Journal of Urban Research, Vol. 49, Issue 2, April 2025
Faculty of Urban and Regional Planning, Cairo University

Smart City Strategies for Playas, Ecuador: A Framework for Transformation

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Received 6 January 2025; Received in revised form 8 February 2025; Accepted 24 March 2025;
Available online 24 March 2025, https://doi.org/10.21608/jur.2025.350766.1183

ABSTRACT

General Villamil (Playas), Ecuador, is a well-known tourist destination recognized for its favorable climate and economic accessibility. However, it faces significant challenges in telecommunications, transportation, public services, environmental sustainability, and data-driven decision-making. This article proposes a roadmap to transform Playas into a smart city by leveraging emerging technologies and strategic partnerships, integrating the development of smart infrastructure, implementing IoT-based solutions, big data, artificial intelligence, cloud computing, and cybersecurity, and promoting sustainability through the integration of renewable energy and energy efficiency practices. The methodology is based on a local feasibility analysis, the definition of short-, medium-, and long-term implementation phases, and the establishment of a governance framework that prioritizes citizen participation. The results reveal the need to overcome challenges such as the lack of basic sanitation, limited connectivity, and unequal access to essential services. Additionally, key indicators are proposed to monitor progress, such as reducing energy consumption in public buildings and implementing intelligent waste management systems. Ultimately, adopting these strategies could enhance efficiency, sustainability, and quality of life in Playas, making it a benchmark for other cities undergoing transformation toward smart urban models.

KEYWORDS

Decision-making; environmental sustainability; public services; artificial intelligence; data management.

1. INTRODUCTION

The canton of General Villamil Playas, situated on Ecuador's western coast (Figure 1), has emerged as a popular tourist destination in recent years. Its appealing climate, welcoming residents, and affordability attract both domestic and international visitors seeking to enjoy its picturesque beaches and natural beauty. However, despite these advantages, Playas faces critical challenges that hinder its potential for growth and development.

Figure (1): General Villamil Playas.
Source: (Menéndez, 2022)

The General Villamil Playas canton, renowned as a tourist destination for its favorable climate and natural beauty, faces significant challenges that limit its potential for growth in this key sector. Tourism, which constitutes one of the primary sources of income for the local economy, is hindered by a lack of adequate infrastructure and basic services. In particular, digital connectivity is extremely limited, with only 6.4% of the population having Internet access (INEC, 2022). This shortfall impedes the digital promotion of the destination, the efficient management of reservations, and the implementation of innovative technologies that could enhance visitors' experiences. Moreover, the existing tourist infrastructure—such as accommodations and attractions—lacks sustainable standards, thereby reducing its competitiveness in an increasingly environmentally conscious global market. Most hotels and tourist establishments are small and operate informally, failing to meet international quality or sustainability standards. This not only affects visitors' perceptions but also limits Playas' ability to attract international tourists seeking high-quality experiences.

Another significant issue is the lack of effective tourism marketing strategies. Unlike more developed tourist destinations, Playas lacks a coordinated promotional campaign that highlights its unique attributes and attracts diverse tourist segments. The absence of a strong and differentiated brand makes it difficult to compete in the global tourism market, where better-positioned destinations capture most of the attention. Additionally, the limited diversification of tourist activities negatively affects tourism in Playas. Currently, the offer is focused primarily on beach enjoyment, but it lacks complementary options such as ecotourism, cultural tourism, organized water sports, or local gastronomic experiences. This restricts Playas' ability to attract tourists with varied interests and to prolong their stay at the destination.

Presently, one of the issues that concerns the residents of Playas is security. Potential tourists may perceive certain risks associated with insecurity in poorly lit rural or urban areas, as well as the lack of police patrolling in tourist zones. Furthermore, the absence of adequate signage and reliable emergency systems may deter visitors from exploring the destination with confidence. Finally, the lack of initiatives to promote sustainable tourism practices contributes to the degradation of the natural environment, negatively affecting Playas' image as an attractive destination. The accumulation of waste on the beaches, water pollution resulting from the lack of adequate sewage systems, and the deforestation of coastal areas are issues that erode the appeal of the location. Without proper environmental management, Playas risks losing its primary tourist asset: its natural beauty.

Limited infrastructure and inadequate access to basic services represent a significant obstacle for Playas. While the town boasts a population of approximately 60,000, a substantial portion lacks access to reliable electricity, clean water, and proper waste management systems. One of the most pressing problems facing Playas is the lack of a comprehensive sewage system. According to recent data (see Table 1), only 50% of the population has access to basic sanitation systems, while the remainder depends on rudimentary solutions such as latrines and septic tanks (INEC, 2022). This situation not only poses a risk to public health by increasing the likelihood of waterborne diseases, but it also has serious environmental implications. Untreated waste is frequently discharged directly into the sea, contaminating the beaches and affecting both local ecosystems and the residents' quality of life. Furthermore, the absence of a wastewater treatment plant exacerbates the problem, as there is no structural solution to manage waste in a safe and sustainable manner. These critical challenges in the sanitation sector not only affect the inhabitants' quality of life but also undermine Playas' ability to attract tourists and foster economic development.

Table 1. Access to basic services for the population of Playas.

Basic services	Service (%)	Without the service (%)
Electric power	88	10
Water	83	11
Sewage system	50	50
Waste collection	50	50
Internet	6.4	93.6

Source: (INEC, 2022)

While homeownership is relatively high at 74%, access to essential services like electricity and water remains limited for certain segments of the population (Table 1) (INEC, 2022). The lack of a comprehensive sewerage system and inadequate solid waste collection, with no designated facilities for treatment or disposal, further underscore the urgent need for intervention by local authorities to ensure equitable access to these fundamental services.

Beyond infrastructure, Playas grapples with economic and social disparities that impede its progress. The local economy relies heavily on the fishing and shrimp industries, which, while providing substantial employment, are inherently vulnerable to global market fluctuations (INEC, 2022). A large informal sector further complicates efforts to track economic activity and contributions. Furthermore, Playas' young population faces significant barriers to education and career advancement, with limited access to higher education and professional development opportunities. Despite these challenges, Playas holds significant potential for transformation into a smart city by harnessing technological innovations to enhance its infrastructure, service delivery, and overall quality of life. Implementing smart city strategies, such as the Internet of Things (IoT), data analytics, and sustainable urban planning principles, can contribute to improvements in energy efficiency, transportation networks, public safety measures, and environmental sustainability. Crucially, fostering public-private partnerships and actively engaging local communities will be paramount in ensuring that these initiatives are tailored to the specific needs and priorities of Playas' residents.

The city of Playas stands out as one of the main seaside resorts in Ecuador, attracting visitors due to its favorable climate, natural beauty, and affordability. However, despite its potential, Playas faces significant challenges, such as inadequate access to basic services (e.g., sanitation, clean water, and internet connectivity), limited infrastructure, and a lack of sustainable tourism practices. These issues not only hinder the quality of life for its residents but also prevent the city from fully exploiting its tourism potential. Given this context, Playas

represents an ideal case study for exploring the transformation into a smart city, as it highlights the urgent need for innovative solutions to address these critical challenges. Therefore, the objective of this work is to conduct a study with a general approach that serves as a first step toward transforming Playas into a smart city, laying the foundation for future research and implementation efforts.

By addressing the current challenges facing Playas from a comprehensive perspective, this document aims to provide a preliminary roadmap to guide decision-makers, academics, and other stakeholders interested in the process of urban transformation. The following sections will present a comprehensive overview of the theoretical foundations of smart cities, outlining key strategies and technologies relevant to Playas' context. Section three explores strategies that should be applied to make Playas Canton intelligent. Section four proposes the implementation methodology for the Transformation of Playas into a Smart City. Finally, section five includes the conclusions and recommendations based on the findings of previous sections. Together, these sections provide an in-depth analysis of how to develop a smart-city model for Playas.

