



## INTELLIGENT TERRITORY FOCUSED ON THE TRANSPORTATION SECTOR IN SUGAMUXI PROVINCE

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### Abstract

*Sogamoso has an important geographic position at the national level as it is a municipality of origin and destination that connects the center with the east of the country. It is characterized as a municipality whose sources of employment are mainly agriculture, industry, and commerce, so the population tends to increase and require public transportation services. It is important to highlight that both Sogamoso and its surrounding municipalities have tourist areas such as Paramos, the Tota lagoon, the bio park, and thermal wells, among other attractions; however, tourism is inferior to other territories in the country. Its competitiveness is affected by existing shortcomings in the municipality, one of which is the quality of public transportation and the little information that tourists can obtain about it. Thanks to current technological advances, a new concept is emerging in public policies called an intelligent territory, which consists of increasing sustainable development and generating strategies for collective growth and progress in the territories supported by technology. To provide improvements in the sector, the creation of an intelligent territory is proposed, supported by technological advances and the collection of accurate and timely information focused on the public transportation sector, since mobility is a fundamental factor that allows citizens to move from their homes to their jobs and studies, and tourists to access the areas and tourist attractions that each municipality has, becoming an important element in the quality of life of a community and the economic growth of the municipality.*

**Keywords:** Intelligent Territory, Transportation

### 1. INTRODUCTION

In search of development, sustainability, and inclusion, a new modality is incorporated into the public policy model that reduces bureaucratization in public decision-making, which is based on the constitution of intelligent territories (IT), current technology has been a great ally in the construction of IT in the globalized world, so the idea of building IT has increased in developed and underdeveloped countries. Cities like Tokyo, New York, Singapore, and Barcelona are at the forefront of the different areas of activity related to a Smart City. The benefits of a Smart City include improved environmental quality, urban mobility, security, education, health, economy, and government. IT is understood as those innovative cities capable of building their competitive advantages concerning their environment, seeking a balance between the aspects of economic competitiveness, social cohesion, and sustainability, regardless of their size, with people and technology as the main focus (A., 2016)

Paskaleva (2011) proposes a multidimensional approach that integrates factors such as infrastructure, the physical and environmental setting, social characteristics, and economic potential. Secondly, the smart territory approach is based on the consideration of innovation and knowledge as fundamental pillars in the growth of territories, as well as on the definition of a strategic vision oriented toward competitiveness. Finally, in all definitions, the implementation of technological platforms is considered, to a greater or lesser extent, as a transversal axis of the different urban spheres (Vega Jurado, 2018).

According to the Maturity Model proposed by David Hammer in 2007, to create a territory or smart city, a fundamental factor is the use of information, as it is well known that information is effective when it is time for decision making and allows to highlight the problems to find the right solutions, based on the analysis of the information collected, focusing its actions always in search of sustainability and inclusion, oriented to the fulfillment of challenges and expectations of the people

who inhabit it to ensure the common welfare, generate an environment of collaboration, innovation, and permanent communication with all the actors and institutions that compose it (National Planning Department [DNP], 2020), being of great importance the technological advances in the development, growth, and generation of wealth, supported in the era of industrial production reaches a higher level of economic welfare generating more job opportunities and benefits in education. Thanks to this and due to the existence of universities and institutes of higher education more population tend to move to the municipality, increasing the volume of inhabitants, which leads to new challenges in terms of mobility which the municipality has not managed to meet efficiently since according to censuses conducted by DANE 2018 the population in Sogamoso is 120.462 and taking into account that a percentage of the population migrates from their municipalities of origin temporarily to access higher education offered, which increases the demand for public transportation service. In addition to this, the municipality and surrounding municipalities do not give due importance to tourism, taking into account that they have a large number of attractions and tourist areas that if taken advantage of to attract the attention of tourists can generate greater economic development, so taking advantage of these tourist resources also increases the need for improvements in public transportation services that allow citizens to travel to their workplaces and homes, and the access of tourists to tourist areas and attractions, but without neglecting the fact that transportation costs must be affordable for the population, which means a change in the appreciation of urban centers associated with ideas of chaos, disorder, noise, and pollution (Echavarría Ochoa, n. d.).

Citizens' perception of these technological changes varies in very significant ways depending on the field of action in question. As a general rule, and regardless of the economy, transport is one of the aspects that most concern citizens, reducing transport time and costs, avoiding traffic jams and incidents en route, and maintaining a healthy lifestyle. Therefore, the transportation sector is a transcendental axis in the creation of intelligent territories, for the opportunities and strengths that it allows in the development of other economic sectors; since it expands the competitiveness of the municipality at the national level. Sogamoso and its surroundings present great strengths in the tourism sector since they are territories with beautiful attractions.

In search of improvements for the sector, information is required to make the right decisions with a focus on public transportation service, to achieve an accessible service that provides sufficient information, providing ease to the tourist when visiting the municipality, and thus strengthen the economy and increase the quality of life and opportunities of the inhabitants relying on innovation, application and use of new technologies.

