Research Paper: Smart Mobility Solutions in Konza City: Economic and Consumer Behaviour Trends

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ABSTRACT

The adverse impacts of climate change have prompted smart cities worldwide to transition from conventional transportation systems to smart mobility systems. Smart mobility systems are seen as a gateway to sustainable transportation modes for smart cities globally. Urban areas encounter numerous challenges when it comes to moving people efficiently. Prominent among these challenges are traffic congestion and greenhouse gas emissions. Smart mobility gives the authority advantages such as promoting innovation, generating revenue, and alleviating traffic congestion. The market share for smart mobility is steadily expanding, with expectations that it will grow from 57 billion USD to 345.63 billion USD by 2032. Several smart mobility systems are being integrated, including Autonomous Vehicles (AVs), Electric Vehicles (EVs), Bus Rapid Transit (BRT), Mobility-as-a-Service (MaaS), Micro Mobility Solutions such as E-scooters and bikes, Internet of Things (IoT), Dynamic pricing systems, demand-responsive systems, wireless sensor networking, Cloud Computing, Big Data technology, and Artificial Intelligence. Smart Mobility systems offer economic advantages such as cost reduction, increased revenue generation, enhanced efficiency, job creation, and environmental conservation. Furthermore, the integration of smart mobility systems influences consumer behaviour. Age, flexibility, costs, reliability, trust, and reputation are pivotal in shaping consumer habits and behaviours. This paper presents recommendations categorized into five pillars: infrastructural development, data management and analysis, regulatory framework, user engagement, and monitoring and evaluation. However, there are challenges that authorities may encounter when integrating smart mobility systems, including E-waste generation, data privacy concerns, budget constraints, difficulties in adopting foreign ITS systems, stakeholder coordination, and keeping pace with technological advancements.

Keywords: Smart mobility systems, , sustainable transportation modes, consumer behavior, , Mobility-as-a-Service, traffic congestion,

1. Introduction.

Smart Mobility Technologies encompass cutting-edge technologies that have the potential to transform transportation systems in Konza City. This concept covers various modes of transportation enabled by wireless communication and leverages real-time data analytics and machine learning to enhance safety and efficiency in transportation. Across the globe, smart cities are increasingly prioritizing the development of sustainable transportation infrastructure to address longstanding challenges associated with urban transport. Integrating smart mobility technologies in Konza City presents an opportunity to revolutionize transportation systems and enhance the quality of transportation services for its residents.

2. Overview of Smart Mobility and Transportation Economics.

Conventional transport economics systems face challenges in solving problems associated with Urban transport systems since they rarely measure the economic efficiency gains that support strategies geared toward evaluating higher-value trips and more effective transport systems. In the long run, this feature creates challenges in developing transport systems that consumers desire but do not realize. Smart mobility systems have gained recognition from policymakers and urban planners recently. The concept is gradually being introduced in urban planning development projects, making it an essential feature in transport infrastructure systems used in Konza City. Smart mobility technology offers a new paradigm in transportation economics that can help redefine transport structures developed and utilized in Konza City.

3. Relevance and Importance of Smart Mobility Systems to Konza City.

In the modern world, cities face challenges ensuring citizens move effectively and efficiently. The rise of urban areas brings myriad challenges that governments are trying to solve. It has brought an influx of congestion due to the rise in private ownership of vehicles and increased environmental pollution. Modern technology has drastically revolutionized the movement of people, making traditional transport services struggle to keep pace with the demands of an ever-growing population witnessed in urban areas. The importance that smart mobility systems will have to Konza City includes the following:

3.1. Promote Innovation

Smart mobility and transportation economics are essential for Konza City as they are instrumental in developing sustainable transportation systems. The Konza Technopolis Development Authority (KoTDA) should prioritize the seamless movement of residents and goods within the city. Integrating smart mobility solutions within transportation economics presents an innovative avenue for KoTDA to leverage advanced technologies and enhance the overall quality of life and services in Konza City.

3.2. Improve the Quality of Life in Konza City

Efficient urban mobility is one of the factors that will influence the quality of life in Konza City. Using conventional transportation systems can cause challenges in mitigating common problems that urban transport cities face. Once Konza City is completed, the population will gradually increase, creating many issues for the Konza Technopolis Development Authority (KoTDA). Therefore, this creates an urgency and need for the authority to invest in robust public transportation infrastructures.

3.3. Adapt to technological advancements in the transport sector.

Konza Technopolis has taken the necessary steps to integrate smart mobility systems. However, the technology sector is evolving rapidly, making it imperative for the authorities to continually adapt to these changes and incorporate the latest technology in the transportation sector. Smart cities worldwide are consistently engaged in innovative research to pave the way for the next generation of ICT solutions.