2. FUNDAMENTALS OF A SMART CITY. LITERATURE REVIEW

The concept of a "smart city," while present for some time, gained significant momentum in the early 2000s, coinciding with rapid technological advancements. The rise of sophisticated electronic equipment and communication networks presented opportunities for holistic urban development, characterized by planned growth and a focus on sustainability. Amsterdam, a pioneer in this domain, leveraged information and communication technologies (ICT) to enhance urban planning, paving the way for other cities like Rio de Janeiro, Barcelona, and Singapore to implement data-driven strategies for improving citizens' quality of life. By the 2010s, the smart city concept had become a global phenomenon, with numerous urban centers investing heavily in technological integration to address growing urban challenges associated with increasing populations (Caragliu et al., 2011).

A fundamental aspect of urban administration, the smart city concept aims to enhance the well-being of residents through strategic implementation of technology. As populations continue to gravitate towards urban centers, the strain on resources and infrastructure intensifies. Smart cities, by leveraging advancements in telecommunications, renewable energy, robotics, artificial intelligence, and data analytics, offer a framework for optimizing resource allocation and service delivery. These technologies, combined with sophisticated data processing capabilities, provide a powerful toolset for tackling the multifaceted challenges confronting modern cities.

Mohanty *et al* (Mohanty et al., 2016) defines a smart city as "*an innovative city that uses information and communication technologies* (ICTs) *and other means to improve the quality of life, the efficiency of urban operations and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, and environmental factors*." This definition highlights the multifaceted nature of smart cities, encompassing technological advancement, social equity, economic viability, and environmental sustainability. Other authors such as Ramaprasad *et al*. (Ramaprasad et al., 2017), propose a more modular, ontological definition, allowing for adaptability based on specific urban contexts. Their framework emphasizes the interplay of 25,200 components that contribute to a city's "smartness," underscoring the complexity of this concept (see Figure 2).

Figure (2): Unified definition of smart city applied to the city of Playa.
Source: Obtained using the Stability.ai image models (*Stability.ai — 2024*.)

Various studies have explored the core characteristics and components of smart cities. Hollands (Hollands, 2008) identified six key dimensions: smart economy, smart mobility, smart environment, smart people, smart living, and smart governance. Similarly, Batty *et all*. (Batty et al., 2012) emphasize the critical role of integrating technology with urban design, infrastructure, and management to create truly smart urban environment. Stübinger and Schneider (Stübinger & Schneider, 2020), analyzing research trends, highlight five critical components: smart infrastructure, smart technology, smart sustainability, smart health, and a smart economy intertwined with effective governance. For The Royal Academy of Engineering (The Royal Academy of Engineering, 2012), intelligent infrastructure is a system capable of monitoring and analyzing the information obtained through sensors to provide the necessary feedback to make decisions that optimize the use of facilities, plan needs, and adapt efficiently to new technologies such as:

- Smart networks of public services (energy, water) characterized by being adaptive, predictive, integrated, reactive and optimized,
- Land, sea, air transportation, and,
- Telecommunications.

Using the words of Albino *et al*. (Albino et al., 2015) and Chourabi *et al*. (Chourabi et al., 2012), smart politics is in charge of designing a strategy for the creation of a smart city. This encompasses the application of smart economic policies such that companies apply ICT in business processes and technological sectors. Forte *et al*. (FORTE et al., 2006) and Mitton *et al* (Mitton et al., 2012), argue that smart technology refers to technological products or movements that respond intelligently to a constantly changing environment. This implies the development of connections among mobile devices, sensor computers, materials, and communication networks. These technologies are tailored to improve performance, efficiency, reliability, and reduce operating costs. Smart sustainability refers to the development of cities based on the efficient use of renewable resources such as energy, electricity, water, and proper waste management. The use of renewable energy from the sun, biomass, and wind is essential, as well as afforestation, reforestation, and proper waste management to recycle and avoid pollution. According to (IBM, 2022), cities depend on several basic systems for their operation

and development, such as services, citizens, businesses, transportation, communications, water, and energy. These core systems are interrelated and, therefore, need to be addressed both individually and holistically. Its efficiency and effectiveness determine how well the city functions and achieves its goals.

The Internet of Things (IoT) emerges as a key driver of smart city development, enabling the interconnection of physical devices and objects to collect and analyze vast amounts of data (Zanella et al., 2014). This data-driven approach allows for optimization of urban services, ranging from traffic management and environmental monitoring to energy consumption and public safety. Furthermore, smart cities prioritize sustainability through the integration of renewable energy sources, green infrastructure, and initiatives aimed at reducing energy consumption and emissions (Caragliu et al., 2011). Equally important is the use of technology to promote social inclusion, citizen engagement, and equitable access to opportunities and services.

Case studies worldwide demonstrate the tangible benefits of implementing smart city initiatives. For example, Song *et al*. (Song et al., 2021a), analyzed the impact of a smart transportation system in Hangzhou, China, finding significant reductions in traffic congestion and travel times. Similarly, Al Awadhi *et al* (Alawadhi et al., 2012), reported substantial energy savings and improved safety through a smart lighting system in Dubai. However, alongside these successes, it is crucial to acknowledge potential risks and challenges, such as privacy and security concerns, data ownership and control, and the potential for exacerbating the digital divide. Cities must prioritize transparency, citizen engagement, and equitable access to technology to ensure that smart city initiatives are truly inclusive and sustainable.

In conclusion, literature underscores the transformative potential of smart cities in leveraging digital technologies and innovative approaches to address urban challenges. By prioritizing sustainability, social inclusion, and citizen engagement alongside technological integration, smart city initiatives can contribute to a more equitable, efficient, and resilient urban future. However, it is essential for cities to address potential risks proactively and ensure that these advancements benefit all residents. Although the concept of a smart city is globally applicable, its implementation must be adapted to the unique characteristics of each city. In the case of Playas, the lack of access to basic services such as sanitation and digital connectivity requires a specific approach. For example, integrating IoT technologies into waste management and sewage systems can directly address environmental pollution and public health issues. Additionally, the local economy's reliance on tourism highlights the need to enhance tourism infrastructure through smart technologies.

3. STRATEGIES AND TECHNOLOGIES FOR MAKING PLAYAS A SMART CITY

Based on what has been mentioned so far, we can realize that transforming Playas into a smart city necessitates a comprehensive strategy that integrates technological solutions, infrastructure improvements, and a focus on sustainability and citizen well-being. This section outlines key strategies and technologies that Playas can adopt, drawing upon successful examples from other smart cities globally.

Álvarez *et al*., (Álvarez et al., 2016) propose a methodology for sustainable city development centered around a "problem tree" analysis, which identifies key challenges, critical subsystems, and performance indicators. Figure 3, adapted from their framework, illustrates this approach for Playas, highlighting areas requiring intervention to achieve a smarter and more sustainable urban environment. Building upon this framework and drawing upon the work of Stübinger and Schneider (Stübinger & Schneider, 2020) and (Giffinger et al., 2007) we propose five core components that underpin a successful smart city transformation: smart infrastructure, smart technology, smart sustainability, enhanced quality of life (smart

life), and effective governance interwoven with a thriving smart economy. These components encompass a wide range of objectives related to health, education, equality, economic growth, environmental sustainability, and citizen engagement.