## 2. OBJECTIVES

### 2.1 General objective

Create an intelligent territory in the municipality of Sogamoso focused on the transportation sector.

### 2.2 Specific objectives

- Evaluate how the constitution of a smart territory focused on the transportation sector benefits the improvement of the quality of life of the community.
- Identify what opportunities the strengthening of the transportation sector represents for the constitution of a smart territory in the municipality of Sogamoso.
- Establish a methodology for the implementation of an intelligent territory focused on the transportation sector.

## 3. METHODOLOGY

### 3.1 Focus of the study

#### 3.1.1 Mix

The approach of the study was mixed since data were analyzed and for this purpose, the quantitative method was taken into account at the time of statistical analysis through surveys and tabulation of information, then the results were analyzed through the qualitative method for strengthening the transport sector through the proposal of an intelligent territory, to provide a database that

subsequently allows the creation of an application that will increase the opportunities of the potential sectors of the municipality.

### 3.2 Method of study

#### 3.2.1 Deductive

The data analysis was carried out through the deductive method, based on the maturity model for smart cities and territories, taking into account the dimensions proposed therein, strategies are proposed for the constitution of a smart territory with some municipalities of the Sugamuxi province.

### 3.3 Type of study

#### 3.3.1 Descriptive

This research has a descriptive approach since it analyzes and describes the opportunities and strengths of the tourism sector in Sogamoso and some municipalities of the Sugamuxi province and the advantages of implementing an improvement in the transportation sector through a proposal with the application of technologies and innovation oriented to the construction of an intelligent territory. For this purpose, the information collected through methods such as information gathering, observation, community interviews, and documents and references about the topic are taken into account to obtain conclusions based on the information collected.

### 3.4 Sources and techniques of data collection

#### 3.4.1 Primary sources

The primary sources used in this project were:

- Information provided by officials of the Sogamoso Transportation Terminal.
- Information provided by public transportation service officials: urban buses, cabs, and inter-municipal buses.
- Surveys of users and service providers.

#### 3.4.2 Secondary sources

Departmental and municipal national development plans, Ministry of Transportation, DANE, Sogamoso transportation terminal page, laws, theories, books, magazines, references of intelligent territories constituted.

### 3.5 Population and sample

The affected population is:

- Users of the public transport service in Sogamoso
- Providers of the service of public transport for passengers in Sogamoso.

## 4. RESULTS

### 4.1 Intelligent Territory in the Municipality of Sogamoso

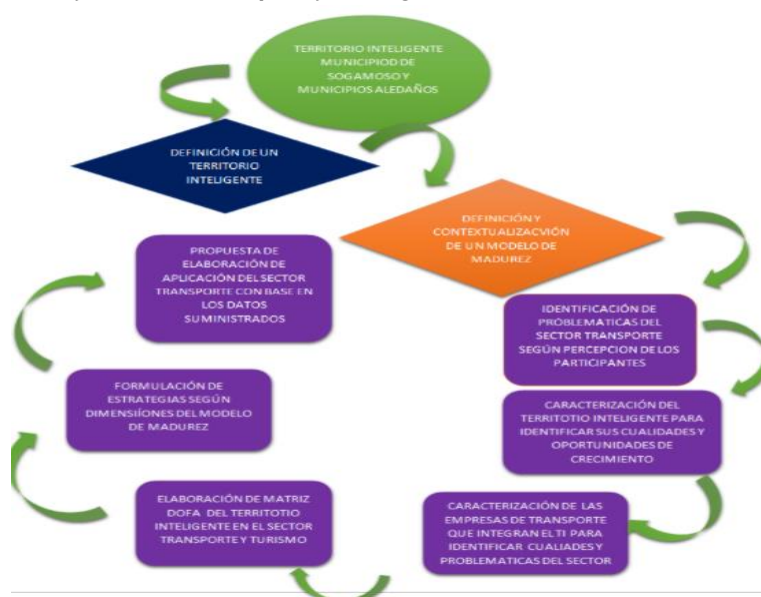


Figure 1. Process cycle for the smart territory proposal in Sogamoso.

Source: Own elaboration



#### 4.1.1 Intelligent territory

When talking about intelligent territory, it is necessary to start by knowing about territorial development understood as a process of the social construction of the environment, driven by individual and collective initiatives of different actors and the operation of economic, technological, socio-political, cultural, and environmental forces in the territory, also including characteristics related to innovation, an example of this is the case of Medellin that through technological implementations in different areas. This has allowed improving the quality of life of its inhabitants, establishing a metropolitan transportation system that allows access of the entire population to vulnerable and remote areas, in addition to the creation of the MEDATA platform that consolidates the information in the open data format of the municipal administration of Medellin, these among other contributions, earned Medellin an important recognition in the second edition of the World Smart Cities Awards, (World Smart Cities Awards), in Barcelona.

