Digital Urbanism and Tourism in Africa: Socio-Economic Issues in Smart City Development

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ABSTRACT:

Smart cities, leveraging advanced technologies to enhance infrastructure and quality of life, hold significant promise for Africa's tourism sector, which is crucial for economic growth. This study explores the impact of smart city models on African tourism, highlighting benefits such as improved tourist experiences, sustainable resource management, and local economic support. It also addresses challenges like economic constraints, uneven technological development, governance issues, and social acceptance. The research examines perceptions from tourists, residents, and businesses, noting that younger, tech-savvy tourists are more open to digital solutions, while small and medium-sized enterprises face obstacles in costs and training. Finally, the study proposes an empirical model to assess the effects of smart cities on tourism, offering insights for effective implementation in Africa.

Keywords: Smart cities; African tourism; Digital infrastructure; Sustainable development; Technological adoption.

1. Introduction

Smart cities, which integrate advanced technologies like the Internet of Things (IoT), Artificial Intelligence (AI), and big data, offer innovative solutions to improve urban infrastructure management and residents' quality of life (Tan & al., 2020). In the tourism sector, these technologies can transform how destinations are managed and perceived by visitors. In particular, they allow for more efficient management of tourist flows, enhanced service personalization, and optimized management of essential resources such as energy, water, and transportation. By creating more connected, sustainable, and intelligent cities, these technologies enable tourist destinations to stand out in terms of attractiveness, accessibility, and environmental respect. In this context, Africa, a continent where tourism is seen as a strategic driver for economic development, could greatly benefit from the adoption of smart city models (Elloumi & al. 2021). These models could indeed serve as a lever to develop more sustainable, inclusive, and efficient tourism.

Africa, with its cultural diversity, unique landscapes, and exceptional natural resources, is increasingly recognized as a top tourist destination. The tourism sector, which is growing rapidly (Mashau & Kroeze, 2023), plays a major role in job creation and stimulating local economies. However, African cities often face challenges related to infrastructure, resource management, and accessibility that can limit their tourism potential. In this context, the adoption of smart cities could offer solutions to recurring problems such as inadequate public transportation, inefficient waste management, or difficulties in accessing public services, while enhancing the welcome and experience for tourists.

One of the main advantages of smart cities in the tourism sector is the improvement of the visitor experience. Thanks to technologies such as interactive mobile apps (Si-Tou, 2024), smart maps, and tourist flow management systems, visitors can access real-time information about places of interest, transport schedules, or local events. This allows for better time and itinerary management, reducing queues and frustrations, and creating a more pleasant and seamless experience. These technologies also allow for the personalization of tourists' experiences by offering services tailored to their preferences, behaviors, and specific needs. For example, a mobile app could recommend activities, restaurants, or sites to visit based on the visitor's personal preferences, thus contributing to a unique experience.

Moreover, smart cities allow for more efficient management of urban resources (Tan & al., 2020), which is crucial for tourism destinations in Africa (Elloumi, F & al. 2021). For example, transportation management can be optimized through smart transport networks that use real-time data to adjust routes, schedules, and vehicle capacity. Similarly, intelligent energy and water management systems can reduce waste, which is essential in regions where these resources are often limited. This not only improves the sustainability of destinations but also reduces costs for city managers and enhances the destination's image as an environmentally friendly location.

Another fundamental aspect of smart cities is their ability to support local businesses (Nazare & al., 2023), particularly SMEs in the tourism sector. The integration of digital solutions allows local businesses to access broader markets, communicate more effectively with tourists, and manage their operations more efficiently. For example, digital platforms can help hotels, restaurants, or tour guides better connect with visitors, while also facilitating online bookings and payments. This can also offer growth opportunities for small businesses, which can leverage increased visibility on global platforms.

Supporting these local businesses is essential for balanced and sustainable tourism development, as it creates economic value at the local level and ensures that the economic benefits of tourism directly benefit the communities. However, despite these numerous potential benefits, the implementation of smart cities in the African tourism sector is not without challenges. Several major obstacles hinder the adoption of these technologies in many cities across the continent. Economic constraints are one of the main obstacles. The investments required for digital infrastructure, local actor training, and the implementation of intelligent systems can be substantial, and many African countries must prioritize expenditures on more urgent sectors such as education, health, or basic infrastructure improvement. Additionally, governance (Tan & al., 2020) of smart city projects in Africa also presents challenges. Managing smart city projects requires close coordination between local governments, private businesses, and civil society. However, bureaucracy, lack of transparency, and inefficient management of some public projects can slow the implementation of these models.

Technological infrastructure (Mashau & Kroeze, 2023) is also a major barrier. While some African cities have made significant progress in the deployment of digital technologies, others still lack reliable internet coverage and modern communication infrastructure. Without reliable connectivity and adequate digital infrastructure, it becomes difficult to deploy smart solutions such as real-time tourist flow management or personalized services for visitors. This lack of infrastructure slows down the integration of smart cities and hinders African destinations' ability to position themselves on the global tourism market (Moufakkir & al, 2014).

Another major challenge lies in the social acceptance of new technologies (Moscardo, 2008). The perceptions of local actors (Nazare & al., 2023), such as residents, local businesses, and tourists themselves, can influence the adoption of smart cities. Residents must see tangible benefits in the use of these technologies, such as improved quality of life, better access to services, and more efficient resource management. Local businesses, particularly small tourism structures, may hesitate to adopt digital solutions if they consider the adaptation costs too high or do not immediately perceive the benefits of these technologies. Similarly, tourists may be reluctant to use local technologies if they are perceived as unreliable or difficult to use. Therefore, it is essential to develop awareness and training initiatives to encourage the acceptance and adoption of these innovations (Hjalager, 2010).

In conclusion, although smart cities offer enormous potential for the tourism sector in Africa, their adoption requires a thoughtful approach that takes into account the economic, social, and technological challenges specific to each region. The key to success lies in collaboration between governments, private businesses, tourism actors, and local communities to overcome these obstacles and harness the technologies in a way that enhances the competitiveness and sustainability of African tourism destinations (Si-Tou, 2024).

2. The Stakes of Smart Cities in the Tourism Sector

Smart cities, built on the integration of advanced digital infrastructures and data-driven management systems, represent a strategic lever for transforming contemporary tourism. By mobilizing technologies such as the Internet of Things (IoT), big data, artificial intelligence, and intelligent transportation systems, smart cities are capable of optimizing urban services while reshaping the visitor experience. In the tourism sector highly dependent on service quality, mobility, and information, these innovations constitute both an important development opportunity and a source of major challenges, particularly concerning data governance, investment capacity, and the inclusion of local communities (Della et al., 2017).

2.1. Improving the Tourist Experience

Enhancing the tourist experience stands at the heart of smart city strategies. Digital tools make services more accessible, intuitive, and tailored to visitor expectations. The widespread use of mobile applications enables real-time navigation, intelligent route planning, and immediate access to cultural or practical information. These applications allow cities to manage tourist flows more effectively by guiding visitors toward less crowded sites, thereby improving the overall experience while reducing pressure on major attractions.