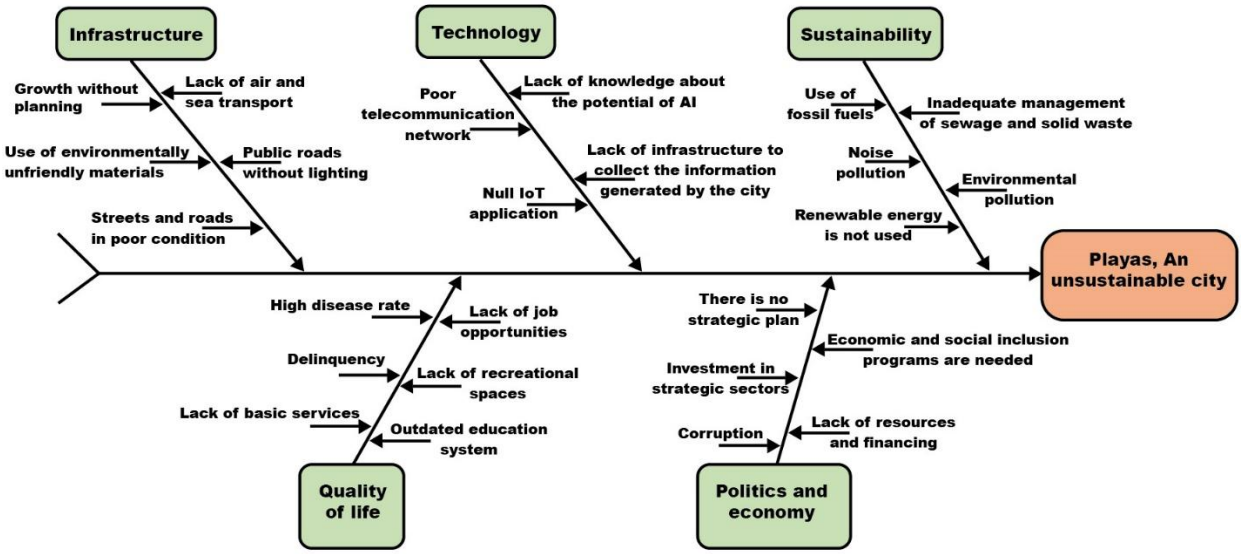

Figure 3: The main problem in the city of Playas and its causes.
Source: Prepared by the author based on data from the references cited thus far.

3.1 Smart Infrastructure

Smart infrastructure, as defined by IBM (IBM, 2022), encompasses buildings, transportation networks, and essential services like water and energy. In a smart city, these elements are interconnected through sophisticated systems that enable efficient data sharing, analysis, and real-time monitoring. This interconnectivity allows for optimized resource allocation, improved service delivery, and data-driven urban planning. Citizens benefit from access to real-time information about their surroundings, including air and water quality, traffic conditions, and public safety alerts. Su *et al*., (Su et al., 2011), highlight the diversity of technologies that contribute to a smart infrastructure, including smart lighting, traffic management systems, energy grids, waste management solutions, and connected healthcare platforms. Smart energy grids, for instance, enhance efficiency, reliability, and safety in electricity distribution, while smart waste management systems optimize collection routes and minimize environmental impact. However, Playas faces significant infrastructural limitations that necessitate strategic intervention. The decentralized autonomous government of the Playas canton should prioritize the development of a comprehensive urban planning framework that regulates land use, encourages sustainable building practices, and prioritizes green spaces. Below, we discuss strategies for sustainable building practices, smart energy management, water resource management, smart transportation, and data-driven infrastructure management, which have been successfully applied by other cities and could be replicated in Playas.

New construction projects, including residential, commercial, and public buildings, must adhere to environmentally friendly standards. This includes utilizing sustainable materials, integrating solar energy for lighting and temperature control, and optimizing space utilization to minimize energy consumption. Singapore, for example, has successfully implemented smart building technologies, such as occupancy sensors that regulate lighting and air conditioning, resulting in significant energy savings (Bhati et al., 2017). Playas can adopt similar measures in public buildings and incentivize private building owners to follow suit.

Given its location and abundant sunshine, Playas has significant potential for harnessing solar energy. The city should invest in developing a smart energy grid that integrates renewable

energy sources, such as solar and wind power, to reduce reliance on fossil fuels and enhance energy independence. Intelligent systems can be implemented to manage energy distribution, forecast demand, and optimize energy usage in buildings and homes. Amsterdam's successful implementation of a smart grid provides a valuable model for Playas (Kern & Smith, 2008).

Playas relies on a water treatment plant located in another city for its drinking water supply. This dependence underscores the need for a holistic approach to water resource management that prioritizes conservation, leak detection, and efficient distribution. Barcelona provides an excellent example with its implementation of smart water meters and sensors that detect leaks in real-time, significantly reducing water loss (Perez et al., 2014). Playas can adopt similar technologies to optimize its water usage and minimize waste.

One of Playas' biggest challenges is the lack of an adequate sewage system, affecting 50% of the population. To address this issue, the implementation of a smart sanitation system is proposed, utilizing IoT sensors to monitor and optimize wastewater treatment. Additionally, the construction of a wastewater treatment plant incorporating advanced technologies is suggested to recycle water and minimize environmental impact. For wastewater treatment, biological processes such as activated sludge, membrane bioreactors, and phytoremediation can be included, which allow the breakdown of organic matter, removal of contaminants, and improvement of water recycling efficiency that could be reused for irrigation or industrial processes, as well as urban systems for use in public spaces. Technologies for denitrification and phosphorus removal can also be applied, contributing to the reduction of nutrient pollution. The recovery of nutrients, such as nitrogen and phosphorus, also offers opportunities for their use as fertilizers in agriculture. Additionally, anaerobic digestion can be incorporated to generate biogas, promoting the use of renewable energy sources like photovoltaic or wind energy in treatment plants, thereby reducing their carbon footprint. Finally, these technologies are supported by international regulations, such as ISO standards and WHO guidelines, and can obtain sustainability certifications, ensuring their effectiveness and lower environmental impact (Basile et al., 2023).

Currently, Playas relies solely on land transportation, primarily via secondary roads and highways. To transition into a smart city, Playas must diversify its transportation infrastructure, considering options such as:

- Railways: Developing a railway system would provide a more efficient and sustainable alternative to road transport, connecting Playas to neighboring towns and cities,
- Electric Vehicles and Charging Infrastructure: Playas should incentivize the adoption of electric vehicles (EVs) and invest in building a robust network of charging stations throughout the city,
- Smart Traffic Management: Implementing AI-powered traffic management systems, similar to those in Hangzhou, China (Jin et al., 2014), can significantly reduce congestion and improve traffic flow. These systems use real-time data from traffic cameras, GPS devices, and other sources to optimize traffic light timings and provide drivers with alternative routes, and
- Public Transportation: Investing in a modern and reliable public transportation system, including electric buses and potentially light rail, can encourage a shift away from private vehicles and reduce traffic congestion. London's integrated public transportation system, featuring real-time monitoring and congestion charging zones, provides valuable insights for Playas.

The implementation of smart infrastructure will generate vast amounts of data that Playas can leverage to improve city operations continually. This data should be collected, analyzed, and utilized to inform decision-making processes, optimize resource allocation, and ensure the long-term sustainability and resilience of the city's infrastructure.

3.2 Smart Technology

Smart technology encompasses the integration of digital technologies, data analytics, and automation to enhance urban services, improve efficiency, and enhance the quality of life for citizens. Key components of a smart city's technological framework include Internet of Things (IoT), Big Data and Analytics, and Artificial Intelligence (AI).