For the development of the smart territory proposal in Sogamoso, its weaknesses, strengths, threats, and opportunities will be studied for an analysis of the municipalities that will integrate it, identifying the capacities it may have to increase the economic development of the municipalities, which implies learning from the experience of other territories and from the own experience to identify a smart profile about its context.

Other characteristics refer to the connections with networks and cities, so it is proposed the union of 6 geographically close municipalities that complement each other by their economic sources, such as Sogamoso and Nobsa that are characterized by their main sources of employment based on the steel and manufacturing industry, Iza, and Tibasosa are characterized by their gastronomic variety such as desserts, sweets, and typical drinks like sabajon and chicha, Aquitania and Tota are characterized by their onion crops and trout farms. These municipalities have the potential to form a tourist ring because they have natural parks, paramos, lagoons, thermal wells, ecological trails, biodiversity, and historical tourism, which allows for better regional operations through cooperation and harmonious relations at the local, regional, and national levels.

On the other hand, the introduction of technology to the transportation service is intended to create an application focused on the public transportation sector, which allows consolidating the necessary information and facilitates its use, contributing to the improvement of the quality of life of the inhabitants, since it promotes the use of collective transportation, reducing the emission of polluting gases, vehicular congestion, and the reduction of waiting times for the service since the use of private vehicles is reduced. Taking into account that, from the point of view of environmental sustainability, IT is characterized by urban development models based on the valuation and preservation of the environment and renewable resources.

On the other hand, it is important to clarify that the concept of a smart city or territory is still in a primary stage, although there are plans and policies to create smart systems and services and to improve the telecommunications infrastructure, there is still no consolidated effort to create a smart city and there are weaknesses in the formulation of projects and the articulation with the productive and economic sectors of the territory, highlighting the use of technology as a means to improve people's quality of life, through the efficient use of information for better management of resources directed to the provision of public services, investment in human development, reduction of environmental impact, promotion of new forms of governance, and therefore, contribute to the sustainable development of the city.

In conclusion, a territory is economically sustainable when its competitiveness is determined by innovation, appropriation, knowledge diffusion, creativity, and the talent of its citizens, which allows competitive advantages at a global level. It is important to clarify that any city or municipality, regardless of its size and level of infrastructure, can be a smart territory.



**Figure 2.** Triangle of economic, social, and environmental sustainability.

**Source:** Taken from Smart territory and creative economy space: a first conceptual and practical research approach.

#### 4.2 Analysis of participants' perception of the public transportation service in the municipality of Sogamoso

To describe the current conditions of public transportation in the municipality of Sogamoso, surveys were structured and applied to both service providers and users, to determine the perception of the sector's participants in terms of expectations and problems that currently arise in the provision of the service.

##### 4.2.1 User survey

The population to be surveyed for the development of the objectives of the proposal for the constitution of an intelligent territory in the municipality of Sogamoso is 164 users of the public transportation service to know how the transportation service benefits the tourism sector of the territory; based on the application of simple random sampling with infinite population because the amount of population that enters the municipality as a visitor is uncertain, applying a confidence level of 80%, a probability of occurrence of 50% and a margin of error of 5%.

As a result of the surveys conducted, the population was classified according to gender and age, and it was determined that 37.5% are men and 62.5% are women, with a tendency to be higher among people between 21 and 25 years of age.

In terms of the time needed to travel to their destinations, 35.7% take less than 15 minutes and 35.7% take between 15 and 30 minutes. This is since Sogamoso is a municipality with a small territorial extension so the work and study sites are close, being urban transportation with 43% the most used means of transportation by users, 7% walking because of the proximity of their path, also 19% opt for the use of bicycles which is a good option because it is a sustainable and environmentally friendly means of transportation.

Regarding the provision of cab service, 56 people surveyed gave a rating of 7 on a scale of 1 to 10, and of the service provided by the buses within the municipality of Sogamoso 42 users gave a rating of 6 on a scale of 1 to 10, 42 people assigned a rating of 5, regarding the provision of public service users considered that the most important aspects are: punctuality, safety, and price, they also think that other aspects could be improved such as the implementation of new routes and schedules,



modernization of vehicles, regulate the collection in cab services, extension of night bus schedules and better attention and tolerance towards users.

Regarding the contribution of public transportation to the tourism sector of the territory, users believe that it is an economical option when traveling since several people can go in the same vehicle, minimizing costs. 52.4% of people do not have a preference for a transportation company when traveling outside the municipality, allowing transportation companies to provide added value to build user loyalty. However, the remaining population prefers the Libertadores and Concorde companies for long distances such as the Sogamoso-Bogotá route, due to their price and quality, while for short distances, users prefer the Cootracero company.

Currently, the use of mobile technologies and applications has increased, however, 92.7% of the users do not use the existing applications of the transportation service, however, 92.7% of the users would use an application that is efficient and contributes to the improvement in the provision of public service.