As a response to this dynamic environment, technology organizations have embraced Technology Road Mapping (TRM) as a framework to support the research and development of future technologies and products that can provide a sustainable competitive advantage. Recent research conducted on manufacturing organizations in the United Kingdom revealed that 80% of these entities routinely utilize the TRM framework in their operations to keep pace with new and emerging technologies (Lee, Phaal & Lee, 2013).

Smart mobility systems present an opportunity for the authorities to establish such a framework. This framework will facilitate brainstorming sessions to identify emerging technologies that offer optimal solutions for enhancing the mobility of people and goods within Konza City. As smart mobility technologies continue to evolve in the future, having such a framework in place will be invaluable.

3.4. Eliminate congestion and inefficiencies in Konza City

Smart mobility systems empower urban planners to create a highly efficient automobile navigation system, catering to the transportation modes and trends that align with the needs, aspirations, and concerns of the city's residents (Biyik et al., 2021). Konza Technopolis aims to be Kenya's pioneering smart city, integrating advanced urban infrastructure to alleviate congestion and enhance service delivery to its residents. At the forefront of addressing traffic-related challenges, Konza Technopolis is actively implementing smart mobility solutions. These include a comprehensive traffic management program, purpose-built parking structures, and an internal transit system, all of which equip the city with the essential tools to combat traffic congestion (Konza Technopolis Development Authority, 2021).

3.5. Promote environmental sustainability.

The transportation sector stands as a significant contributor, responsible for 75% of global greenhouse gas emissions (UNEP, n.d.). Konza Technopolis has proactively implemented measures aimed at reducing greenhouse emissions by embracing sustainable infrastructure, thereby mitigating the adverse

impacts of climate change. To achieve this goal, authorities are harnessing innovative technology to develop a sustainable city through the implementation of smart transport systems designed to curtail carbon emissions.

Kenya has witnessed a concerning upward trajectory in carbon emissions, with the transport sector being accountable for 80% of the overall carbon emissions growth (Njogu, 2023). This concerning trend poses challenges to the promotion of environmental sustainability within urban areas. Smart mobility systems play a pivotal role in environmental conservation by decreasing carbon emissions through the adoption of eco-friendly transportation methods, such as electric vehicles (EVs). Notably, there has been a surge in the demand for EVs in Kenya, with estimates projecting that electric vehicles will comprise 60%-70% of total vehicle sales by 2040 (Njogu, 2023). With plans to encourage the use of EVs in Konza City, Konza Technopolis is poised to lead the charge in leveraging this heightened demand for EVs to support environmental conservation initiatives.

4. Current areas of opportunities for Konza Technopolis.

4.1. Technological advancements and Market Trends

Several technological advancements have led to different types of smart mobility models that can be utilized in Konza City. The types of smart mobility technologies that have been developed and created include:

- ***Autonomous Vehicles (AV)***

AVs are self-driving vehicles equipped with computer algorithms and AI that enable them to operate autonomously. Organizations like Tesla have successfully implemented autopilot AI systems, allowing vehicles to drive themselves when needed. Implementing such technology in smart cities can reduce accidents and improve road safety.

- ***Electric Vehicles (EVs)***

EVs are predicted to be the future of transportation, with many global car manufacturers planning to phase out fossil fuel-based vehicles by 2050. They offer a sustainable approach to reducing carbon emissions, conserving the environment, and enhancing air quality. In Kenya, EV sales have seen a remarkable 108% increase in 2022-2023, according to the National Transport and Safety Authority (The Standard, 2023).

- ***Bus Rapid Transit (BRT)***

BRT systems provide fast, comfortable, and cost-effective transit services by leveraging intelligent transportation systems (ITS) technologies. Examples of cities implementing BRT systems include Dar es Salaam in Tanzania, which enhances transportation services for its citizens.

- ***Mobility-as-a-Service (Maas)***

Maas involves digital platforms that offer integrated transportation services, enabling residents to plan, book, and pay for various transportation options from a single platform. Konza City can benefit by creating such a platform for its residents.

- ***Micro Mobility Solutions***

Micro Mobility Solutions uses e-scooters and e-bikes, facilitating convenient short-distance travel within urban areas.

- ***Internet of Things (IoT)***

IoT technology can improve transportation services by deploying a network of sensors to monitor traffic flow. It also enhances security in public transport by tracking and monitoring vehicles.

- ***Dynamic Pricing Systems***

Dynamic pricing systems adjust transportation prices based on demand, time of day, and traffic conditions. Konza City can implement such a pricing model to optimize transportation services.