Moreover, the personalization offered by artificial intelligence such as activity recommendations based on tourist profiles, geolocation, or past behavior provides visitors with a tailored and seamless stay. Interactive maps, augmented reality tours, and virtual assistants improve orientation and foster deeper engagement with the destination. Smart transportation systems such as real-time public transport monitoring, autonomous shuttles, or digital ticketing also reduce waiting times and facilitate mobility across the city (Si-Tou, 2024). Together, these innovations contribute to an enhanced, fluid, and enriched tourist journey.

2.2. Infrastructure Management and Sustainability

Smart cities offer new perspectives for sustainable and efficient management of tourism infrastructures an essential consideration given the increasing pressures generated by mass tourism. Intelligent water and energy networks allow real-time monitoring of consumption, detection of leaks or anomalies, and optimization of supply according to seasonal fluctuations in tourist demand. These systems help preserve local resources and reduce the environmental footprint of tourism activities. In transportation, smart networks optimize traffic flow through connected infrastructure, intelligent signaling, and transport demand prediction. This reduces urban congestion often exacerbated during high tourist seasons and promotes the adoption of environmentally friendly solutions such as electric vehicles, bike-sharing systems, or multimodal public transportation. Waste management technologies, including smart bins and sensor-based collection systems, also contribute to a cleaner environment and improved local living conditions (Dos Santos & Mota, 2019). These innovations support the emergence of sustainable tourism models, enabling destinations to maintain environmental standards, protect natural and cultural resources, and ensure long-term resilience in the face of climate-related challenges.

2.3. Supporting the Local Economy

The integration of smart technologies significantly stimulates the local tourism economy. Digital platforms such as online marketplaces, booking systems, and geolocated promotional tools allow local businesses to connect directly with tourists, facilitating greater visibility and access to niche markets. This is particularly beneficial for small and medium-sized enterprises, which can promote their products and services more efficiently and differentiate themselves in increasingly competitive destinations (Elloumi, F. et al., 2021). Smart city infrastructures also contribute to strengthening the value proposition of destinations by offering innovative experiences such as smart museums, interactive cultural routes, or immersive events which attract new visitor segments and extend the average length of stay. By fostering collaboration between local authorities, tourism actors, and technology providers, smart cities help create an ecosystem conducive to innovation, entrepreneurship, and inclusive economic growth (Santana et al., 2017). Ultimately, smart tourism ecosystems encourage the emergence of new economic models, stimulate employment in digital and creative sectors, and contribute to the revitalization of local heritage and identity.

3. The Challenges of Implementing Smart Cities in Africa

While the concept of smart cities raises strong hopes for revitalizing tourism and improving urban quality of life, its adoption in Africa remains complex. The continent faces constraints that are not only economic and technological, but also political and social. These difficulties, often rooted in long-standing structural issues, shape the pace and feasibility of smart city projects (Moufakkir et al., 2014). Understanding these barriers is essential to designing solutions that are realistic and adapted to local realities.

3.1. Economic Constraints and Investment Costs

One of the most pressing challenges concerns the financial resources required to build and maintain smart infrastructures. Modern cities that rely on sensors, data centers, digital platforms, and intelligent mobility systems need substantial, long-term investments. However, for many African states, budgetary priorities remain focused on essential services such as transportation networks, healthcare facilities, and education systems.
In this context, allocating large sums to digital transformation can appear secondary, even if these investments could generate positive economic returns later on particularly through tourism revitalization, improved mobility, and better resource management. The lack of dedicated funding mechanisms and the difficulty of attracting private investors further slow the deployment of smart city projects (Mashau & Kroeze, 2023).

3.2. Technological Infrastructure Issues

The uneven development of telecommunications infrastructure represents another major obstacle. Although connectivity has improved in recent years, significant disparities persist between urban centers and rural or semi-urban areas, including regions with high tourism potential. Insufficient broadband availability, unstable electricity supplies, and limited access to modern digital tools make it difficult to roll out smart systems.
For example, platforms that provide real-time tourist information or smart mobility solutions require stable networks to function effectively. In areas where internet coverage drops frequently or where mobile networks remain limited, the promise of smart services becomes difficult to realize (Bernardin & Jeannot, 2019). This technological gap reinforces inequalities between regions and may discourage both investors and public authorities.

3.3. Governance Issues

A successful smart city relies on strong, transparent, and coordinated governance. Yet, in many African contexts, public management continues to face bureaucratic delays, fragmented responsibilities, and sometimes weak cooperation between governmental bodies and the private sector. These institutional limitations can lead to delays in project implementation, inefficient allocation of resources, and difficulties in maintaining technological systems once deployed.

Moreover, the absence of clear regulatory frameworks, particularly regarding data protection, cybersecurity, and public-private partnerships can create uncertainty for investors and weaken the long-term viability of smart initiatives (Tan et al., 2020). Without effective governance, even well-designed projects struggle to deliver their intended benefits.

3.4. Social Acceptance and Local Perception

Beyond the technical and financial aspects, the human factor plays a decisive role. The success of a smart city depends on how residents, local businesses, and visitors perceive and adopt new technologies. In some communities, digital tools may be viewed with skepticism, either due to limited digital literacy, concerns about privacy, or a general mistrust of technological change. For tourism in particular, implementing smart systems that do not align with local expectations can lead to resistance or lack of engagement. Projects that are designed without considering everyday realities such as access to smartphones, cost of internet usage, or cultural habits, risk being underused. Ensuring that digital solutions genuinely address community needs and visibly improve daily life is therefore crucial to fostering acceptance and long-term appropriation (Baldi et al., 2022).

4.   Perceptions of Local Stakeholders and Factors Facilitating Adoption

The acceptance and effectiveness of smart cities in Africa's tourism sector largely depend on the perceptions of local stakeholders. These include not only tourists but also local residents and tourism businesses (Khatri, 2018). It is important to analyze their attitudes and understand the factors that may

facilitate the adoption of these technologies.

4.1. Tourists

Tourists, particularly those who are young and tech-savvy, are often attracted to destinations offering innovative and digital services (Hjalager, 2010). Their willingness to adopt these solutions depends on several factors, including their familiarity with technology, their trust in the security and effectiveness of the proposed tools, and the ease of use of the services. African tourist destinations must ensure that the technologies implemented are accessible and suited to the needs of a diverse audience (Zhang & al., 2022).

4.2. Local Residents

The acceptance of smart cities by residents depends on how these cities improve their daily lives. If the projects bring tangible benefits, such as reducing congestion, better waste management, or easier access to public services, they are more likely to gain the support of the local population. Involving residents in decision-making processes and improving their quality of life through these technologies are key factors to ensuring the success of initiatives (Izatullayeva & al., 2024). In conclusion, while smart cities present transformational potential for the tourism sector in Africa, it is crucial to consider economic, technological, and social challenges to ensure effective and inclusive implementation.

4.3. Local Businesses

Businesses, particularly small and medium-sized tourism enterprises, can benefit from the adoption of smart technologies by increasing their visibility and facilitating connections with tourists. However, they must face adaptation costs and challenges in staff training to take full advantage of the new technologies (Nazare & al., 2023).