Being one of the main purposes of an intelligent territory the improvement of the quality of life of the people, supported by technology, which allows outlining sustainable projects, through these it is sought to scale in the economic, social, and environmental development; taking into account the response of the users it was concluded that most of the users have knowledge of the main purpose of an intelligent territory, despite being a recent term and that it has been promoted in the country for a short time.

#### **4.2.2 Survey of public service drivers**

The target population to be surveyed for the development of the objectives of the proposal for the constitution of an intelligent territory in the municipality of Sogamoso is 143 people based on the application of simple random sampling with a finite population since the population providing transportation services is a defined number of people, applying a confidence level of 80%, a probability of occurrence of 50% and a margin of error of 5%.

In terms of gender, it was determined that 95% of the surveyed population of public transport service providers are men and only 5% are women, with the highest average age being between 35 and 50 years old.

It was found that 66.7% of the surveyed population spend less than 15 minutes to reach their destination. 7% spend less than 15 minutes to get to their destination because most of the drivers park their vehicles at their place of residence and 16.7% use bicycles, showing the need to adapt bicycle routes in the municipality. In addition, regarding the quality of the cab service, 36 people assigned a score of 7, which is the highest score assigned by drivers, and 2 people gave a score of 1, which is the lowest for this service; while in the provision of the service in urban transportation buses, 47 transporters gave a rating of 5 on a scale of 1 to 10 being this the score chosen by most people and 12 people rated it at 1. It can therefore be concluded that the service providers are aware that the service has several shortcomings and believe that the responsibility of the driver, attention to the user, cleanliness, safety, punctuality, and routes are very important aspects of good service provision, and consider the price to be less relevant, availability and schedules, taking into account that the perception of those who provide the service is based on the fact that the price is low, for some routes and the costs incurred at the time of providing the service, in addition, cab drivers consider that the fares are not reasonable for some routes.

91.7% of the drivers consider that public transportation contributes to the growth of the tourism sector of the territory since they believe that the cab service is the primary transportation for tourists who do not have a private vehicle, in addition, the person providing the service can guide tourists and inform them about the culture and all the qualities that the area can offer, thus improving the quality of service and encouraging the use of public transportation by visitors.

Despite the existence of different applications that facilitate the provision of the service, most drivers do not make use of them because it is difficult to use and there is no cost-benefit relationship, however, 58.3% would use an application that consolidates the information of the transport service as this would facilitate the service to be provided in a more agile way, allowing for greater interaction with users.

Most drivers do not know an intelligent territory, so training would be required to provide the necessary information on the benefits of IT, which would encourage a greater influx of tourists. Based on these surveys it can be concluded that in general, the users do not consider that the service provider has the optimum quality and fully satisfies their needs, noting that several shortcomings are established in the service not only by the perception of the users but also by the drivers since it is aware that in many occasions an adequate, respectful and responsible attention is not given to the user. It is also evident that there is a deficiency in terms of adequate infrastructure of bicycle routes that cover the need to protect cyclists, since it is the most sustainable means of transportation in the municipality and provides the opportunity to reduce costs to citizens, in addition to allowing the decongestion of vehicles in the municipality.

#### **4.3 Characterization of the Municipalities that will constitute the Intelligent Territory**

The province of Sugamuxi- Is located in the northeast of the department of Boyacá, with a territorial extension of 2456 km<sup>2</sup>, corresponding to 14.4% of the total area of Boyacá. It borders to the north with the provinces of Tundama and Valderrama, to the south with part of the province of Lengupá and with the department of Casanare; to the east, with part of the province of Valderrama, with Casanare and closes to the west with the province of the north. Sogamoso is its capital; the municipalities of Tópaga, Mongui, Mongua, Aquitania, Cuítiva, Firavitoba Nobsa, Gámeza, Iza, Tibasosa, Pesca, and Tota are also part of the region. The predominant economic activities are livestock, agriculture, mining, handicrafts, industry, and commerce.

The main productive sectors are the industry and the service sector. The primary sector is also of great importance as it provides the production and extraction of natural resources necessary for industrial production. It is important to highlight Tota Lake as a strategic area of high environmental and tourist importance for the province.

It has a total population of 197,346 inhabitants (DANE, 2018) equivalent to 16.9% of the departmental population and 0.41% of the national population, which means a population density in the province of 81 people per km<sup>2</sup> being Sogamoso one of 10 municipalities with the highest population concentration.

([https://www.dapboyaca.gov.co/wp-content/uploads/2020/07/PDD\\_version\\_web\\_Final.pdf](https://www.dapboyaca.gov.co/wp-content/uploads/2020/07/PDD_version_web_Final.pdf))

To increase the sustainable development of the territory, the proposal is established to constitute the municipality of Sogamoso as an intelligent territory in union with 5 municipalities belonging to the province, since regionalization is sought, i.e., the union of the municipalities in search of the same purpose, the main purpose being the improvement in the transportation service and the strengthening of tourism in these municipalities.