The IoT refers to the interconnected network of devices, sensors, and objects that collect and exchange data, enabling real-time monitoring and control of various urban systems (Ullah et al., 2024). Playas can leverage IoT technology to:

- Environmental Monitoring: Deploying IoT sensors to monitor air quality, water quality, and noise levels can provide valuable data for identifying pollution hotspots and informing mitigation efforts,
- Smart Waste Management: Sensor-equipped bins can optimize waste collection routes, reduce collection costs, and minimize environmental impact, and
- Smart Parking: Sensors in parking spaces can provide real-time parking availability information to drivers, reducing traffic congestion and improving parking efficiency, as demonstrated in San Francisco (Jin et al., 2014).

The ability to collect, process, and analyze vast amounts of data is crucial for a smart city. Playas can utilize big data to:

- Improve Urban Planning: By analyzing data on traffic patterns, population density, and resource consumption, Playas can optimize urban planning initiatives and ensure efficient resource allocation.
- Enhance Public Safety: Data from sensors, cameras, and social media can be integrated and analyzed to identify high-crime areas, predict potential incidents, and optimize resource deployment for emergency response, as seen in Chicago's Strategic Decision Support Center (Mukhopadhyay et al., 2022).
- Promote Citizen Engagement: Open data portals, can provide citizens access to city data, fostering transparency and enabling citizen-led innovation initiatives.

The AI and machine learning can automate tasks, analyze data, and make predictions to support smarter decision-making in various domains. Playas can leverage AI for:

- Traffic Management: As discussed earlier, AI-powered traffic management systems can optimize traffic flow in real-time, reducing congestion and improving travel times (Song et al., 2021b).
- Security Measures: AI can also be used to analyze data from various sources to identify potential security threats, predict crime patterns, and enhance security measures.

Other key technologies that Playas should implement include (Allam & Dhunny, 2019):

- Cloud Computing: Cloud-based platforms provide a scalable and flexible infrastructure for data storage, processing, and application deployment, enabling the efficient management of smart city services,
- Cybersecurity: As Playas becomes increasingly reliant on digital technologies, robust cybersecurity measures are crucial for protecting sensitive data and ensuring the integrity of critical infrastructure, and
- Digital Platforms and Applications: User-friendly platforms and mobile applications can provide citizens with access to information, services, and opportunities for engagement and participation in shaping their city. Boston's BOS:311 mobile app (Hartmann et al., 2017) and Tallinn's city-wide free Wi-Fi are notable examples (Soe & Mikheeva, 2017).

While Playas currently faces limitations in terms of internet access and computer literacy, the widespread use of mobile phones (80% penetration) presents an opportunity to bridge the digital divide. Mobile applications can be developed to provide citizens with access to information, services, and opportunities for civic engagement. By strategically implementing these smart technologies, Playas can enhance the efficiency of its urban operations, improve service delivery, and create a more connected and responsive urban environment.

3.3 Smart Sustainability

Smart sustainability emphasizes the use of technology and data-driven solutions to create a more environmentally friendly and resilient Playas. Key components include Renewable Energy Integration, Energy Efficiency, Smart Water Management, Waste Management and Recycling, and Green Buildings and Infrastructure. As discussed in the context of smart infrastructure, transitioning to renewable energy sources is crucial for reducing Playas' carbon footprint. Copenhagen's ambitious goal of becoming carbon neutral by 2025 and its investments in wind and biomass energy offer valuable lessons (Damsø et al., 2017). Playas should incentivize the adoption of solar panels on buildings, explore the potential of wind energy, and educate citizens about the benefits of renewable energy. Fortunately, owing to its geographical location, the Playas canton has the conditions for the use of renewable energy such as wind, tidal, and especially solar energy. For this reason, to raise awareness about caring for the environment, both the central government and the decentralized government should promote the use of renewable energies in all their facilities and in the infrastructure dedicated to tourist activities, which are what drives the economy from the city.

Smart technologies can significantly improve energy efficiency in buildings, transportation, and city operations. This includes:

- Smart Buildings: Implementing energy-efficient lighting, HVAC systems, and building management systems, as seen in Singapore, can significantly reduce energy consumption.
- Sustainable Transportation: Promoting electric vehicles, public transportation, and active transportation (cycling, walking) will contribute to a cleaner and more efficient transportation system.
- Smart Street Lighting: Installing smart streetlights that adjust brightness based on ambient light and pedestrian presence, like those in Copenhagen (Damsø et al., 2017), can conserve energy and reduce light pollution.

Beyond leak detection, smart water management systems can:

- Monitor Water Usage: Smart meters can track water consumption patterns and identify areas for conservation.
- Optimize Irrigation: Smart irrigation systems, as implemented in Los Angeles (Blanco et al., 2012), use real-time data to adjust watering schedules based on weather conditions and soil moisture, conserving water and reducing waste.

In addition to the problems derived from the use of fossil fuels, the Playas canton has problems related to solid waste management, garbage burning, wastewater discharged directly into the sea, tree felling, and erosion. The examples mentioned in the previous paragraph illustrate how other smart cities have implemented various strategies and technologies to promote smart sustainability, and Playas can learn from these initiatives and adapt them to their

specific context and priorities. Playas can significantly improve its waste management practices by:

- Implementing Smart Waste Collection: Sensor-equipped bins and optimized collection routes can reduce costs and emissions.
- Promoting Recycling and Composting: San Francisco's comprehensive zero-waste program, which includes mandatory composting and recycling, provides a successful model (Shelton, 2017).
- Exploring Waste-to-Energy Technologies: Technologies like anaerobic digestion can convert organic waste into biogas, a renewable energy source.

For the construction of new infrastructure, the use of environmentally friendly materials and minimization of energy consumption should be promoted. Care for flora and fauna, the creation of new green areas, the development of family gardens, and self-generation in homes through solar panels and small wind turbines should be promoted. In addition, recycling programs must be developed that include the classification of waste from homes and the design and construction of a landfill for the waste generated by the city, increasing the percentage of access of the population to sewage, and the construction of a plant sewage treatment. The objective would be, according to what Colding and Barthel propose (Colding et al., 2020), achieve a city that balances biological, social, and technical factors, to achieve a city that is friendly to nature, that adapts to technological advances, and is sustainable over time. New construction should prioritize:

- Sustainable Materials: Utilizing locally sourced, recycled, and low-impact materials can minimize the environmental footprint of buildings.
- Green Roofs and Walls: Incorporating green spaces into building design can reduce the urban heat island effect, improve air quality, and enhance aesthetics.
- Rainwater Harvesting: Collecting and reusing rainwater can conserve water resources and reduce strain on the city's water supply.

3.4 Smart Life

Smart Life encompasses the ways in which smart city technologies and initiatives can improve the overall well-being, convenience, and quality of life for citizens. Key components include: Smart Healthcare, Smart Education, Smart Mobility, Smart Public Safety, Digital Inclusion and Accessibility, Citizen Engagement and Participation.

Because the most important part of a city is its people, the main objective of the available infrastructure and technology must be to maximize the quality of life of the inhabitants. A happy and healthy population (physically and mentally) will become the main force to increasingly improve a smart city; on the contrary, a stressed population with high morbidity will incur a high cost for society. To maximize quality of life, a smart city must achieve a system that guarantees physical and mental health in an environment of security and social cohesion that is attractive to residents, investors, and tourism in general. Achieving this implies guaranteeing access to educational and cultural institutions from preschool ages to the elderly. The educational models used must be in accordance with international standards in such a way that, in addition to the knowledge of each profession or specialty, the entire population acquires skills that allow them to function anywhere in the world, such as computer programming, mathematics, languages, art, values, and general culture. From an ideal point of view, all inhabitants should have a level of qualification in areas commensurate with the needs of society and with a sufficient level of flexibility to unlearn and learn new skills.