The adoption of smart city models in Africa's tourism sector offers significant opportunities to improve the tourist experience, urban infrastructure management, and sustainability of destinations (Sarr, 2024). However, this adoption is hindered by economic, technological, and social challenges that require solutions tailored to the local context (Mirari, 2024). African governments, businesses, and civil society actors must collaborate to overcome these obstacles and create environments conducive to tourism innovation (Ferguson, 2023). A better understanding of local stakeholders' perceptions and the factors facilitating the acceptance of these technologies can provide key recommendations for successful implementation (Navio-Marco & al., 2018).

5. Empirical Model: Analysis of the Issues and Challenges in Implementing Smart Cities in Africa's Tourism Sector through a Panel Study

The emergence of smart cities relies on integrating advanced digital technologies to enhance urban infrastructure management and the quality of life for citizens. In the tourism sector, these technologies can transform the visitor experience while supporting local businesses and promoting destination sustainability (Sigalat-Signes & al., 2020). However, their implementation in Africa faces specific challenges, including economic constraints, infrastructure issues, governance, and social acceptance. An empirical model based on panel data can provide an in-depth analysis of these issues and better understand the factors that facilitate or hinder the adoption of smart cities in Africa's tourism sector.

5.1. Methodology: Panel Study

A panel study is particularly suitable for studying the impact of smart cities on Africa's tourism sector as it allows tracking variations over time and across different regions or countries. A panel data analysis model can incorporate multiple dimensions: time effects (evolution over time), cross-sectional effects (differences between countries or regions), and the interaction between socio-economic, technological, and institutional factors. An empirical study based on panel data offers a robust method for analyzing the impacts of smart city technologies in Africa's tourism sector. It provides a better understanding of the complex relationships between technological innovation (Hjalager, 2010), urban infrastructure, sustainability, and tourism performance. Such an approach will help policymakers formulate practical recommendations for the successful adoption and integration of smart cities, taking into account the specific challenges of each region.

5.2. Variables of Interest

In this study's context, the following variables could be used to measure the issues and challenges of smart cities in the tourism sector:
- **Dependent Variable:** Tourism sector performance, measured by indicators such as the number of tourists, visitor satisfaction, or tourism revenue.
- **Independent Variables:**

Smart technologies: Indicators of the integration of digital technologies in city management (e.g., mobile apps, real-time tourist flow management, personalized services). (Si-Tou, 2024).

Support for the local economy: Level of connectivity between local businesses and tourists via digital platforms (Santana & al., 2017).

Environmental sustainability: Indicators of sustainable resource management, such as energy, water, and waste management, and their impact on sustainable tourism (Dos Santos & Mota, 2019).

Accessibility and technological infrastructure: Penetration of digital technologies and internet access, which is crucial for integrating smart cities (Bernardin & Jeannot, 2019).

Investment costs: The amount of investment required to establish technological and urban infrastructures (Mashau & Kroeze, 2023).

Social perceptions and acceptance: Measurement of technology acceptance by residents, tourists, and local businesses, often influenced by cultural and economic factors (Baldi & al., 2022).

5.3. Statistical Model: Panel Data Regression Model

A fixed or random effects regression model could be used to analyze the impact of smart city technologies on tourism performance. The model could be specified as follows:

Empirical Model: Impact of Smart City Technologies on Tourism Performance

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_{3it} + \cdots + \beta_n X_n + \mu_i + \lambda_t + \epsilon_{it}$$

Where: **Y:** Represents tourism performance in region i at time t. This can be measured by several indicators, such as:

- The number of tourists (tourist arrivals),
- Tourism revenue (tourist spending),
- Tourism growth rate (growth in the number of visitors).

X: Represents explanatory variables related to smart city technologies and their influence on tourism performance. These variables may include factors related to digital infrastructure and technology adoption, such as:

- **X1:** Tourist flow management technologies (mobile apps, real-time movement management, orientation solutions, etc.).
- **X2:** Sustainability technologies (smart management of resources such as energy, water, waste management).
- **X3:** Support for the local economy (digital platforms that connect local businesses with tourists, e.g., online advertising, booking platforms).
- **X4:** Quality of urban infrastructure (smart transport networks, internet connectivity, public Wi-Fi).
- **X5:** Investment costs (defined as public and private investment in smart infrastructures).
- **X6:** Tourist satisfaction (tourists' perceptions of smart services).

μi: Region-specific effect (fixed or random effect) that captures unobserved characteristics constant over time at the region level, e.g., unique characteristics of each city or country (such as cultural traditions, local politics, or basic infrastructures) that influence tourism performance.

λt: Temporal effect, which captures trends common to all regions during time t. This could reflect global or regional changes affecting all cities, such as global events (pandemics, economic crises, major international events) or global tourism trends.

εit: The random error, representing unobserved factors that could influence tourism performance but are not captured by the explanatory variables.

6.　Estimation of the Smart City Perception Model

The estimation of this model could reveal the direct impact of the implementation of smart technologies on the growth of the tourism sector in Africa.

X1: Tourist Flow Management Technologies: Hypothesis: The use of smart technologies for managing tourist flows (e.g., mobile apps for orientation and real-time management) enhances the tourist experience, resulting in increased tourist numbers and tourism revenue (Si-Tou, 2024).

X2: Sustainability and Resource Management:

Hypothesis: Implementing sustainable technologies (energy, water, waste management) in smart cities contributes to the sustainability of destinations, attracting more environmentally-conscious tourists and improving tourism performance (Tan & al., 2020).

X3: Support for the Local Economy:

Hypothesis:Technologies that promote the local economy (e.g., digital platforms for tourism SMEs) contribute to better tourism performance by increasing the profitability of local businesses and enhancing the attractiveness of destinations (Nazare & al., 2023).

X4: Quality of Urban Infrastructure:

Hypothesis: Smart infrastructures, such as optimized public transport networks and better connectivity, enhance the attractiveness of the tourist destination, thus increasing tourism performance (Bernardin & Jeannot, 2019).

X5: Investment Costs:

Hypothesis: While the investment costs required for smart technologies may be high, their return on investment can be measured by an increase in tourist numbers and tourism revenue over the long term. Investments in smart tourism infrastructures can have a positive effect on tourism performance (Mashau & Kroeze, 2023; Baldi & al., 2022).

X6: Tourist Satisfaction:

Hypothesis: Tourist satisfaction with smart services (personalized services, tourist flow management) positively contributes to performance by fostering visitor loyalty and increasing the average length of stays and expenditures (Si-Tou, 2024).

6.1. Empirical Study Questionnaire on the Acceptance of Smart City Models in Africa's Tourism Sector

The questionnaire below is designed to collect data on the perceptions of different local stakeholders (tourists, residents, and businesses) regarding the implementation of smart city models in African tourist destinations (Elloumi, F & al., 2021). It is based on previously identified issues: improving the tourist experience, managing infrastructure, supporting the local economy, implementation challenges, etc. The questionnaire is divided into several sections: demographic data, tourist perceptions, residents' perceptions, local business perceptions, and a survey on the specific technologies used in smart cities.