For the development of the intelligent territory, a previous study of the municipalities of the province was taken into account for the constitution of a metropolitan area in which it is established that the participants selected for their demographic and population characteristics, territorial extension, customs, and tourism potential, among other qualities, will be Sogamoso, Tibasosa, Nobsa, Aquitania, Tota, and Pesca, in which the municipality of Pesca does not show interest in forming a metropolitan area or union with the other municipalities since it is considered at a disadvantage with the selected municipalities, so for the constitution of the intelligent territory, the municipality of iza is included since it represents great benefits for its tourism potential and its geographical location between Sogamoso and Aquitania, being a municipality of great importance for the improvement of the transportation service thought in the tourism increase of the territory.

These municipalities have a total of 166,470 inhabitants, equivalent to 84.3% of the total population of the province, with a greater number of people in the municipality of Sogamoso, which shows that the population tends to move to larger cities for work and study opportunities.

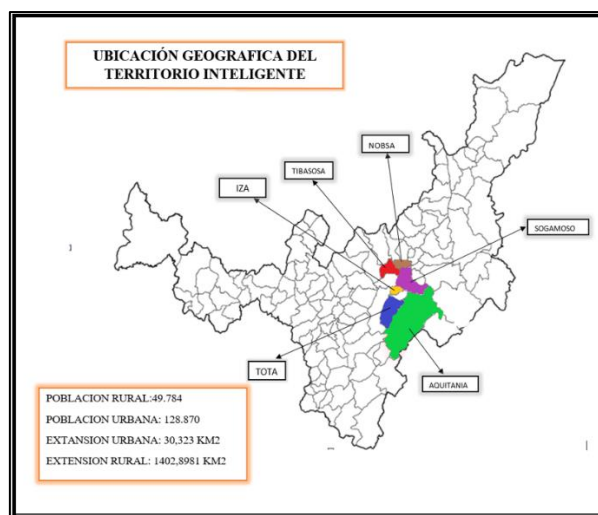


Figure 3. Geographical location of municipalities in the intelligent territory

Source: Own elaboration

Sogamoso, recognized for its commercial potential and mining possibilities, has a cultural heritage, with an important pre-Hispanic legacy and a history of blood by contributing to the formation of our Republic, is today a growing city that, given its consolidation as a territorial center, should strive for the recovery of its cultural heritage as a criterion for the construction of a city that is a Land of Blessings and monuments of heritage interest.

#### 4.4 Demographics of the Smart Territory municipalities

Municipio	Población Urbana		Población Rural		Población Total	Grado De Urbanización
	Población	Porcentaje	Población	Porcentaje		
Aquitania	5777	41.68%	9600	69.26%	13860	41.68%
Iza	1160	59.67%	787	40.48%	1944	59.67%
Nobsa	5026	34.30%	10950	74.74%	14651	34.30%
Sogamoso	111815	92.82%	15420	12.80%	120462	92.82%
Tibasosa	4238	38.45%	8702	78.94%	11023	38.45%
Tota	854	18.85%	4325	95.47%	4530	18.85%
Territorio Inteligente	128870	77.41%	49784	29.91%	166470	77.41%

Table 1. Population distribution by area

Source: Own elaboration According to data yielded by DANE- SISPRO- MSPS, 2018.

The degree of urbanization of the territory is 77.41%, noting that of the 6 municipalities the only municipality with more than 50% of the population located in the urban area is Sogamoso with 92.82% and the municipality with the highest rural population is tota with 95.47% of its inhabitants, (taking as a basis the population adjusted by coverage census in 2018 which is 7% of the total population) so it is evident that the degree of urbanization is so high thanks to the fact that the majority of the population is located in the municipality of Sogamoso.

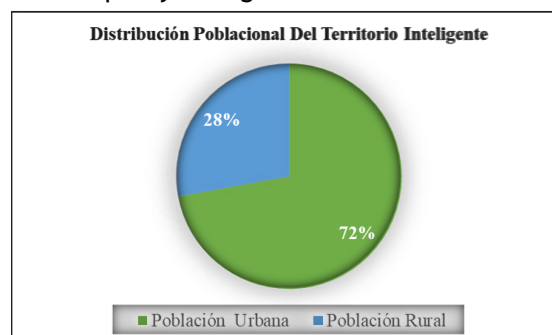


Figure 4. Population distribution of the Intelligent Territory

Source: Own elaboration



#### 4.4.1 Demographic Indicators

Taking into account that the demographic study can determine changes in the volume and structural characteristics of the population and that by conducting demographic studies, results can be obtained at the level of structural phenomena at social, economic, historical, and cultural levels (INTRODUCTION TO DEMOGRAPHY).