Living smart devices require various interconnected technologies designed to improve the lives of citizens. This includes smart water and energy systems, transportation networks, waste management, and healthcare systems. Smart cities also incorporate smart buildings designed to be energy-efficient and use renewable energy sources. In addition, they are connected to the Internet with access to real-time data and analytics that can be used to create efficient urban planning and development. Smart cities incorporate smart infrastructure, such as connected roads, bridges, and public transportation systems, which provide citizens with safer and more efficient transportation options. Finally, smart cities also feature smart services such as access to online education, healthcare, and other services, making life easier and more enjoyable for citizens.

To guarantee the health of the population, every person from birth should have access to a public or private health system. The objective of all parties involved (patients, doctors, hospitals, clinics, firefighters, ambulances, and city authorities) should be to know in real time the living conditions and health status of each citizen in order to take preventive and corrective measures. For this purpose, modern condition monitoring systems or sensors installed on the human body should be connected directly to the communication network or use applications installed on the mobile device.

Smart cities must prioritize the health of their citizens to ensure a productive and prosperous population. Popular wisdom states that health is our most precious asset, as without it, we would not be able to make use of material wealth or contribute meaningfully in society. Therefore, smart city initiatives should focus on creating a comprehensive and integrated smart health system that involves people, the community, education, research and development, and prevention, alongside infrastructure for healthcare services such as hospitals and clinics. This will help reduce costs associated with diseases while also ensuring healthy populations are capable of contributing positively to their communities (Solanas et al., 2014).

All decisions and actions of a smart city must focus on facilitating the lives of the inhabitants, and for this, the Playas canton must focus on providing its citizens with a range of services that promote a high quality of life. This includes:

- Provide access to reliable and efficient public transportation options, such as buses, trains, and ride-sharing services,
- Develop infrastructure that allows easy flow of traffic and provides pedestrian-friendly streets and paths,
- Invest in green spaces and parks to promote physical activity and mental health,
- Create opportunities for economic growth and development, such as job training programs, job fairs, and mentoring initiatives,
- Make investments in education, such as providing access to high-quality schools, libraries, and learning centers,
- Implement smart technology solutions to improve efficiency and safety, such as automated street lighting and sensors,
- Adopt and enforce policies that protect citizens from environmental hazards and pollution,
- Develop programs and initiatives that promote social inclusion and foster community participation, and
- Guarantee that city services respond to the needs of citizens.

Various smart cities have implemented initiatives to enhance Smart Life for their residents. Playas can draw inspiration from these examples and adapt them to their specific context and priorities. In Spain, the city of Barcelona has implemented a telehealth program that allows patients to consult with doctors remotely, improving access to healthcare for those

with mobility limitations or residing in remote areas. Barcelona has also implemented a participatory budgeting process that allows citizens to vote on how a portion of the city's budget is allocated, empowering residents to directly influence city projects (Blakeley, 2010). In South Korea, Songdo's ubiquitous healthcare system integrates sensors and wearable technology to monitor patient health data and provide personalized medical recommendations (Im, 2014). In Finland, the city of Helsinki utilizes digital learning platforms and personalized learning approaches to cater to individual student needs and improve educational outcomes (Halinen & Järvinen, 2008). In Estonia, the city of Tallinn offers free Wi-Fi throughout the city, providing access to online educational resources for all residents (Soe & Mikheeva, 2017). Singapore has a highly efficient and integrated public transportation system, including a comprehensive network of buses, trains, and taxis, reducing reliance on private vehicles and promoting sustainable transportation (Diao, 2019a). In United State, the Chicago's Strategic Decision Support Center integrates data from various sources, including crime statistics and 911 calls, to identify high-crime areas and deploy resources effectively, enhancing public safety. New York City has implemented programs to provide affordable internet access and digital literacy training to low-income communities, bridging the digital divide and ensuring equitable access to technology. The city of Boston utilizes the BOS:311 mobile app to facilitate citizen engagement, allowing residents to report issues, provide feedback, and participate in city initiatives (Hartmann et al., 2017).

3.5 Tourism and Local Economy

Tourism plays a pivotal role in the economic vitality of General Villamil Playas (Playas), Ecuador, as it is one of the region’s primary sources of income and employment. As a coastal city renowned for its natural beauty, affordable living, and favorable climate, Playas has significant potential to leverage smart city technologies to enhance its tourism sector and strengthen its local economy. By integrating smart solutions into tourism management, infrastructure, and services, Playas can position itself as a sustainable and technologically advanced destination, attracting both domestic and international visitors while fostering inclusive economic growth. To improve this situation, the implementation of digital platforms that provide real-time information on tourist attractions, accommodations, and events is proposed. Additionally, the creation of a certification program for tourism establishments that adopt sustainable practices, such as the use of renewable energy and efficient waste management, is suggested. In the existing literatura (Gretzel et al., 2015), it is widely accepted that the components of smart tourism include: Enhancing Visitor Experience, Sustainable Tourism Practices, Boosting the Local Economy Through Tourism, and Data-Driven Decision Making for Tourism Development. Below, we describe each of them as applied to the city of Playas.

3.5.1 Smart Tourism: Enhancing Visitor Experience

Smart tourism involves the use of digital technologies and data-driven strategies to improve the experience of tourists while ensuring sustainable practices that benefit local communities. For Playas, this could include:

Personalized Digital Platforms: Developing a mobile application or web portal tailored to tourists would provide real-time information about attractions, accommodations, transportation options, and events. For instance, Barcelona’s "Barcelona Turisme" app offers personalized recommendations based on user preferences, enhancing visitor satisfaction (López Palomeque, 2015). A similar platform for Playas could highlight eco-friendly activities, cultural heritage sites, and local businesses, encouraging responsible tourism.

Augmented Reality (AR) and Virtual Reality (VR): AR and VR technologies can be used to create immersive experiences for tourists. For example, Playas could implement AR-guided tours of its beaches, historical landmarks, and natural reserves, allowing visitors to learn about the area's unique biodiversity and history through interactive content. Studies show that such innovations increase engagement and extend the duration of tourist stays (Gretzel et al., 2015).

Smart Navigation Systems: Implementing IoT-enabled navigation systems with real-time updates on traffic, parking availability, and public transportation routes would make it easier for tourists to explore Playas efficiently. Singapore's smart mobility initiatives, which include GPS-integrated apps for tourists, serve as an excellent model (Diao, 2019b).

3.5.2 Sustainable Tourism Practices

Given Playas' reliance on its natural environment as a key attraction, integrating sustainability into its tourism strategy is essential. Smart city technologies can help minimize the environmental impact of tourism while maximizing economic benefits:

Eco-Friendly Accommodations: Encouraging hotels and resorts to adopt green building practices, renewable energy systems, and smart resource management tools would align with global trends in sustainable hospitality. For example, Copenhagen's Green Key certification program incentivizes hotels to reduce their carbon footprint through energy-efficient operations and waste reduction measures (Lu et al., 2021). Playas could develop a similar initiative to promote eco-certified lodging options.

Waste Management at Tourist Sites: Deploying smart bins equipped with sensors at popular tourist spots would optimize waste collection and recycling efforts, reducing litter and environmental degradation. San Francisco's zero-waste program, which includes mandatory composting and recycling, demonstrates how technology can support sustainable tourism (Ayeleru et al., 2018).

Environmental Monitoring: Installing IoT sensors to monitor air and water quality in high-traffic areas would enable authorities to address pollution concerns promptly. This proactive approach not only protects the environment but also reassures tourists that Playas prioritizes ecological preservation.