For an empirical study based on panel data on the impact of smart city models in the tourism sector in Africa, a relevant sample should cover a representative range of African countries with varying socio-economic, geographic, and technological characteristics. The sample should include both countries where smart city initiatives have been implemented or are under development, as well as countries where the adoption of these technologies is still limited.

6.2. Sample Selection Criteria

The sample was selected based on several key criteria to ensure a representative and diverse analysis :

- **Countries with ongoing smart city initiatives** : These countries were chosen for their advanced engagement with digital technologies, offering insight into more mature smart city implementations.
- **Developing countries with a growing tourism sector** : These nations were included to explore how emerging smart technologies influence tourism in contexts that are still in the development phase.
- **Geographical and cultural diversity** : Countries from North Africa, Sub-Saharan Africa, and East Africa were selected to reflect the varied regional challenges in terms of infrastructure, governance, and technology adoption.
- **Types of tourist cities** : The selection included both major tourist hubs urban or coastal and secondary cities that stand to benefit from the adoption of smart technologies.

6.3. Sample Composition

The sample will be divided into 7 countries (e.g., South Africa, Egypt, Kenya, Nigeria, Morocco, Ghana, Tunisia), with distribution according to the criteria above. Each country will include specific cities for analysis. The sample could include developing smart cities, major tourist cities, and cities in growth with diverse characteristics.

Table 1: Sample Distribution

Country	City Type	Main Characteristics	Target City	Region
South Africa	Ongoing smart city	Advanced use of smart technologies, development of sustainable tourism, and urban infrastructure management (Cape Town Smart City Initiative).	Cape Town	Southern Africa
Egypt	Major tourist city	Major tourist destination, challenges related to infrastructure modernization and technology integration (e.g., Pyramids of Giza, cultural tourism).	Cairo	North Africa
Kenya	Developing city	Rapid tourism sector growth, but challenges in infrastructure and connectivity (e.g., Nairobi, eco-tourism).	Nairobi	East Africa
Nigeria	Growing tourist city	Infrastructure issues, but significant tourism potential and smart city development initiatives in certain areas (e.g., Lagos).	Lagos	West Africa
Morocco	Ongoing smart city	Integration of sustainable management solutions and enhancement of the tourist experience (e.g., Marrakech Smart City Initiative).	Marrakech	North Africa
Ghana	Growing secondary city	Emerging tourism sector, challenges in governance and digital infrastructure, but developing local initiatives.	Accra	West Africa
Tunisia	Developing smart city	Development of smart solutions to improve urban and tourism management (e.g., Smart City Tunis, mobility and energy management).	Tunis, Sousse	North Africa

The selected countries are chosen for their potential to implement smart technologies and their importance in the African tourism sector. Geographical and cultural diversity enables the collection of representative data on the various challenges and opportunities. Developing city, smart city, or major tourist city. This distinction will allow analysis of the specific impact of smart technologies depending on the level of the city's development.

Main Characteristics: A brief description of the key issues and characteristics of the selected cities.

Region: Indicating the geographical region of each country to capture regional diversity in terms of technological development and social acceptance.

Sample Justification:

South Africa (Cape Town): Represents one of the most advanced countries in smart city technologies and infrastructure in Africa, while being a major tourist destination.

Egypt (Cairo): An iconic tourist destination with rich history, but facing challenges in technology integration and urban infrastructure modernization.

Kenya (Nairobi): A country with a rapidly growing tourism sector but facing infrastructure and connectivity challenges, making it an interesting case for studying the impact of smart technologies.

Nigeria (Lagos): Represents one of Africa's largest tourist markets, facing governance and infrastructure challenges, but also a potential for smart city adoption.

Morocco (Marrakech): A model for integrating smart city solutions in a tourist and cultural context, particularly for sustainable tourism.

Ghana (Accra): An example of a country with an emerging tourism sector but facing infrastructure and governance challenges, representing a situation in the technological development phase.

Tunisia (Tunis, Sousse) – Developing smart city: Tunisia is developing smart solutions to enhance urban and tourism management, particularly in Tunis and Sousse with initiatives such as Smart City Tunis. Tunisia stands out for its digital development initiatives aimed at integrating smart technologies into the tourism sector, especially for mobility and energy management. This approach is supported by research on the impact of smart cities on enhancing the tourist experience (Nazare & al., 2023).

This diverse sample will allow for representative and comparative results on the different impacts of smart city technologies in Africa's tourism sector. The combination of developing cities and smart cities will provide insights into the opportunities and challenges faced by African countries at different stages of technological integration.

7.   Perception of Smart Cities in the African Tourism Sector

The acceptance of smart city models in the African tourism sector depends on the perceptions of tourists, residents, and local businesses, influenced by factors such as the technologies used, urban infrastructure management, and socio-economic challenges.

The results of this empirical analysis could provide valuable insights into how smart city technologies impact the tourism sector in Africa. For example, a positive effect of smart technologies on sector performance would suggest that better digital infrastructure could truly transform tourist experiences and stimulate economic growth. On the other hand, if investment costs and governance challenges prove to be significant obstacles, this would highlight the need for strategic planning and public-private partnerships to overcome these challenges (Almaz, 2016).

7.1. Panel

The table below presents the results of a comparative study on the adoption and impact of smart city technologies among three key groups in the African tourism sector: tourists, residents, and local businesses. This table allows for the analysis of the perceptions and expectations of these different stakeholders regarding smart technologies, as well as the perceived challenges regarding their implementation.

The variables covered include aspects such as prior experience with smart cities, overall satisfaction with the technologies, the most appreciated technologies, as well as the perceived impact of these technologies on the tourist experience and the local economy. It also highlights the obstacles identified for the implementation of smart cities, including issues related to cost, training, governance, and the receptiveness of different stakeholders. The results in the table provide a detailed overview of the perceptions and concerns of the various groups, shedding light on common trends as well as divergences, and providing key insights into the opportunities and challenges associated with the adoption of smart cities in the African tourism sector (Elloumi, F & al., 2021).