- Demand Responsive Systems

Demand-responsive systems use computer software and AI to collect data on transportation demand patterns and offer flexible on-demand transportation solutions. Companies like Uber and Bolt use this pricing system.

- ***Wireless Sensors Networking***

This technology involves fitting vehicles or roadside sensors with wireless units to collect traffic surveillance and management data.

- ***Big Data Technology***

Big data is revolutionizing the transport sector by predicting disasters accidents, optimizing travel routes, and minimizing emissions through machine learning and data analysis.

- ***Artificial Intelligence***

AI is pivotal in smart mobility, from powering AVs to optimizing travel routes and improving transportation services based on user behaviour.

4.2. Changing Consumer preferences Opportunities

Smart mobility is an emerging field that is steadily evolving. New technologies are being developed and integrated to address contemporary challenges in conventional urban transportation. Market trends in smart mobility are shifting from focusing on reducing traffic congestion, optimizing routes, and reducing ecological footprints to promoting active and inclusive mobility. This shift includes encouraging the use of environmentally friendly fuels and enhancing citizen engagement (Paiva et al., 2021). Smart mobility models are being developed using cutting-edge technologies like Big Data, the Internet of Things (IoT), Artificial Intelligence, and Blockchain Data (Paiva et al., 2021).

The concept of mobility is evolving within organizations and governments, with a growing emphasis on treating it as a service provided to citizens. It is anticipated that ongoing technological advancements

will transform how traffic flow is optimized and how logistics and vehicles are manufactured and developed in the future. The rapid population growth in urban areas will drive the need for new transportation routes, optimization of vehicle algorithms, and effective traffic management (Paiva et al., 2021).

Scholars and researchers argue that the evolution of smart mobility systems will be shaped by two key approaches in the coming years. The first approach will focus on solutions for transporting goods, services, and people efficiently. The second approach will target a paradigm shift in the transportation of people, transitioning towards mobility as a service (Paiva et al., 2021). This shift is also expected to lead to changes in vehicle design, with future vehicles likely to be smaller, lighter, and more autonomous, potentially reducing the prevalence of private vehicle ownership as mobility transitions to a service-oriented paradigm (Paiva et al., 2021).

Opportunities also arise in the way consumers choose transportation modes when traveling from one place to another. One significant opportunity lies in the proliferation of Information Technology. In recent years, the use of smartphones has dramatically transformed the transport sector, making smart mobility services like ridesharing and carpooling the preferred choices for consumers.

Smart mobility apps play a vital role in addressing the issues associated with the shortcomings of public transportation, such as overcrowding (Schulz et al., 2020). Schulz et al. (2020) reported that conventional transportation modes often fail to provide transportation services from origin to destination.Smart mobility apps and systems centered on providing car-sharing services offer personalized and dynamic trip recommendations from the point of origin to the destination. Moreover, they cater to individual needs and preferences, being fast, cost-effective, and environmentally friendly (Schulz et al., 2020).

4.3. Market Overview and Future Outlook Opportunities

The growth of smart mobility systems is poised for significant expansion, with the market size projected to soar from 57 billion USD to a substantial 345.63 billion USD by 2032. This reflects a remarkable growth rate of 19.8% between 2023 and 2032. Among the key contributors to this growth, smart solutions geared towards traffic management account for a substantial 31% of the revenue share, while ride sharing makes up 36%. Notably, North America commands the largest market share at 40%, with the Asia-Pacific region holding a substantial 21% market share (Precedence Research, 2022).

