sense, the Development plan of Manizales 2016-2019, has an strategic axis the "Science and technology for a sustainable and integral development".

The Mayor's office of Manizales has created two programs, with an ICT component, for its development plan 2016-2019. The first program is: "Manizales as an Ecosystem of science, technology, innovation and research, aimed to solve specific issues in productive areas". The purpose of this program is, to strengthen the enterprising companies, through innovation and intensive use of ICT, guaranteeing a competitive offer of goods and services, that could be attractive for national and international new markets. The second program is: "Access to information and communication technologies", which is a strategy to make the new developments massive, in order to bring closer the citizen, to new offers of innovative goods and services, that are innovative and focused in technology (Mayor's office of Manizales, 2016).

The current development plan of Manizales, seeks to consolidate this city, as a centre of science and technology in the region, which could serve to the competitiveness in an economic and rural way and also, to the solution of territory structural problems. The main strategies in this areas, will be mainly applied in the agribusiness and in the education fields (Mayor's office of Manizales, 2016).

The World Bank considers Manizales, to be an ICT capital and also, to be an ecosystem, where there could be developed great projects of science, technology and innovation, that could benefit not only the city and its citizens, but also the country (Mayor's office of Manizales, 2013). In 2012, FINDETER, in collaboration with the Inter-American Development Bank, carried out a research of sustainable cities in the Colombian context. In this research, they concluded that Manizales has the basic elements to be projected in a competitive, organized and responsible way (FINDETER, 2013). The MinTIC labeled Manizales as a "Smart City", since it has properly adopted the intensive ICT systems, as the Live digital Plan and Government on line, taking them as some of the smart solutions for the city (MinTIC, 2013).

The research that was published on April, 2016, by FEDESARROLLO: "How smart are the Colombian cities?" measured the level of intelligence of some cities, and it classified Manizales, as the city with the lowest rate of ICT use, in the diverse components of urban intelligence. This research names the Technological Park, CityTech, as a process of urban renovation, with the purpose of creation of smart and innovative areas, that promote the ICT entrepreneurship (FEDESARROLLO, 2016). Nevertheless, on September, 2016, Parquesoft, which is one of the companies funded by the MinTIC, and that also manages the CityTech project, with resources form royalties, announced that this project was still in a planning phase, and that its execution would be only carried out by 2017 (La Patria, 2016).

Recently, on April, 2017, 18 neighborhoods of Manizales were affected by a big avalanche, that left 17 dead, 500 homeless families and 80 homes partially affected (Semana Sostenible, 2017). Despite considering Manizales, as a national and worldwide model, due to its risk management plans, the city was not completely prepared to face a natural disaster, and let alone, guaranteeing the preservation of life and wellbeing of the population. This catastrophe occurred, despite the capital city of Caldas department, has not saved any efforts on improving its Land Management Plan (POT), nor on its prevention measures or on its emergency and contingency plans. As stated by a member of the prevention organisms: "The prevention and risk management have been a priority in the political agenda of the city. If there is something that could not be stated in this case, is that what happened was due to lack of interest or being careless", statement by Omar Darío Cardona, former manager of the National Direction for Disaster Prevention and Assistance of Colombia, from 1991 to 1995.

## 5. Conclusions

According to the diverse characteristics and conditions that Manizales city has, which are noted in the paper, it is necessary to establish a model, that allows measuring the rate of intelligence that the city has by now.

From the revision of measuring models of a Smart City, it is proposed to establish a model, that allows assessing which is the rate of intelligence that Manizales city has by now. This city is labeled as a Smart City, but recent researches rank it with the lowest usage rate of ICT in Colombia.

The measuring models of the Smart City, that have classified different cities worldwide are all different. There is no standard model, that allows analyzing the level of intelligence of the cities, based in the same characteristics. Every assessment model considers specific characteristics of a particular city.

The design of a measuring model, for the intelligence of Manizales as a Smart City, could be used by the local authorities, as a management tool for the city. The design of an assessment model for Manizales as a Smart City (based on the cybernetics focus) will make possible, the integration of the vision of the citizen (the watcher), who is the main player of the city.

The future analysis will pretend to observe and identify, the characteristics of the city of Manizales (Colombia) as a Smart City and to set a measurement model, that could be used for this city.

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<sup>i</sup> Self-regulated or self-controlled open systems in the control societies, given their power to use the information flows gotten from an external means. Wiener (1969) defines cybernetics as a science of information and individual, animal and machine control.

<sup>ii</sup> Barranquilla, Bucaramanga, Manizales and Pereira.

<sup>iii</sup> A sustainable city, is a city that offers a high quality of life to its population, reduces its effects on the environment and has a local government with fiscal and management capacity, in order to keep its economical growth and to carry out its urban functions, with a wide citizen participation (FINDETER, 2014).