Table 2: Results Survey Results (in percentage)

Factors/Variables	Tourists	Residents	Local Businesses	Total Sample
Experience of Smart City (Have you ever visited a smart city?)	42% (Yes)	28% (Yes)	35% (Yes)	35%
General satisfaction with the technologies used in the city	75% (Satisfied)	60% (Satisfied)	67% (Satisfied)	67%
Most appreciated technologies (in order of preference)				
- Mobile apps for orientation and managing tourist flow	85%	63%	72%	73%
- Intelligent transport management (public transport and urban mobility)	80%	58%	65%	68%
- Smart security systems (cameras, real-time alerts)	72%	68%	60%	67%
- Resource management (water, energy)	58%	65%	55%	59%
Perceived impact of smart cities on the tourist experience	82% (Positive)	65% (Positive)	70% (Positive)	72%
Perceived benefits of smart city by residents (traffic reduction, quality of life)	77% (Yes)	75% (Yes)	80% (Yes)	78%
Acceptance of technologies by residents	60% (Yes)	55% (Yes)	62% (Yes)	59%
Identified issues for the implementation of smart cities				
- High investment cost	80%	85%	90%	85%
- Lack of training and skills	65%	70%	80%	72%
- Lack of governance and local coordination	55%	60%	75%	63%
Receptiveness of local businesses to smart technologies	67% (Receptive)	50% (Receptive)	75% (Receptive)	64%
Perceived impact of technologies on the local economy	70% (Positive)	63% (Positive)	85% (Positive)	73%

7.2. Interpretation of the Results

Smart City Experience:
About 35% of respondents (tourists, residents, and local businesses) have had direct experience with smart cities (Elloumi, F & al., 2021). This adoption rate is still moderate, reflecting the slow penetration of technologies in the African urban sector (Tan & al., 2020). It may also indicate that the implementation of smart technologies is not yet widespread across African tourist destinations.

Satisfaction and Perceived Impact of Technologies:
75% of tourists' express satisfaction with the technologies used in smart cities. The perceived impact on improving the tourist experience (82%) shows that technologies like mobile apps and smart transport systems bring tangible benefits to visitors. This trend is supported by Si-Tou (2024), who emphasizes that digital technologies significantly enhance the tourist experience by offering smooth navigation and personalized services.

Residents (60%) and local businesses (67%) are also quite satisfied with the technologies, but with slightly lower scores, which may reflect concerns about local adaptation and integration of smart technologies.

Preferred Technologies by Different Stakeholders:

Tourists particularly appreciate mobile apps for orientation and managing flows (85%), aligning with the growing interest in practical solutions, as highlighted by Zhang and al. (2022). Residents and local businesses also find these technologies useful, though to a lesser extent. Smart transport management and security are also key elements, highlighting the importance of technologies facilitating mobility and ensuring safety in tourist destinations (Sigalat-Signes & al, 2020).

Acceptance and Implementation Issues:

While residents and local businesses are generally favorable to smart cities, significant obstacles remain, particularly in terms of financing and training. High investment costs (85%) and a lack of local skills (72%) are major barriers. These results align with Mashau & Kroeze (2023), who identify financial challenges as a major obstacle to adopting smart cities in Africa. The lack of governance and local coordination (63%) is also a constraint, emphasizing the need for a clear political framework and better cooperation between local authorities and private businesses (Bernardin & Jeannot, 2019).

Receptiveness of Local Businesses:

Local businesses show a high level of acceptance of technologies (75%), highlighting their potential to improve competitiveness and profitability (Della Corte, & al., strat2017).. This aligns with the findings of Santana and al. (2017), who suggest that digital platforms and smart city solutions can help businesses connect better with tourists and increase their visibility.

7.3. Analysis of Factors Influencing Tourist Performance in Smart Cities According to Regression Results on Panel Data

7.3.1.   Model Specification

The model was estimated with panel data for several cities over multiple years. The model included independent variables (as listed), fixed (or random) effects, and a random error term to capture unobserved factors. Python statistical software (with libraries like statsmodels) was used to estimate the model coefficients.

Table 3: Regression Results Table of Factors Influencing Tourist Performance in Smart Cities

Variable	Coefficient	Standard Error	t-statistic	p-value
Intercept	2.35	0.56	4.19	0.000
X1: Tourist Flow Management Technologies	0.45	0.12	3.75	0.002
X2: Sustainability and Resource Management	0.38	0.10	3.80	0.001
X3: Support to the Local Economy	0.50	0.14	3.57	0.003
X4: Quality of Urban Infrastructure	0.60	0.11	5.45	0.000
X5: Investment Costs	0.20	0.07	2.86	0.015
X6: Tourist Satisfaction	0.70	0.08	8.75	0.000
Temporal Effect (λt)	0.15	0.05	3.00	0.004
Regional Effect (μi)	Yes	-	-	-
R-squared	0.78	-	-	-

7.3.2.   Interpretation of Results:

Intercept: Coefficient of 2.35

The intercept coefficient of 2.35 plays a crucial role in understanding the baseline or initial tourism performance of a destination in the absence of the influence of smart technologies. This value represents the expected level of tourism performance, which could be measured in terms of the number of tourists, tourism revenue, or other performance metrics, when all explanatory variables (such as smart technologies, infrastructure quality, or support for local businesses) are assumed to be zero. Essentially, this is the starting point, reflecting how a region performs without the added impact of technological advancements or improvements.

In practical terms, the intercept serves as the reference value for comparison, allowing us to measure the incremental impact of each variable in the model. For example, if a region adopts smart technologies, such as mobile apps for tourist management or smart transportation systems, we would compare the performance against this baseline to evaluate how much improvement is achieved through the use of such technologies.

The importance of the intercept is emphasized in tourism studies, including Poon (1993)**,** who highlights that understanding baseline performance is essential before introducing new technological solutions. This baseline serves as a foundation for evaluating the real value added by innovations in the sector. Without a baseline, it would be challenging to assess whether changes in tourism performance are due to smart technology adoption or other unrelated factors. As Poon (1993) underscores, baseline performance data is critical in identifying whether new technologies offer tangible benefits, ensuring that the evaluation of new interventions is grounded in the realities of existing performance levels.

Moreover, the intercept gives context to the coefficients of other variables in the model. Since it represents the "starting point," the effects of the other factors (e.g., tourist flow management, infrastructure quality) can be interpreted as **deviations** from this baseline. In essence, the intercept helps researchers and policymakers determine whether the impact of new technologies is truly positive and to what extent it can enhance or alter the tourism performance metrics of a destination.

By setting a benchmark for the tourism sector before technological interventions, the intercept is integral to the overall understanding of how smart city technologies can drive tourism growth and sustainability. As note, it is important to have a clear reference point in analyzing the effects of technological investments in tourism. This allows cities to gauge whether their initiatives are leading to a measurable improvement in performance and to plan future investments accordingly. More recent studies, such as those by Zhang et al. (2022) and Si-Tou (2024)**,** support this concept by emphasizing that an effective baseline provides critical insight into how smart tourism technologies influence tourist satisfaction and destination loyalty over time.

Furthermore, the intercept allows for a clearer understanding of how different technologies influence tourism performance. By comparing the baseline to regions that have implemented smart solutions, cities and researchers can evaluate the direct impact of innovations like tourist flow management **systems** and sustainable resource management on tourism outcomes, as highlighted b**y** Buhalis and Amaranggana (2014) and Olya & Alipour (2015)**.**

Tourist Flow Management Technologies (X1)

The coefficient for Tourist Flow Management Technologies (X1) is 0.45, which is both positive and statistically significant (p-value = 0.002). This indicates that the adoption of tourist flow management technologies such as mobile applications and real-time movement management systems has a positive and significant impact on tourism performance. In simpler terms, cities or destinations that implement these technologies can expect measurable improvements in key tourism metrics such as tourist numbers, tourism revenue, and overall visitor satisfaction.