Figure 1. Smart Mobility Market Size from 2023-2032

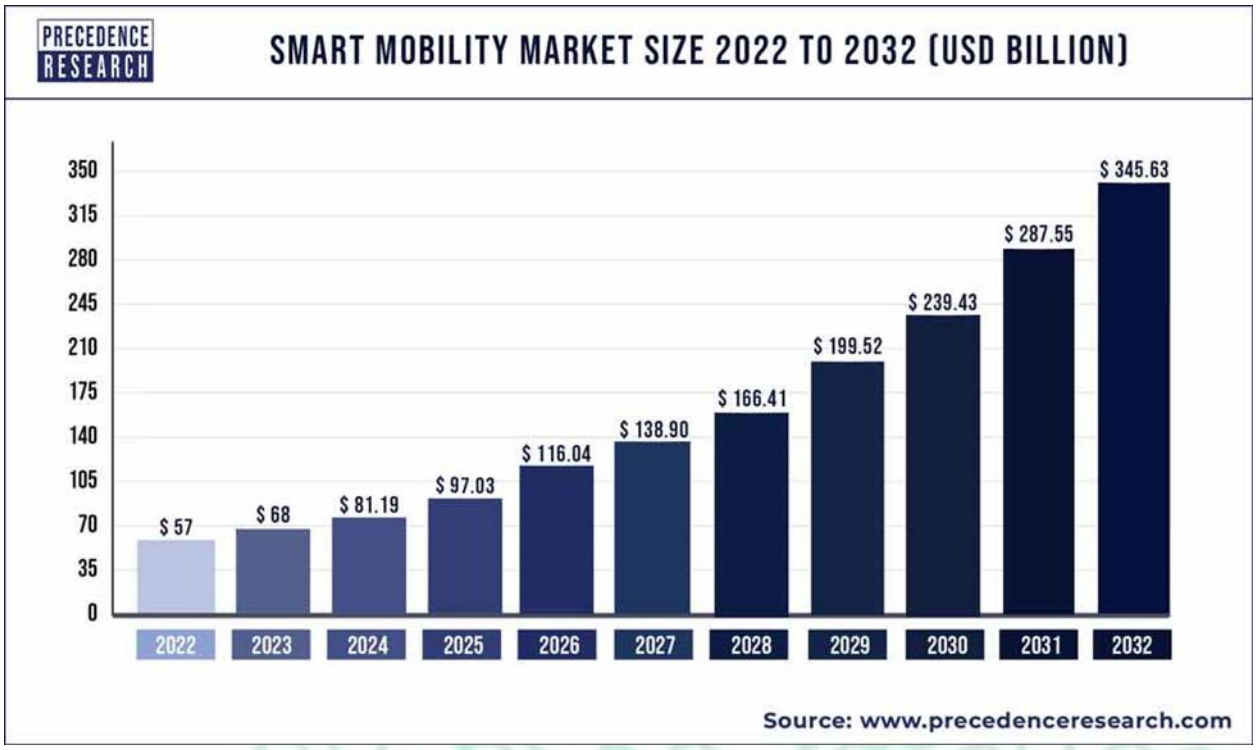


Figure 2. Smart Mobility Market Share by Element.

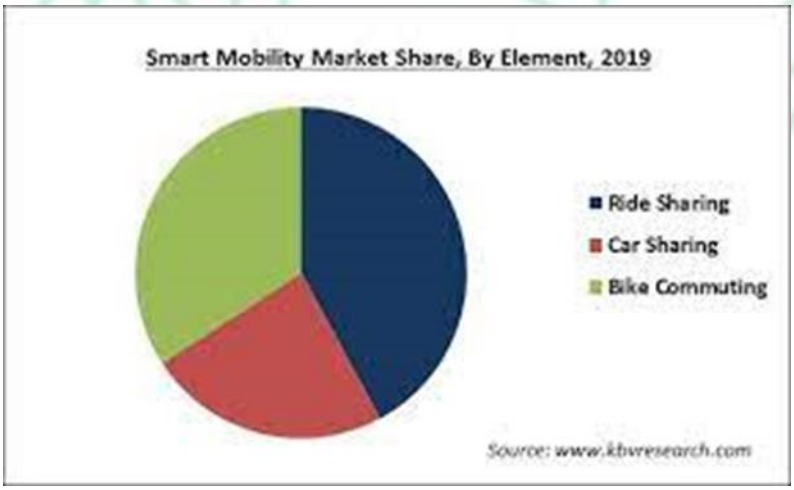
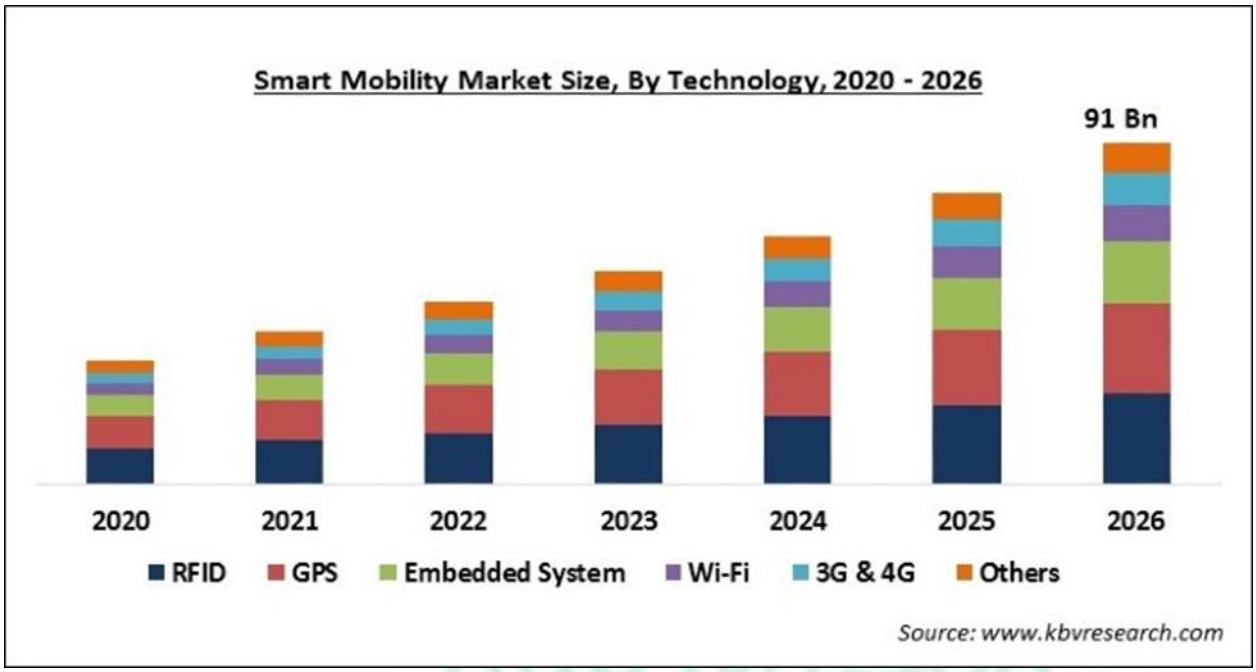