3.5.3 Boosting the Local Economy Through Tourism

A thriving tourism sector can stimulate job creation, entrepreneurship, and investment in Playas. To maximize these benefits, the following strategies are recommended:

Support for Local Businesses: Creating a digital marketplace where local artisans, restaurants, and tour operators can showcase their offerings would connect them directly with tourists. Tallinn's e-commerce platforms for small businesses have successfully increased revenue streams for entrepreneurs (Soe & Mikheeva, 2017). Similarly, Playas could establish an online directory promoting locally sourced products and services.

Public-Private Partnerships (PPPs): Collaborating with private companies to fund and implement smart tourism projects would ensure long-term sustainability. For example, Songdo's smart city development in South Korea was made possible through PPPs that attracted significant foreign investment (Kshetri et al., 2014). Playas could replicate this model by partnering with tech firms, travel agencies, and hospitality providers to co-create innovative tourism solutions.

Event-Based Tourism: Hosting smart-themed events, such as eco-tours, hackathons focused on sustainable tourism, or cultural festivals featuring augmented reality exhibits, would draw diverse audiences and generate additional revenue. Amsterdam's annual "Amsterdam Smart City Event" attracts innovators and investors from around the world, boosting the city's profile as a hub for creativity and technology (Putra et al., 2018).

3.5.4 Data-Driven Decision Making for Tourism Development

Harnessing big data analytics can transform Playas' approach to tourism planning and marketing. By analyzing patterns in visitor demographics, spending habits, and seasonal trends, local authorities can make informed decisions about infrastructure investments, promotional campaigns, and service improvements. For instance:

Targeted Marketing Campaigns: Using social media analytics and geolocation data, Playas could design targeted advertising campaigns to attract specific segments of travelers, such as eco-tourists or adventure seekers.

Dynamic Pricing Models: Hotels, restaurants, and transportation providers could implement AI-powered dynamic pricing systems to adjust rates based on demand fluctuations, optimizing revenue generation during peak seasons.

Integrating smart tourism strategies into Playas' broader smart city framework presents a unique opportunity to elevate its status as a premier coastal destination while driving inclusive economic growth. By adopting cutting-edge technologies, promoting sustainable practices, and fostering collaboration between stakeholders, Playas can create a resilient and future-ready tourism ecosystem. This will not only enhance the quality of life for residents but also ensure that the city remains competitive in the global tourism market.

3.6 Politics and Economics

No change is possible if there is no political decision by the authorities or the creation of economic conditions. Without smart governance, a smart city cannot guarantee a smart economy characterized by an innovative spirit, entrepreneurship, productivity, job opportunities, labor flexibility, ability to adapt to changes, efficient exchange of information, collaboration, and transparency (Chourabi et al., 2012). The objective of the government is to create an environment that guarantees the production and distribution of quality goods and services to all inhabitants of a city. A smart city must be able to efficiently manage its resources while responding to the changing needs of its citizens. This requires good governance and the strong fundamentals of macroeconomics and microeconomics, fiscal responsibility, economic development, and job creation. The main components of smart politics and economics are as follows:

- Smart Infrastructure: This includes efficient energy, water, and transportation systems that reduce emissions and conserve resources.
- Smart Mobility: This includes the development of new mobility solutions such as bike sharing, car sharing, and shuttle services to reduce traffic congestion and pollution.
- Smart Technology: This includes the use of sensors, Internet of Things (IoT) devices, and artificial intelligence (AI) to improve the efficiency of city operations.
- Smart Governance: This includes transparent and participatory governance and decision-making mechanisms to ensure efficient service delivery.
- Smart Economy: This includes developing a strong local economy by attracting new businesses and investments, promoting a favorable business environment, and facilitating a vibrant business ecosystem.

- Smart Environment: This includes initiatives to reduce waste and pollution, improve air quality, and promote green spaces.

Transforming Playas into a smart city requires a supportive political and economic environment that encourages innovation, attracts investment, and prioritizes the well-being of its citizens. Based on the experiences of other cities, below we mention the strategies that could be implemented in Playas in the dimensions that involve politics and economy. Transparency, accountability, and citizen engagement are fundamental to smart governance. Playas should:

- Establish a Representative Municipal Council that reflects the diversity of the city's population and prioritizes the needs of its residents,
- Develop Laws and Regulations that Protect Citizens ensuring the responsible use of technology, data privacy, and environmental protection,
- Create Incentives for Businesses, attracting investment, promoting economic growth through tax breaks, streamlined regulations, and support for entrepreneurship, and
- Promote Equity and Social Inclusion ensuring that the benefits of smart city initiatives reach all residents.

A thriving economy is essential for supporting Playas' smart city transformation. Key strategies include:

- Public-Private Partnerships (PPPs) can leverage the expertise and resources of the private sector to develop and implement innovative solutions, as seen in London's smart parking and traffic management systems (Metz, 2018),
- Investment in Smart Infrastructure, prioritizing investments in transportation, energy, water management, and communication technologies will create a foundation for a smart and sustainable city,
- Financial Incentives for Businesses. Tax breaks and other incentives can attract investment, stimulate economic growth, and create jobs, and
- Fostering a Business-Friendly Environment. Streamlined regulations, access to capital, and support for innovation can encourage entrepreneurship and create a vibrant business ecosystem.

Playas can draw inspiration from numerous cities that have successfully implemented smart governance and economic strategies. The city of Amsterdam utilizes a revolving fund to finance such projects, ensuring continuous investment in sustainable urban development. The Amsterdam Smart City platform facilitates collaboration and communication between citizens, businesses, and the government on smart city initiatives (Capra, 2016). The city of Tel Aviv has cultivated a thriving innovation ecosystem that supports startups and research institutions, attracting investment and driving economic growth in the smart city sector (Mitra et al., 2023). In the city of Boston (United State of America,), the Innovation District fosters collaboration between universities, research institutions, and businesses to develop innovative solutions (Agbali et al., 2019), while after winning the Smart City Challenge in 2016, the city of Columbus has leveraged grant funding to implement smart city initiatives, attracting significant investment and promoting economic growth. Songdo (South Korea) purpose-built smart city has attracted substantial investment and created new economic opportunities in areas related to its smart infrastructure and technologies (Im, 2014). Singapore's successful implementation of PPPs for smart city projects, particularly in transportation, energy, and water management, serves as a valuable model. The city of Tallinn (Estonia) has established clear regulatory frameworks for data privacy and security, addressing concerns related to data collection and use in smart city applications (Soe & Mikheeva, 2017).

To ensure that the proposed strategies are effective, it is crucial to involve citizens in the decision-making process. In the case of Playas, the creation of a Citizen Advisory Council representing various sectors, including tourism, education, and health, is proposed. This council will work alongside local government to prioritize investments in critical areas such as basic sanitation and digital connectivity. Additionally, the implementation of tax incentives for companies investing in sustainable technologies and local development projects is suggested.

Transforming Playas into a smart city is an ambitious but achievable goal. By adopting a holistic approach that integrates smart infrastructure, technologies, sustainability initiatives, and citizen-centric policies, Playas can enhance its livability, resilience, and economic vitality. The strategies and examples discussed in this section provide a framework for Playas to embark on this transformative journey and create a smarter and more sustainable future for its residents.

4. IMPLEMENTATION METHODOLOGY

To ensure that the plan to transform Playas into a smart city is feasible and sustainable, this section proposes a methodology that addresses both local viability and phased planning, monitoring progress, and integrating key stakeholders. This methodology is adaptable and takes into account the socioeconomic and structural characteristics specific to Playas, as well as the need for a collaborative and measurable approach.