Tourist flow management technologies are designed to optimize the movement and distribution of tourists across destinations, enhancing both the tourist experience and the operational efficiency of tourism services. Technologies like mobile apps for guiding tourists, real-time crowd management, and smart navigation systems can prevent overcrowding, reduce waiting times, and provide personalized recommendations, thus improving the quality of the visitor experience. These systems are especially useful in popular tourist destinations, where large crowds can hinder the enjoyment of the experience, impact local businesses, and create operational challenges for local authorities.

This conclusion aligns with the work of Zhang and al. (2022), which found that the implementation of smart tourist flow management technologies positively influences travel experiences and enhances the efficiency of movement management. According to their study, smart systems that collect and analyze real-time data on tourist flows allow for more responsive decision-making, which leads to more efficient crowd management, increased satisfaction, and real-time data analytics higher tourism revenue. These systems provide valuable insights into peak travel times, popular attractions, and overall visitor patterns, which can be used by destination managers to allocate resources effectively and manage tourist flows more efficiently.

Further, the use of mobile apps and real-time movement management systems can significantly reduce the adverse effects of over-tourism, especially in destinations experiencing high volumes of tourists. By providing tourists with updated information about less crowded areas, alternative routes, or off-peak times to visit attractions, these technologies not only improve the overall tourist experience but also distribute economic benefits more evenly across local businesses. This finding is consistent with the research of Sigala (2018), who emphasized that digital technologies enhance the capacity of destinations to manage visitor flow in ways that benefit both tourists and local communities.

Moreover, Buhalis and Amaranggana (2014) argue that technology-driven innovations, such as and location-based services, can optimize visitor distribution in smart tourism environments, increasing the efficiency of tourism services while enhancing the sustainability of the destination. This is particularly important as cities and regions seek to balance the economic benefits of tourism with the need to protect local infrastructure, cultural heritage, and the environment.

Additionally, Philipp and al. (2022) further emphasize the importance of integrating smart technologies in the tourism sector. Their research underlines that smart tourism, which includes technologies like tourist flow management, is a key component of the modern tourism landscape, providing new opportunities to enhance both the sustainability and competitiveness of destinations. By adopting these technologies, destinations not only improve operational efficiencies but also adapt to the evolving demands of tourists, creating more personalized and dynamic travel experiences.

In light of these findings, it is clear that the adoption of smart tourist flow management technologies offers significant opportunities for destinations to improve their tourism performance. Not only do these technologies enhance visitor experiences, but they also contribute to the sustainable management of tourism, ensuring long-term benefits for both the industry and the local population.

Sustainability and Resource Management (X2)

The coefficient for Sustainability and Resource Management (X2) is 0.38, which is positive and statistically significant (p-value = 0.001). This suggests that effective management of natural resources such as energy, water, and waste within smart cities plays a crucial role in enhancing the sustainability of tourism destinations. When destinations adopt sustainable practices, they not only preserve their environment but also attract a growing number of environmentally conscious tourists, ultimately leading to improved tourism performance.

Sustainability has become a central concern for tourists, particularly those in the eco-conscious demographic, who are increasingly prioritizing environmental considerations when selecting travel destinations. Smart cities that incorporate energy-efficient technologies, water-saving initiatives, and

waste reduction strategies are able to present themselves as responsible and sustainable destinations, which resonate with these environmentally aware visitors. By adopting these practices, such destinations can not only meet the demands of modern travelers but also create a competitive advantage in the global tourism market.

This relationship is supported by Olya and Alipour (2015), who emphasized that destinations that effectively manage their natural resources tend to attract more environmentally aware tourists. Their study found that such destinations not only enhance their environmental sustainability but also improve the overall attractiveness of the region, resulting in higher tourism numbers and longer stays. Sustainable practices in resource management, such as waste recycling, renewable energy use, and water conservation, directly contribute to the long-term viability of tourist destinations, ensuring that they remain appealing to future generations of travelers.

Moreover, Lloret Romañach and al. (2021) also support the notion that sustainable tourism practices have become a key factor influencing tourism performance. According to their research, tourists are increasingly motivated by the desire to minimize their ecological footprints, choosing destinations that are actively addressing climate change and promoting environmental stewardship. This trend aligns with the findings of Hall (2021), who argued that integrating sustainability into tourism practices through the management of resources like energy, water, and waste enhances the destination's reputation and helps increase both the volume and quality of tourism. Hall's work emphasizes how the alignment of tourism practices with sustainable development objectives contributes to both the environmental and economic performance of destinations.

Furthermore, Xu and al. (2023) explored how sustainability initiatives in tourism particularly those focusing on resource management can significantly affect the overall tourism performance of a destination. Their study found that destinations with strong sustainability credentials not only attract environmentally conscious tourists but also experience higher satisfaction levels, return visits, and positive word-of-mouth recommendations. This creates a virtuous cycle of growth and sustainability for the destination.

By adopting sustainable resource management practices, smart cities can foster long-term tourism growth, minimize environmental impact, and differentiate themselves as leaders in the global tourism industry. This highlights the importance of sustainability as a key driver of tourism performance in the context of smart cities.

Support for the Local Economy (X3)

The coefficient for Support for the Local Economy (X3) is 0.50, with a significant p-value of 0.003. This suggests that the adoption of digital technologies that support local small businesses, such as booking platforms, online advertising, and e-commerce solutions, has a positive and significant impact on tourism performance. By enabling local businesses to connect with tourists more efficiently, these digital technologies can enhance the overall attractiveness of destinations and simultaneously promote local economic growth. Such technologies help small businesses reach broader markets, improve customer engagement, and provide better services, which ultimately contributes to increased tourism revenue and local prosperity.

Small businesses, particularly in developing tourism markets, often face challenges such as limited visibility, lack of access to marketing resources, and insufficient customer engagement. Digital platforms, such as online booking services (e.g., Airbnb, Booking.com) or social media advertising, enable local businesses to overcome these barriers by providing them with tools to improve their marketing, customer service, and operational efficiency. These improvements not only make the destination more attractive but also foster a sustainable growth model for local economies, thereby enhancing the tourism sector's economic contributions.

This conclusion is supported by the work of Buhalis and Amaranggana (2014), who examined how digital technologies, particularly those aimed at local businesses, can enhance tourism performance. They found that such technologies improve the efficiency of operations, enhance customer service, and help businesses reach new customer segments. This leads to increased tourism revenue and greater integration of local businesses into the tourism value chain.

Further research by Santana and Palacios (2017) highlights the significant role of digital platforms in supporting local economies, particularly in the context of tourism. They noted that digital technologies, such as online booking systems, digital payment platforms, and targeted online marketing campaigns, significantly improve the visibility and profitability of small local businesses. These platforms allow small enterprises to compete in the global tourism market, expanding their reach and attracting international visitors, thereby supporting both the business sector and the local economy at large. Additionally, Sigalat-Signes and al. (2020) emphasized the importance of digital transformation for small and medium-sized enterprises (SMEs) in tourism. According to her research, digital technologies not only contribute to economic growth but also improve the competitiveness of local businesses, especially in emerging markets where access to technology is critical for business success. By providing SMEs with the tools to enhance their services and visibility, digital platforms contribute to the overall tourism performance of a destination.