Figure 3. Smart Mobility Market Size by Technology from 2020-2026



4.4. Policy Opportunities.

4.4.1. National level policy opportunities.

The Kenyan government has initiated the development of a national smart mobility policy as part of the Bottom-up Economic Transformation Agenda (BETA), offering various opportunities for the authorities. In August 2023, the national government established a 15-member taskforce to create Kenya's First National Electric Mobility Policy, which is expected to submit its findings to the Ministry of Transport in the coming months (ESI, 2023). This policy is poised to benefit Kenya's transportation sector by increasing the production of renewable energy by 90% (ESI, 2023). Furthermore, the Finance Act of 2019 has played a significant role in reducing excise duty on Electric Vehicles (EVs) from 20-35% to just 10%, making EVs more affordable for local consumers. An ongoing revision of the Integrated National Transport Policy is also in progress to include provisions for electric vehicles and the necessary infrastructure to support e-mobility (KIPPRA, 2023).

4.4.2. Regional Level Policy Opportunities.

Africa is at the forefront of creating innovative policies to support sustainable transportation. The Sub-Saharan Africa Transport Policy Program (SSATP) stands as Africa's primary transport policy initiative and provides a conceptual framework that Konza Technopolis can draw upon. SSATP introduces EASI as a robust conceptual framework to drive transport policies in Konza City. EASI, an acronym for "Enable, Avoid, Shift, and Improve," encompasses a comprehensive approach to transport policy:

"ENABLE" focuses on establishing transport policies that enable the creation of an effective and responsible government system capable of assessing needs, guiding actions, and ensuring integrated management and development of the urban transport system.

"AVOID" concentrates on policies aimed at reducing individualized motorized travel through appropriate land use.

"SHIFT" centers on initiating transport policies that encourage the use of non-motorized transport modes like walking and cycling.

"IMPROVE" centers on transport policies that enhance the efficiency and safety of transport modes while minimizing their environmental footprint (Stucki, 2015).

4.4.3. International Level Policy Opportunities.

On the international stage, the Global Roadmap of Action Toward Sustainable Mobility (GRA) stands as a vital policy tool that allows countries to achieve sustainable mobility. This tool presents significant opportunities for Konza Technopolis, as it enables the authority to measure its progress towards sustainable mobility in Konza City. It also allows the authority to explore 180 practically tested policy measures from around the world and prioritize those that have the most significant impact. GRA further provides a decision-making framework for effective policy decisions and a Global Tracking Framework for Transport to monitor country-level progress. This framework can be used by the authority to benchmark its progress against other smart cities globally (The World Bank, 2020).

5. Unlocking Opportunities for Konza Technopolis in the Smart Mobility space.

Konza Technopolis has taken the necessary steps to implement effective smart mobility systems in Konza City. The Authority is a leading force in promoting sustainable transportation systems in Kenya by establishing high-quality transport infrastructure within Konza City. Their primary objective is to develop a comprehensive physical development plan for public transport and create high-density activations along designated corridors.

Furthermore, the Authority is committed to implementing a comprehensive traffic management program to alleviate traffic congestion. This program includes the construction of parking structures to ensure efficient vehicle parking, the introduction of Bus Rapid Transit, and transit hubs, and the promotion of hybrid and electric vehicles to foster e-mobility in Konza City (Konza Technopolis Development Authority, 2021). Leveraging these measures, the authority is well-positioned to harness the opportunities offered by smart mobility systems.