4.1 Local Feasibility Analysis

The feasibility analysis considers the financial, technological, and human resources available in Playas, along with its main limitations:

- Financial Resources: Playas, like many small cities in Latin America, faces budgetary constraints that may limit investment in smart infrastructure. The project's implementation will require identifying funding sources, including public-private partnerships (PPPs) and government and non-governmental funds for emerging cities.
- Technological Infrastructure: Connectivity and access to advanced technology are fundamental for the success of a smart city. Currently, Playas shows low internet penetration and telecommunications services. It will be necessary to prioritize the deployment of digital infrastructure and communication networks, starting with connectivity in key areas to improve coverage.
- Human Resources and Training: Digital transformation requires a skilled team to develop, operate, and maintain smart technologies. Training local officials and collaborating with academic institutions are essential to creating a foundation of technical and administrative knowledge at the local level.
- Social and Cultural Aspects: Any strategy must consider community participation and acceptance. Lack of familiarity with technology can be an initial barrier; however, an educational and awareness campaign could facilitate the gradual adoption of these innovations.

4.2 Implementation Phases

The implementation of Playas' smart transformation will be divided into three phases: short, medium, and long term. In the initial phase (1-3 years), the focus will be on improving digital connectivity and implementing smart sanitation systems. In the intermediate phase (4-6 years), digital infrastructure will be expanded and sustainable mobility solutions, such as electric vehicle charging stations, will be introduced. Finally, in the long-term phase (7-10 years), the use of renewable energy will be consolidated and the impact of the initiatives will be continuously evaluated using key indicators. Below is a more specific description of what needs to be done in each phase.

Short Term (1-3 years): Preparation and Initial Infrastructure

- Connectivity Infrastructure: Initiate a pilot connectivity project in strategic areas (such as commercial and tourist zones) to ensure high-quality internet access.
- Capacity Building: Create training programs for local officials and develop skills in data management, IoT handling, and cybersecurity.
- Community Awareness: Implement citizen awareness campaigns about the benefits of digital transformation and sustainability.

Medium Term (4-6 years): Expansion and Integration of Smart Systems

- Implementation of Smart Service Management Systems: Establish monitoring systems for traffic, air quality, and waste management using IoT technologies.
- Intelligent Transportation and Mobility: Introduce sustainable transportation solutions, such as charging stations for electric vehicles and bike-sharing systems that promote sustainable mobility in the urban center.
- Expansion of Digital Infrastructure: Increase internet coverage and connect public buildings, health centers, and educational institutions to the smart network.

Long Term (7-10 years): Consolidation and Sustainability

- Sustainable Energy and Smart Grids: Promote solar and wind energy generation through microgrids and energy storage systems.
- Evaluation of Results and Continuous Improvement: Implement a continuous evaluation system for programs and adjust strategies based on the results obtained.
- Sustainable Governance and Expansion: Integrate new citizen participation technologies and consolidate public-private cooperation to ensure the continuity and sustainability of programs.

4.3 Measurement Indicators

To monitor progress and evaluate the impact of the strategy, first the variables will be defined and operationalized (see Table 2). This matrix organizes the essential variables, their indicators, how they'll be measured, and specific targets for tracking progress, making it actionable and aligned with the strategic goals outlined in your methodology.

Table 2: Operationalization Matrix

Strategic Area	Variable	Indicator	Measurement Method	Target
Smart Infrastructure	Sustainable Construction	% of new constructions using eco-friendly materials	Regular inspection reports	70% of new buildings by year 5
	Energy Optimization	Reduction in energy consumption (kWh)	Monthly energy audits	20% reduction in public building energy use
	Renewable Energy Integration	% of energy sourced from renewable sources	Utility company data analysis	30% renewable energy usage by year 5
	Smart Water Management	% reduction in water wastage	Real-time monitoring from smart meters	15% reduction in water wastage by year 5
	Smart Traffic Management	Decrease in average traffic congestion time	Traffic data analysis	25% reduction in congestion by year 4

	IoT-based Environmental Monitoring	Number of sensors installed city-wide	Sensor installation records	200 sensors installed in key areas
Smart Technology	Waste Management	% of waste collected and sorted automatically	Waste collection and processing reports	60% smart waste collection by year 3
	Smart Parking	Increase in available parking via smart parking tech	Parking system reports	50% increase in parking efficiency
	Renewable Energy Adoption	% of total energy from renewable sources	Energy provider data	40% renewable energy by year 6
Smart Sustainability	Water Efficiency	Reduction in water usage per capita	Smart meter data	20% decrease in water usage per resident
	Recycling Rate	% of waste recycled	Monthly waste audits	50% recycling rate by year 4
	Smart Healthcare	% of population using telehealth services	Healthcare provider reports	70% adoption in remote areas
	Smart Education	Student performance improvement	Digital learning platform analytics	20% improvement in student performance
Smart Life	Digital Inclusion	% of population with internet access	City digital inclusion reports	95% internet access in public areas
	Citizen Engagement	Participation rate in city feedback platforms	City engagement platform data	70% active participation rate
	Smart Governance	Number of participatory processes implemented	Governance reports	100 annual citizen participatory events
	Business Incentives	% increase in smart tech-related business investments	Economic development reports	30% increase in smart tech investments
Politics & Economics	Public-Private Partnerships	Number of ongoing public-private initiatives	Partnership project records	10 major partnerships by year 5
	Environmental Policies	% reduction in city-wide waste generation	Annual environmental impact reports	25% reduction in waste
	Job Creation	Increase in employment in smart city projects	Employment data	15% increase in smart jobs by year 4
Economic Development	Air Quality Improvement	% improvement in air quality index (AQI)	Monthly air quality reports	30% improvement in AQI

Source: (*IMD World Competitiveness Center, 2023*)

Table 2 is based on global smart city standards, such as those proposed by the International Institute for Management Development (IMD), and its indicators have been adapted to the context of Playas to ensure their relevance and applicability (IMD World Competitiveness Center, 2023.). To assess performance against the variables and goals outlined in the operationalization matrix, a balanced scorecard can be designed using the four key perspectives (Financial, Customers, Internal Processes, and Learning and Growth) in line with the strategic objectives of the smart city proposal (see Table 3). This Balanced Scorecard is structured to focus on both short-term and long-term goals, aligning financial resources, citizen satisfaction, process optimization, and learning and growth in a way that supports the overarching objectives of your smart city initiative.

Table 3. Balanced Scorecard for Smart City Proposal

Perspective	Objective	Measure	Target	Initiative

	Increase investment in smart infrastructure	% increase in smart city project funding	30% funding increase by year 4	Public-private partnerships and grants
Financial	Improve energy efficiency and reduce costs	Reduction in energy costs for public facilities	20% cost reduction by year 5	Implementation of energy-efficient systems
	Promote renewable energy to reduce operational expenses	% of energy sourced from renewable sources	40% renewable by year 6	Invest in solar and wind energy projects
	Enhance citizen satisfaction	Citizen satisfaction index	75% satisfaction rate by year 5	Develop citizen-centered digital services
Customer (Citizen)	Increase public engagement in city initiatives	Citizen engagement rate on digital platforms	70% active participation	Launch awareness and engagement campaigns
	Improve accessibility to healthcare	% population accessing telehealth services	70% adoption rate in remote areas	Expand telehealth infrastructure
	Enhance waste management and recycling	Recycling rate	50% recycling rate by year 4	Implement smart waste collection systems
Internal Process	Optimize transportation and reduce congestion	Average traffic congestion reduction	25% decrease in congestion by year 4	Develop smart traffic and parking systems
	Improve data-based decision-making processes	Number of active IoT sensors for data collection	200 sensors city-wide	Deploy IoT infrastructure
	Increase efficiency of water management	% reduction in water wastage	15% reduction by year 5	Smart water meter installation
	Develop a skilled workforce for smart city operations	% of city employees trained in smart city tech	80% trained staff by year 3	Conduct training and partnerships with academia
	Promote digital literacy among citizens	% citizens with basic digital skills	90% digital literacy by year 5	Offer digital literacy programs
Learning & Growth	Strengthen environmental awareness	% reduction in carbon emissions	30% decrease in city emissions	Awareness campaigns and renewable energy projects
	Foster innovation through collaborative projects	Number of innovation-driven partnerships	10 active partnerships by year 5	Establish public-private tech collaborations

Source: The authors.