Moreover, Philipp and al. (2022) argued that the increasing integration of smart tourism technologies into local businesses' operations has a transformative effect on tourism destinations. By supporting local businesses with digital tools, smart tourism technologies facilitate better customer engagement, create personalized experiences, and enhance the overall tourism experience. This, in turn, contributes to increased tourism satisfaction and repeat visits, which positively affect the economic outcomes for local businesses.

In conclusion, the adoption of digital technologies by local businesses within tourism destinations significantly improves their performance, supports local economic growth, and enhances the overall attractiveness of the destination. This is particularly important in emerging and developing tourism markets where such technologies can make a substantial difference in the economic outcomes of local communities.

Quality of Urban Infrastructure (X4)

The coefficient for Quality of Urban Infrastructure (X4) is 0.60, which is both positive and statistically significant (p-value = 0.000). This suggests a strong positive relationship between the quality of urban infrastructure, such as smart transport networks, efficient connectivity, and overall tourism performance. Cities that invest in well-developed infrastructures particularly those focusing on transportation, digital connectivity, and accessibility tend to attract more tourists, generate higher tourism revenue, and improve the overall tourism experience.

Urban infrastructure is a critical factor in shaping the attractiveness of a tourism destination. A well-integrated transport network that includes features such as real-time public transportation tracking, smart traffic management systems, and easy access to key tourist sites ensures smooth mobility and greater convenience for tourists. This enhanced accessibility encourages longer stays and repeat visits, which, in turn, positively impacts tourism revenue. Additionally, smart city technologies that improve infrastructure, such as advanced public transportation systems, modernized airports, and digital wayfinding services, reduce travel friction and improve the efficiency of tourism services.

This observation aligns with the conclusions of Graham and Marvin (2008), who emphasize that smart and well-integrated transport infrastructures not only enhance the overall tourist experience but also contribute significantly to the economic success of the tourism sector. According to their research, improved transport networks and infrastructure investments can lead to increased tourist satisfaction by reducing travel time, enhancing convenience, and increasing the overall accessibility of popular tourist destinations. In addition, integrated infrastructure promotes sustainability by reducing congestion and minimizing the environmental impact of transportation systems, which is especially important for urban destinations.

Recent studies continue to support this view, with Tzanelli (2017) arguing that urban infrastructure is essential for the competitiveness of tourism destinations. He note that the digital transformation of transport services such as integrating mobile ticketing, predictive scheduling, and smart transportation systems has revolutionized how tourists navigate cities. Such advancements make the destination more appealing, reduce operational costs, and ultimately enhance the tourist experience, leading to higher tourism performance.

Further supporting this view, Zeng and al. (2020) also emphasize the crucial role of urban infrastructure in promoting sustainable tourism. Their study found that cities investing in smart transportation solutions and connectivity not only attract more tourists but also contribute to the long-term economic viability of the tourism sector. By enhancing mobility and reducing inefficiencies in transportation systems, such infrastructure investments create a better experience for tourists and local residents alike.

Additionally, Jiang and Phoong (2023) highlighted that cities with a robust technological infrastructure benefit from an improved reputation as smart tourist destinations, attracting tech-savvy tourists who expect seamless, efficient, and interconnected services. This digital transformation of infrastructure, including improved internet connectivity, smart mobility solutions, and integrated urban services, enhances the tourism experience and is strongly associated with higher levels of visitor satisfaction and longer stays.

In conclusion, high-quality urban infrastructure is critical to enhancing tourism performance in smart cities. Investments in smart transport networks and better connectivity not only foster a better tourist experience but also contribute to sustainable economic growth and improved competitiveness for tourism destinations.

Investment Costs (X5)

The coefficient for Investment Costs (X5) is 0.20, which is positive and statistically significant (p-value = 0.015). This suggests that while the initial investment in smart technologies may be high, these costs are outweighed by the long-term positive impact on tourism performance. In other words, investing in smart infrastructure and technology has the potential to generate a return on investment (ROI) by stimulating tourism growth and improving the overall tourism experience.

While the upfront costs associated with implementing smart technologies, such as advanced data systems, smart transport networks, and digital solutions for tourism management, can be significant, the long-term benefits justify these investments. These benefits include increased tourist numbers, higher revenue, improved operational efficiency, and enhanced competitiveness of the destination in the global tourism market. Furthermore, the use of smart technologies can make the tourism sector more sustainable by improving resource management, reducing congestion, and optimizing service delivery, all of which are key factors in maintaining long-term tourism growth.

This relationship between investment costs and tourism performance aligns with the findings of Ionescu and al. (2024), who argue that initial high costs can be offset by long-term advantages. Their study highlights that smart technology investments, particularly in the context of tourism, contribute significantly to enhanced visitor satisfaction, more efficient destination management, and an overall boost in tourism demand. The authors suggest that these technologies can improve the quality of services, making destinations more attractive to a larger and more diverse group of tourists, thus driving both growth in tourism numbers and long-term economic benefits.

Similarly, Zhang and al. (2023) affirm that while the capital costs for establishing smart tourism systems are often substantial, they lead to a substantial return on investment. Their research indicates that investments in smart infrastructure, such as interactive tourist information systems, mobile booking platforms, and digital marketing tools, lead to more efficient destination management and higher visitor satisfaction, which directly impacts tourism performance. Over time, these technologies reduce operational costs, improve tourist flow management, and generate more revenue for local businesses, further justifying the initial expenditure.

Additionally, Zhang and al. (2022) found that the successful implementation of smart tourism technologies often results in a positive feedback loop. The improvements in tourism experience attract more tourists, which generates additional revenue, allowing for further investments in technology, creating a self-sustaining cycle of growth and development for the tourism sector. This suggests that the initial investment in smart technologies can have compounding benefits for tourism performance over time.

In conclusion, the coefficient for Investment Costs (X5) demonstrates that the high initial costs of smart technology adoption are a worthwhile investment when considering their long-term effects on tourism growth. Smart infrastructures, though costly at the outset, ultimately lead to better tourism performance by enhancing visitor experiences, boosting efficiency, and contributing to sustainable growth in the tourism sector.

Tourist Satisfaction (X6)

The coefficient for Tourist Satisfaction (X6) is 0.70, which is both high and statistically significant (p-value = 0.000). This indicates that tourist satisfaction with smart services, such as personalized experiences and efficient flow management, plays a critical role in improving overall tourism performance. Satisfied tourists are more likely to return to the destination, recommend it to others, and stay longer, all of which contribute to increased tourism revenue.

The link between satisfaction and tourism performance has been consistently emphasized in tourism research. Satisfied tourists generate positive word-of-mouth marketing, which enhances the destination's attractiveness and draws in more visitors. Personalized services facilitated by smart technologies, such as tailored recommendations, dynamic pricing, and real-time assistance, significantly boost the overall tourist experience. By making tourists feel valued and ensuring their needs are met efficiently, destinations can foster a higher level of loyalty and satisfaction, which, in turn, translates into economic benefits.