To become a prominent figure in the regional and international smart mobility space, Konza Technopolis can employ the following strategies to initiate innovative discussions and preparations:

*i. **Webinars and roundtable***

These discussions serve as essential platforms for fostering conversations on smart mobility. KoTDA can facilitate the dissemination of knowledge, and engagement with stakeholders, and provide accessibility to a diverse audience interested in learning about smart mobility.

- Theme: KoTDA can propose a central theme for these webinars and roundtables. For instance "Navigating the Future: Building Sustainable, Connected, and Inclusive Smart Mobility Systems" effectively encapsulates the core of smart mobility advocacy. The theme highlights key aspects that are essential for the development of sustainable, efficient, and accessible transportation solutions.
- Target audience: The Authority should consider inviting participants actively involved in the smart mobility space to the proposed sustainable smart transport webinars and forums. Some Potential participants include private sector representatives, such as Super Metro, known for their significant initiatives in promoting e-mobility in the country. Super Metro, the leading transport service company in Kenya, has already launched electric buses for transportation within Nairobi and its environs. Other key participants should encompass government representatives from the Ministry of Transport, urban planners, policymakers, industry experts, academicians, researchers, and industry agencies like BasiGo, Ecoboda, Nopea Ride, Kiri Electric, Roam Rapid, and Opibus.

6. Economic Impacts of Smart Transportation Solutions.

6.1. Reduces Costs:

Smart mobility systems are highly effective in cost reduction. One significant way they achieve this is by minimizing energy consumption for vehicles. The adoption of EVs offers a cost-effective solution for motorists, reducing fuel consumption and maintenance expenses. Moreover, mobility systems like ride-sharing and dynamic pricing models contribute to overall cost reduction for residents using transportation services. The consumer surplus theory explains this cost-effectiveness, highlighting that consumers experience added value when they pay less for products or services. Smart mobility systems result in more affordable transportation services for Konza City residents, allowing the authority to introduce lower travel costs.

6.2. Increased Revenue Generation

Smart mobility systems also provide revenue generation opportunities for the authority. For instance, dynamic and demand-responsive pricing models serve as revenue sources that the authority can leverage. These pricing models offer opportunities for profit maximization. Additionally, digital

platforms facilitating booking and route development allow consumers to make payments through them, further generating income for the authority. The revenue generated can vary based on the demand for transport services during a given period. It is estimated that the implementation of Intelligent Transportation System (ITS) will provide a Net Present Value (NPV) amounting to 52.2 million USD with an average of 24.24% in economic Internal Rate of Return.

6.3. Improves Efficiency

Smart mobility systems enhance the efficiency of urban transport systems by collecting real-time data for monitoring and predicting traffic conditions. They also provide dynamic route guidance and improve the overall transportation experience for Konza City residents. The impact of these systems aligns with concepts from Microeconomics, particularly the principle of dynamic pricing, where transport services respond to the laws of supply and demand.

6.4. Enhances sustainability and helps conserve the environment.

Smart Mobility systems are being used to reduce carbon print. The use of EVs can help reduce the emission of greenhouses and help curb the adverse impacts of climate change. Estimates point out that the use of EVs can help curb carbon emissions by 30%. Further, the use of EVs can help improve the quality of air which can help in reducing 150,000 premature deaths that result from air pollution (Carrey, 2023). Smart Mobility systems uses the concept of the Tripple Bottom Line model (TBL) which incorporates the social, environmental, and financial factors to transport infrastructure whereby an organization monitors the impact of their business operation in relation to their social and environment impacts on surrounding environments (Slapper & Hall, 2011).

7. Behavioural changes in adopting smart mobility systems.

7.1. How the introduction of smart mobility systems influences commuting habits and travel behaviour.

7.1.1 Reduced Car Ownership

The rate of car ownership is undergoing rapid change, primarily driven by the evolving dynamics within the transportation sector. Conventional ownership is experiencing a significant shift towards Mobility-as-a-Service (MaaS), which is encouraging commuters to transition from private ownership to utilizing public transport. MaaS has become deeply integrated into modern society, altering the perception of vehicle ownership and promoting convenient mobility from one location to another (Christensen, Friis & Nielsen, 2022).

The shift away from private ownership can be primarily explained by practice theories. These theories suggest that commuting behaviors and practices influence the psychological attachment to private vehicle ownership. Mobility practices are woven into everyday life, shaping commuter choices towards modes of transportation that are faster, healthier, and more convenient. MaaS offers reliable and

convenient public transportation and ridesharing services, thereby contributing to the reduction in car ownership numbers, especially in urban areas.