Therefore, for the smart territory proposal in the municipality of Sogamoso, the latest birth, mortality, and population growth projection figures of the six municipalities that are proposed in the smart territory will be taken into account, considering the information of the last population census carried out in 2018.

<b>Municipio</b>	<b>Natalidad (indicador por cada 1000 habitantes)</b>	<b>Mortalidad (indicador por cada 1000 habitantes)</b>	<b>Proyeccion Crecimiento Poblacional (Periodo 2018-2035)</b>
Sogamoso	12,84 - año 2018	5,89 - año 2018	147.337 Habitantes
Tota	15,5- año 2018	6,59 - año2017	5.703 Habitantes
Iza	8,1 - año2017	5,03 - año2017	2.215 Habitantes
Tibasosa	8,35 - año 2018	4,42 - año 2018	14682 Habitantes
Nobsa	9,89- año 2018	3,39 - año 2018	18.049 Habitantes
Aquitania	13,40- año 2018	6,06 - año 2018	17.033 Habitantes

**Table 2.** Main Demographic Indicators

**Source:** Own elaboration According to data provided by DANE- SISPRO- MSPS, 2018

For Colombia and Latin America, there is a tendency to decrease the young population and the young adult population, since the average number of children per woman is decreasing because currently the presence and easy access to contraceptive methods provides the possibility of choosing to have children and for economic, social or convictions situations some population refrains from having them. While mortality rates are expected to increase as the population continues to age, that is, if between 2015 and 2020 there has been an average of 739,000 births each year, this figure would be only 526,000 between 2050 and 2055, and would fall even further between 2095 and 2100, as there would be fewer than 381,000 births per year. In contrast, while today's average annual deaths are around 272,000 each year, by mid-century they would more than double 538,000 in 2050 and 670,000 in 2100.

In the last two decades of the 20th century, the Colombian population grew at an average rate of 1.5 %, a value that has been decreasing to 1.1 % at present. It is expected that in the long term it will converge to zero and that in 2050 it will be 0.1%. This stabilization of the national population is in line with the Latin American average, whose growth rate for 2014 was 1.3% and for 2050 is expected to be 0.3% (Cotlear, 2011).

Therefore, Sogamoso and its surrounding municipalities are not exempt from these phenomena since observing the projections until 2035 the population in Sogamoso will grow to 147,377 inhabitants also increasing the degree of urbanization since it is currently estimated that 80% of the Latin American population lives in urban areas (Celade, 2014), while in Colombia that percentage is 77%. The average number of people that in 2050 will live in urban areas is estimated to be 86 %, slightly lower than the Latin American average estimated by Celade (90 % for the same year). According to these projections, it is necessary to analyze these figures for the development of the smart territory in the city of Sogamoso as they allow foreseeing future situations, to establishing an action plan according to these results that will allow facing the difficulties that may arise and thus adapt the city in all areas with the help of technology improving the quality of life of the inhabitants.

#### 4.5 Transportation Sector Characterization

For the constitution of an intelligent territory, one of the most important factors is mobility since moving within a territory efficiently, economically, and safely is a need that must be urgently

covered, for which public transportation is one of the major participants in terms of improving the quality of service, in addition to attracting citizens to purchase this service benefits the environment by reducing the use of private vehicles and therefore the emission of gases into the atmosphere.

To improve mobility for citizens and visitors to the territory by facilitating travel within these 6 municipalities at night, allowing a decrease in the cost of fares and time when using a personalized transportation vehicle (TAXI), the possibility of eliminating the requirement of the Occasional Travel Form within the territory was identified, which is a document that must be carried as a driver of a public service vehicle (TAXIS) land motor vehicle so that they can provide transportation service outside the radius of action of their jurisdiction under Decree 1079 of 2015 ARTICLE 2. 2.1.3.4 in which an exemption is established to elaborate this form and make the payment when it is provided by vehicles of companies of the respective capital or Metropolitan Area and the municipality headquarters of the air terminal. In the ARTICLE 2.2.1.3.5.2 Decree 1079 of 2015.

Taking into account this regulation for metropolitan areas, it is proposed that in the municipality of Sogamoso by joining with the 5 municipalities previously mentioned as intelligent territory, this exception be taken advantage of and thus expand the possibility that cabs can provide services to these municipalities, at different times without the user having to incur additional costs since on many occasions the value of the payroll is greater than the value of the race, benefiting the tourism sector of the municipalities as it allows the ease of transportation at any time within the territory. Therefore, a classification of the existing public passenger transportation companies in Sogamoso is established to identify differences between them and shortcomings of the service to optimize transportation in the municipality.

#### **4.6 Economic Cluster**

Knowing the characteristics of tourism, culture, and transportation of the municipalities; and all the attributes that each one can offer to the economy of the department, it can be highlighted that Sogamoso has some additional and special characteristics which help it to be part of the tourist corridor of Boyacá, such as economic geology.