4.4 Governance Framework and Citizen Participation

The success of a smart city largely depends on cooperation between the local government, the private sector, and citizens. To this end, a governance framework is proposed that promotes the active participation of Playas residents and facilitates inclusive and transparent decision-making (Zwick et al., 2019):

- Establishment of a Citizen Advisory Council: Composed of representatives from various sectors (business, academia, community organizations), this council will help

guide strategic decisions and act as a bridge between the community and the government.

- Digital Platforms for Citizen Participation: Implement applications and web portals where citizens can report issues, suggest improvements, and vote on urban development topics.
- Transparency and Accountability Mechanisms: Create an open data portal displaying progress, budget, and impact metrics of each initiative. This will foster transparency and allow citizens to monitor progress in real time.

5. Conclusions and recommendations

Over time, cities increasingly feel the effects of climate change, migration, environmental pollution, and, in general, a constant change in the social, political, economic, environmental, and technological environment. This forces cities to consider the necessary changes to respond to the demands of society in the current and future environment, all this in an environment characterized by the restriction of resources, fight against environmental pollution, guarantee the supply of food and clean energy, adapt to new technologies, and use all available information to make decisions. To holistically manage all of the aforementioned variables, the solution would be to implement the smart city concept.

The smart-city concept offers a comprehensive solution to the current challenges faced by cities. By leveraging technology and data, smart cities can improve urban services, reduce environmental impacts, and enhance the quality of life for citizens. To become a smart city, Playas must focus on creating an integrated urban planning process and developing a comprehensive digital strategy that aligns with the city's goals.

A smart city uses available technology and data to improve the efficiency of its urban services such as transportation, energy, waste, and public safety. Smart cities use sensors, Internet of Things (IoT) devices, and cloud computing to collect data on how people interact with cities. These data are then used to improve urban services and infrastructure, thereby enabling more efficient and cost-effective solutions. Smart cities also use technology to make the lives of their citizens more efficient and enjoyable, from providing access to public Wi-Fi to giving citizens access to real-time public transport and traffic information, improving public safety, and providing more effective and efficient responses in case of emergencies.

This study has identified specific challenges in Playas, such as the lack of basic sanitation, limited connectivity, and issues in the tourism sector. To address these problems, context-specific solutions have been proposed, such as the implementation of smart sanitation systems, the improvement of digital infrastructure, and the promotion of sustainable tourism practices. In addition, the importance of citizen participation and public-private partnerships has been highlighted to ensure the success of the smart transformation.

To become a smart city, Playas must focus on creating an integrated urban planning process and developing a comprehensive digital strategy that aligns with the city's goals. Technology should be used to create an environment for collaboration, transparency, and efficiency. The Playas canton must use all available information, analyze it, share it, and make decisions that prioritize investments for the benefit of all citizens and companies. If Playas has a real interest in becoming a smart city, where technological innovation allows for a more equitable, efficient, and environmentally friendly society, it must begin by defining a macro plan that includes objectives, diagnosis, action schedule, budget, and sources of financing. Specifically, the plan must include the following:

- Have a good understanding of the smart city concept,
- Widely communicate the smart city concept,

- Create a new mechanism for decision-making, which must be evaluated and defined by the community,
- Establish a mission and vision,
- Specify goals and priorities,
- Develop a strategic plan to obtain a smart city,
- Clearly define responsibilities and deadlines, establish community ties,
- Invest in technological infrastructure that allows data exchange and communication between the public and private sectors,
- Take advantage of technology to create an environment of collaboration, transparency and efficiency,
- Use data and analytics to inform decision-making and prioritize investments that benefit citizens and businesses,
- Develop a comprehensive digital strategy that aligns with the objectives of the city,
- Implement an integrated urban planning process that encourages collaboration between the different actors,
- Encourage citizens to participate and engage in the process of building a smarter city,
- Develop public-private partnerships to finance the implementation of smart city initiatives, and
- Establish metrics that must be constantly monitored to determine if the objectives are being met and rethink the strategies if necessary.

Becoming a smart city requires a holistic approach that prioritizes collaboration, transparency, and efficiency. While smart city technologies offer significant benefits, they also raise concerns about data privacy. The collection and analysis of vast amounts of personal data, such as location data and personal habits, could potentially be misused or exploited. To mitigate these risks, Playas should implement robust data privacy policies that ensure data anonymization, secure data storage, and transparent data usage practices. Regular audits and public engagement on data privacy issues would further build trust and ensure responsible data governance. Following the recommendations outlined above, Playas can successfully transition into a smart city and create a more equitable, efficient, and environmentally friendly society.

Conflicts of Interest: We declare that we have no significant competing interests including financial or non-financial, professional, or personal interests interfering with the full and objective presentation of the work described in this manuscript.

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استراتيجيات المدينة الذكية لبلياس، الإكوادور: إطار للتحول

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ملخص البحث

تُعدّ مدينة فيلاميل (بلاياس)، الإكوادور، وجهة سياحية شهيرة، تُعرف بمناخها المُلائم وسهولة الوصول إليها اقتصاديًا. ومع ذلك، تواجه المدينة تحديات كبيرة في مجالات الاتصالات، والنقل، والخدمات العامة، والاستدامة البيئية، واتخاذ القرارات القائمة على البيانات. تقترح هذه المقالة خارطة طريق لتحويل بلاياس إلى مدينة ذكية من خلال الاستفادة من التقنيات الناشئة والشراكات الاستراتيجية، ودمج تطوير البنية التحتية الذكية، وتطبيق حلول إنترنت الأشياء، والبيانات الضخمة، والذكاء الاصطناعي، والحوسبة السحابية، والأمن السيبراني، وتعزيز الاستدامة من خلال دمج ممارسات الطاقة المتجددة وكفاءة الطاقة. تستند المنهجية إلى تحليل الجدوى المحلية، وتحديد مراحل التنفيذ قصيرة ومتوسطة وطويلة الأجل، وإنشاء إطار حوكمة يُعطي الأولوية لمشاركة المواطنين. تكشف النتائج عن الحاجة إلى التغلب على تحديات مثل نقص خدمات الصرف الصحي الأساسية، ومحدودية الاتصال، وعدم المساواة في الحصول على الخدمات الأساسية. بالإضافة إلى ذلك، تُقترح مؤشرات رئيسية لرصد التقدم، مثل خفض استهلاك الطاقة في المباني العامة وتطبيق أنظمة ذكية لإدارة النفايات. في نهاية المطاف، يُمكن أن يُعزز اعتماد هذه الاستراتيجيات الكفاءة والاستدامة وجودة الحياة في بلاياس، مما يجعلها معيارًا للمدن الأخرى التي تشهد تحولًا نحو نماذج حضرية ذكية.

الكلمات المفتاحية: صنع القرار؛ الاستدامة البيئية؛ الخدمات العامة؛ الذكاء الاصطناعي؛ إدارة البيانات.