7.1.2. Enhanced Personalization.

Age indeed plays a significant role in technology adoption, with younger generations showing a greater inclination toward embracing modern technology compared to their older counterparts. This phenomenon can be attributed mainly to the social influence that younger generations wield in driving the adoption of modern technology, leading to a higher frequency of usage of smart mobility systems among them. Additionally, younger generations tend to have a better grasp of the cost-effectiveness associated with using smart mobility systems, making such services more appealing to them. This is particularly relevant because younger individuals often have lower purchasing power compared to older generations.

Research findings support this trend, with estimates indicating that individuals aged 18 to 24 are more inclined to utilize ride-sharing services due to their cost-effectiveness (Azimi, Rahimi & Jin, 2021). Consequently, Generation Z is expected to form the largest consumer base for demand-responsive systems and public transportation in Konza City, followed closely by millennials.

7.1.3. Reduced Environmental Impact.

Smart mobility systems encourage eco-friendly vehicles and bicycles, leading to reduced greenhouse gas emissions and sustainable transportation options in Konza City.

7.1.4. Reduced Parking demand.

By promoting alternative transportation modes like ride-sharing and public transport, smart mobility systems help reduce car ownership, alleviating parking challenges in urban areas. The Internet of Things (IoT) and smart devices facilitate efficient parking reservations.

7.2. Shifts in modal choice, including the use of public transit, shared mobility, and personal vehicles.

7.2.1. Increase in Public Transit Use.

Smart mobility systems make public transit, such as Bus Rapid Transit (BRT), an attractive option due to features like segregated running ways, specialized stations, and unique fare collection systems. These characteristics influence commuters to choose BRT as a favored mode of transportation in urban areas.

7.2.2. Rise in Shared Mobility services.

Ride-sharing services discourage personal vehicle use and are experiencing significant growth. They improve transportation options in Konza City and stimulate the emergence of dynamic ride-sharing start-ups, making shared mobility more accessible and affordable.

7.2.3. Increased Use of Active Transportation.

Smart mobility systems promote healthier commuting habits by enhancing pedestrian and cycling infrastructure. This encourages residents to go cycling or walking, fostering positive physical well-being.

7.2.4. Changing Demographics.

The adoption of smart mobility systems will directly and profoundly impact Generation Z and millennials, as they are more inclined to embrace technology-driven solutions. It's worth noting that Generation Z is the largest population group in Africa, representing approximately 31.20% of the continent's population, followed closely by millennials at 20.49% (Association of Kenya Insurers, 2021). Given this demographic reality, the delivery of smart mobility services will be mainly influenced by Generation Z and millennials. Environmental awareness is also changing behaviors in how commuters use transport systems. More than ever, modern society is more aware of the need to be environmentally conscious to prevent the adverse impacts of climate change. This feature influences people in urban areas to use sustainable modes of transportation like electric vehicles, scooters, and bike-sharing platforms.

7.3. Factors influencing user acceptance and preferences.

7.3.1. Age.

Age is an instrumental factor that influences technological acceptance. Therefore, setting up transportation systems that align with different ages is vital. For example, promoting ridesharing among younger populations would be more considerate than in older generations because younger generations are more prone to accept technology-enabled solutions.

7.3.2. Ease of Use and Accessibility.

Users typically prefer transport systems that are easy to use and are easily accessible. As a result, consumers will choose to use demand-responsive systems that help book and plan their traveling and use public transit systems like BRT, which are easily accessible.

7.3.3. Cost Effectiveness.

Consumers will always choose services or products that are cheap to them. Smart mobility systems are affordable since the means to produce transport services are usually reduced, making it easy to introduce cost-effective traveling prices to consumers.

7.3.4. Reliability and Punctuality.

Smart mobility systems need to be of higher performance. Speed and reliability are major factors that consumers set their needs and preferences when using transport services. As such, commuters will prefer smart mobility systems that reduce the waste of time when traveling.

7.3.5. Flexibility.

Consumers like transport services that are convenient, and which adjust to their time and their plans. Commuters might prefer demand-responsive systems that allow them to adjust their travels based on their desired time than those with fixed timelines.

7.3.6. Trust and Reputation.

Commuters prefer reputable transport systems. For instance, commuters might have a high preference for technological solutions that have a strong brand. For example, commuters might purchase EVs like Tesla, which has a stronger brand and reputation than other EVs.

7.3.7. Attitude.

Attitude is an important factor that influences consumer behavior in the use of smart mobility services. Attitudinal factors such as environmental concerns, technology-based lifestyle and perceived easiness increase the propensity for commuters to use ride sourcing services. On the other hand, attitudinal factors like inclination to use and own private cars and data privacy concerns reduce the propensity for commuters to use ride sourcing services (Azimi, Rahimi & Jin, 2021).