The area of the Sogamoso valley is well known for its mining ancestry being known that inside and outside the area of the municipality, geology has determined the existence of various economically exploitable deposits such as Coal phosphoric rock, recebo, sands, and clays, even when the deposits are not within the municipal perimeter, much of the population lives in the exploitation of limestone for the cement manufacturing process as raw material in the work of the company Cementos Paz Del Rio and Cementos Boyacá, for the production of lime and crushed for concrete, among others.

The economic synthesis shows that the mining activity is a fundamental part of the municipality's economy, since the large industries located in the area and the region of Boyacá and Casanareña depend on it, raw materials that are invested in the production processes of cement, iron, and fertilizers and construction materials. The population rudimentarily extracts clay to make bricks and handicrafts to a lesser extent (htt8).

On the other hand, the "industrial corridor of Boyacá" that corresponds to the "Economic Planning Region" is a territory that covers the municipalities of Ventaquemada, Samacá, Tunja, Combita, Ociará, Sotaquirá, Tuta, Paipa, Tibasosa, Duitama, Nobsa, and Sogamoso, characterized because they are all part of the Chicamocha river basin and because the greatest industrial development of the department has flourished in them.

Over time, companies have joined the industrial corridor of Boyacá creating progress and economic growth, being the companies that are part of this industrial corridor are:

- Paz del Rio steel mills, Nobsa siderurgica
- Argos, Sogamoso cement, Bavaria
- Bavaria, Tibasosa beverages
- Diaco, Tuta siderurgia
- Holcim, Nobsa cement
- Indumil, Sogamoso metalmechanics
- Industria de licores de Boyacá, Tunja liquors

- Invicar, Duitama transportation
- Postobón, Duitama beverages
- Termo Paipa, Paipa energetics

#### 4.7 Value added to GDP by municipality

For this reason, it was decided to analyze how much Sogamoso contributes to the Gross Domestic Product, but one of the most frequent problems when analyzing the structure of the GDP at the municipal level is the lack of real information on the subject, however, for the particular case of Sogamoso, it is possible to build some data from the Regional Economic Reports prepared by the DANE for the department of Boyacá and fundamentally, the documents of the local context.

One of the great unknowns in the economic dimension that would be worth solving is related to the impact of each of the economic sectors in the local economy and thus establish what is the real productive bet of the Municipality.

The following graph allows analyzing the added value generated by each of the economic sectors in the territory, in which primary activities such as:


- Agriculture, mining, and livestock correspond to 1.8%,
- Secondary activities such as industry generate an aggregate value of 38.8% and tertiary sector activities such as commerce
- Tertiary sector activities such as commerce generate the greatest impact on the local economy with 59.3%.

It is observed that within the large branches of economic activity in the municipality of Sogamoso, the sector that participates the most with 35.67% is the Manufacturing Industry, followed by Social, communal, and personal services activities with a participation of 20.10%, and Commerce, repair, restaurants, and hotels with 10.92%.

This represents an aggregate value of close to \$1,587,000,000,000 million pesos. At the regional level, the trends of the local economy define the following conclusions. In the first place, the consolidation of an economic model based on trade and the offer of services for an important part of the population that moves through the regional corridor formed by Tunja, Duitama, Sogamoso, and Yopal. This, as mentioned before, is strengthened by the strategic location of this region as a linked scenario between the central zone of the country and the Eastern Plains, besides being the epicenter of the Sugamuxi tourist circuit, offering diverse tourism options, the result of this is the growth of the participation within the economic structure of the trade and services sector. The added value that the territory contributes to the departmental GDP is 22.3%.



**Figure 5.** Value added by economic activities  
Source: Own elaboration.



<b>Municipio</b>	<b>Valor Agregado 2016</b>	<b>Valor Agregado 2017</b>	<b>Peso Relativo %</b>
Aquitania	314	314	1.4
Iza	24	25	0.1
Nobsa	1598	1346	5.9
Sogamoso	2599	2675	11.6
Tibasosa	665	681	3.0
Tota	62	68	0.3

**Table 3.** Value added to GDP by municipality  
**Source:** Prepared by the Duitama Chamber of Commerce.

The economic development of a region is proportional to the capacity to plan, do, verify and take actions when required. Boyacá is a department with an agro-industrial tradition that over the years has been diversifying its economic activities at the forefront of globalization processes, aiming at regional competitiveness. Proof of this is to be in eighth place out of twenty-six in the 2016 regional competitiveness index, with basic and intermediate education being the most representative aspect with a score of 7.62 on a scale of 1 to 10 (htt12).

Currently, the department of Boyacá has the Boyacá Dairy Derivatives Cluster initiatives but also works on the organization of the Metalworking Cluster with the Chamber of Commerce of Duitama and the Tourism Cluster for the Province of Sugamuxi with the Chamber of Commerce of Sogamoso since Boyacá strengthens the clusters of the department with others in the country (boyacaradio.com).