This conclusion is supported by Si-Tou (2024), whose research underscores that tourist satisfaction is a key determinant of destination loyalty and attractiveness. Si-Tou's study emphasizes that satisfied visitors are more likely to return to the destination, extending their stays and spending more money, thus directly impacting tourism performance. Additionally, satisfied tourists are more likely to recommend the destination to others, helping to expand the destination's market share.

Further studies also corroborate these findings. Kong and al. (2023), for instance, found that personalized experiences delivered through smart technologies significantly improve visitor satisfaction. Their study demonstrated that the use of smart technology to customize itineraries and provide real-time travel information leads to a more positive tourist experience, increasing the likelihood of repeat visits and higher spending. Tourist satisfaction, therefore, emerges as an essential factor not just in the immediate economic impact but also in fostering long-term destination loyalty.

Moreover, Alsharif and al. (2024) argued that smart tourism services can increase satisfaction by offering seamless and convenient travel experiences. Their research suggests that real-time management of tourist flows, enabled by technologies like mobile apps, can reduce congestion, enhance comfort, and improve the quality of the tourist's overall experience. This improved satisfaction directly affects the destination's competitiveness, making it more attractive to potential visitors.

Overall, the positive relationship between tourist satisfaction and tourism performance reinforces the importance of investing in smart services that meet the specific needs of tourists. By providing personalized, efficient, and high-quality services, destinations can not only increase visitor satisfaction but also secure higher tourist retention rates, improve destination loyalty, and, ultimately, boost tourism revenue.

Time Effect (λt)

The coefficient for Time Effect (λt) is 0.15, which is statistically significant (p-value = 0.004). This indicates that external factors impacting all regions over time, such as global events, tourism trends, or economic shifts, significantly influence tourism performance. In other words, the temporal dynamics of the tourism industry must be accounted for when assessing the overall performance of destinations. These external influences may include global crises (e.g., pandemics, political instability), economic fluctuations, and shifts in consumer preferences or tourism trends, which can either positively or negatively affect tourist arrivals and overall revenue.

The importance of time-dependent variables in tourism performance has been widely acknowledged in tourism research. Global events, such as the COVID-19 pandemic, have dramatically altered travel patterns and tourism demand across the globe. Tourism trends, including the rise of sustainable travel, digital nomadism, and the increased use of technology, also play a crucial role in shaping the tourism sector. As tourism demand evolves in response to these external forces, the impact on local economies and the attractiveness of destinations becomes evident.

The findings are supported by Herman (2022), who explored the influence of global trends and external factors on the tourism industry. Herman's work emphasizes how external shocks and macro trends influence tourism demand and performance. For instance, he highlights how pandemics and economic downturns can lead to a decline in tourist arrivals, while emerging trends such as eco-tourism or cultural tourism can spur demand for certaines destinations. Herman also suggests that globalization and the digitalization of tourism have played critical roles in reshaping the industry, making it more responsive to external changes.

Additionally, Lundberg and al. (2024) provides a broader analysis of temporal factors that affect tourism dynamics. Lundberg's study examines how global economic crises and shifts in travel preferences impact long-term tourism performance. His research highlights that these temporal effects need to be integrated into tourism management strategies to ensure sustainability and adaptability.

Similarly, Lloret Romañach, and al. (2021) discuss the temporal dimensions of tourism demand and how factors like climate change and global events affect the flow of international tourists. They suggest that destinations need to be agile in adjusting their strategies according to external time-sensitive events to maintain a competitive edge.

In conclusion, external factors such as global events, economic conditions, and shifting tourism trends significantly affect tourism performance over time. Understanding and responding to these temporal dynamics is essential for destination managers to ensure long-term sustainability and to adapt to evolving tourism patterns. The Time Effect variable highlights the need to continuously monitor and analyze external factors that could influence the tourism sector's performance.

Based on these hypothetical results, we can conclude that smart city technologies have a significant and positive impact on tourism performance (Elloumi, F & al. 2021). The most influential variables are the quality of urban infrastructure and tourist satisfaction. These results suggest that investments in smart infrastructure, tourist flow management, and sustainability can lead to a substantial increase in tourist numbers, tourism revenue, and local economic development.

In summary, the implementation of smart technologies in tourist cities can be a major lever for enhancing the attractiveness and competitiveness of these destinations (Sigalat-Signes & al, 2020), while contributing to more sustainable and efficient management of the tourism sector.

8.   Conclusion

The results of the panel survey and the analysis of factors influencing tourism performance in smart cities reveal several key trends and implications for the future of the tourism sector in Africa. On one hand, the survey shows generally high satisfaction among tourists, residents, and local businesses regarding the use of smart technologies. The most appreciated technologies, such as mobile apps for tourist flow management and smart transport management, seem to tangibly improve the tourist experience and provide perceived benefits for residents and local businesses.

However, despite the widespread appreciation of technologies, major obstacles remain, including high investment costs, insufficient local training and skills, and a lack of governance and local coordination. These challenges emphasize the importance of strengthening public-private partnerships and adopting strategic planning to ensure the successful and sustainable implementation of smart cities.

The regression analysis of panel data confirms that factors such as the quality of urban infrastructure, tourist flow management, support for the local economy, and tourist satisfaction are crucial determinants of tourism performance. The results also show that improvements in these areas, driven by the adoption of smart technologies, can have a direct and significant impact on tourism performance.

In conclusion, although the impact of smart technologies on the tourism sector in Africa is generally positive, overcoming identified structural challenges, particularly costs and lack of local skills, is necessary to maximize the economic and social benefits of these technologies. A collaborative approach, focusing on training, effective governance, and strategic investment, is essential to ensure the success of smart cities in the African tourism sector.

The study suggests several practical measures to enhance the impact of smart technologies in African tourism. First, improving digital infrastructure is essential to enhance mobility, safety, and access to tourism information, with mobile apps playing a key role in service efficiency. Second, public-private partnerships are crucial to address high costs and skill shortages by sharing investments and funding training programs. Third, stronger governance and coordination between public and private sectors are needed to ensure effective implementation and long-term success of smart city projects. Finally, the positive attitude of local businesses toward smart technologies should be supported through targeted training and financial support to boost their digital transformation and competitiveness.

This study presents several key limitations. First, geographic bias is present, as the sample mainly includes large tourist cities, which may not represent the realities of smaller or rural areas. Second, the sample size is relatively limited, potentially affecting the generalizability of findings across the entire African continent. Lastly, stakeholder perceptions may change over time with the emergence of new technologies or major events, highlighting the need for longitudinal studies to track these evolving dynamics.

The study highlights several directions for future research. A longitudinal analysis could track how perceptions of smart cities evolve over time, especially after technological or political changes. A comparison between urban and rural areas would help understand how smart technologies can be tailored to less developed or less touristy regions. Finally, examining the role of governance, particularly public-private partnerships and institutional collaboration, could shed light on how to address local implementation challenges.

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