The productive organization has adequate infrastructure for its development, however, there are still some problems that must be solved to improve the production conditions and increase the positioning of the municipality as an integrating and articulating element of both the province of Sugamuxi and the central region of the country with the Eastern Plains. Given the above, the Governor's Office of Boyacá has promoted the creation of the Tunja-Sogamoso Economic Planning Region. This program seeks to increase competitiveness and integration between the cities of Alto Chicamocha, with special emphasis on strengthening sectors such as mining, metal mechanics, the automotive industry, and construction, whose offer is directed to the Bogotá market, the traditional center of trade and regional exchange of goods produced in the department of Boyacá.

Several intersectoral initiatives are identified within this industrial corridor: The agroindustrial cluster, especially for its potential for extra-regional production and sales in Colombia, targeting international market segments (potato, meat, dairy, fruit, vegetables, quinoa, sugarcane). One of the main economic sources is the production and marketing of large quantities of onions in the municipality of Aquitania.

#### **4.8 Mobility Application for Intelligent Territory**

The proposed mobile application to be developed was designed to improve the transportation sector of the municipality of Sogamoso and focused on the tourism sector of the territory since the purpose of an intelligent territory is the implementation of technologies to improve the quality of life of citizens since currently in Sogamoso no application unifies the information of public transport and tourism.

The objective is to provide timely information to the user by collecting information in real time, allowing him/her to use the public transportation service according to his/her needs.

##### **4.8.1 Modules**

It is proposed that the application be divided into 3 modules:

##### **4.8.1.1 Transportation**

This module proposes to integrate:

- the information of the public transportation companies of Sogamoso, such as cabs, urban transportation buses, and inter-municipal transportation buses, in addition to linking the GPS



for monitoring and location of the vehicles, which allows the user to know the actual location of the vehicle needed for their journey, in addition to the existing stops on the routes and the traffic light points of the municipality.

- Motion sensors on streets and roads, intelligent traffic light control, route monitoring by cameras, dynamic digital signage system on streets and roads, parking places, etc.
- fares, distances, and travel times according to the desired route so that the user has the opportunity to decide which service best suits his needs.
- Cycle routes and status of cycle routes.

#### **4.8.1.2 Tourism**

This module proposes to integrate and improve the application created for the province of Sugamuxi for the tourism sector, it is intended to be a much more interactive application and expand the database of tourist sites, including the means of transportation that can be taken to reach the destination, schedules, rates and contact possible tourist guides in the territory.

#### **4.8.1.3 Suggestion box**

This space will collect suggestions, compliments, or complaints from users of the application and service, to identify the shortcomings that are present in real time and timely for decision-making to provide better quality public transport.

### **5. CONCLUSIONS**

The perception of users and service providers regarding the quality of public transportation is that it does not fully satisfy the mobility needs of citizens, since user service is sometimes not optimal, since it does not provide adequate, respectful, and responsible attention to the user, and due to traffic congestion there are traffic jams during rush hour in the central area of the municipality.

There is a deficiency in terms of adequate infrastructure of bicycle routes, which cover the need to protect cyclists as it is the most sustainable means of transport in the municipality and provides the opportunity to reduce costs to citizens and allows the decongestion of vehicles in the municipality, in addition, improving the roads potentiates the bicycle tourism as it reduces the risk of accidents and increases the flow of trade by the influx of tourists.

For the confirmation of the intelligent territory, it was determined that the municipality of Iza offers more opportunities to strengthen the tourism sector than the municipality of Pesca, at the time of forming a tourist ring within the territory, also in the studies previously carried out in the requests to the governors, the mayor of Pesca expressed no interest in participating in the conformation of a metropolitan area.

Sogamoso, as one of the largest municipalities in the department and with the largest population volume, is one of the 61 municipalities evaluated in the maturity model proposed by Mintic, which provides guidelines for the creation of intelligent territories; a model that was applied for the elaboration of strategies based on the established dimensions.

In the territory, no infrastructure provides the facility for disabled people to access public transportation services, so the transit becomes an unsafe and uncomfortable act, so it is evident the need to take into account significantly this population when making action plans in the transportation sector.

To constitute the municipality of Sogamoso and some municipalities of the Sugamuxi province as an intelligent territory is viable because it provides opportunities to improve the quality of life of the community, based on the strategies applied to each dimension of the maturity model.

### **6. RECOMMENDATIONS**

It is recommended that the proposed maturity model applied in the competitive advantages and strategies for the territory be taken into account when implementing the constitution of the smart territory.



It is recommended that, at the time of creating the smart territory, the application should be created with the information provided in the proposal, so that the users receive the benefits that allow the improvement in the quality of life.


It is recommended that the action and investment plans for infrastructure in the territory analyze and implement improvements that benefit the disabled population since it is a vulnerable population and is not treated equitably in the provision of public transportation and mobility services within the municipality.

It is recommended that the infrastructure for bicycle routes should be adapted and expanded to benefit both the educational and labor sectors.

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