7.3.8 Culture of use.

The culture of using ICT systems determines technological adoption of smart mobility systems in Konza City. A culture of not using ICT systems affects the morale of using newer forms of ICT systems (Muriithi, Horner & Pemberton, 2016).

7.3.9 Social Influence.

Social influence plays a major role in adopting new technologies. People will generally adopt technologies that are widely used by other people in society. Social influence is predominant in areas where the use of technology is mandatory, and people must conform to newer technologies due to social pressure (Muriithi, Horner & Pemberton, 2016). The rampant use of smart mobility systems as the only convenient transport mode and elimination of traditional transport systems in Konza City will create the needed social pressure for residents to use the technological systems set in place to allow free movement of goods and people.

8. Recommendations.

1. Create Sustainable Smart Mobility Infrastructure Dimensions:

a) -The first crucial step is to establish diverse dimensions for the application of sustainable smart mobility infrastructure which can be subdivided into the following categories

b) The environmental dimension focuses on integrating smart infrastructure to improve air quality and reduce greenhouse emissions (Tarek & Nasreldin, 2023).

c) The social dimension involves incorporating smart mobility systems that enhance safety and promote social cohesion (Tarek & Nasreldin, 2023). The technological dimension entails integrating various technologies, expanding transportation options, and enhancing service responsiveness to meet existing demand (Tarek & Nasreldin, 2023).

d) The economic dimension involves integrating smart mobility systems aimed at cost reduction and increased efficiency (Tarek & Nasreldin, 2023).

e) The urban dimension focuses on smart mobility systems that improve service coverage, offer diverse transportation modes, enhance service flexibility, reduce travel time, and alleviate congestion.

2. Implement Smart Mobility Strategies:

f) The next step is to develop strategies for the integration of smart mobility systems, which can be categorized as follows:

g) Parking and Access Management: Incorporate parking sensors and a real-time parking information system.

h) Centralized Traffic Management System: Utilize technologies such as Vehicle-to-Infrastructure (V2I), AI, and IoT for real-time traffic control, including traffic monitoring, intersection control, and transit connections.

i) Digital Platforms and Apps: Create and maintain digital platforms and apps supporting Mobility as a Service (MaaS), enabling residents to plan, book, and pay for transport services.

j) Data Integration and Sharing: Establish data sharing protocols among transport providers to facilitate easy access to real-time information for motorists and commuters.

k) Payment and Ticketing Systems: Implement integrated payment and ticketing systems, including demand-responsive and dynamic pricing models, to optimize revenue based on demand.

l) Open Application Programming Interfaces (APIs): Develop public APIs to encourage third-party developers to innovate and contribute to technology advancement in Konza City.

m) Public Transport and On-Demand Services: Introduce smart public transport network access, such as Bus Rapid Transit (BRT), and develop an information management system for data exchange and distribution.

n) Carpooling and Car/Bike Sharing Services: Promote car and bike sharing services through demand-responsive systems.

4. ***Regulatory Framework:***

a) Create regulations and standards for smart mobility technologies like electric vehicles (EVs), e-scooters, and electric bikes.

b) Develop standards and policies to safeguard data privacy.

c) Implement regulations governing ride-sharing transport services, including background checks of drivers, insurance requirements, and pricing transparency.

d) Offer incentives, subsidies, and tax breaks to encourage electric vehicle adoption. Promote Transportation Demand Management policies to reduce traffic congestion and encourage sustainable commuting.

e) Enforce accessibility standards for transportation infrastructure and services to accommodate individuals with disabilities.

f) Implement policies to manage parking spaces.

g) Develop standards for smart infrastructure.

h) Foster private partnerships with companies to drive innovation and investment in smart mobility solutions.

5. ***User Engagement:***

a) Behavior Assessment: Monitor user behavior by identifying relevant metrics such as active users, user retention rates, and user feedback.

b) City-Specific User Habits: Identify common habits among city users and align them with desired behaviors based on city strategies.

c) Programming Visual Language: Create a compelling visual language for demand-responsive, expressive, easy-to-understand, and flexible systems.

d) Develop tools and systems to assess the effectiveness of engagement campaigns.

6. Monitoring and Evaluation:

a) Develop measures for motor travel and congestion reduction.

b) Establish pollution abatement measures.

c) Ensure regular road maintenance.

d) Define performance metrics aligned with smart infrastructure goals.

e) Promote regular vehicle maintenance among vehicle owners.

f) Enforce regulations on safety features installation in vehicles.

g) Establish clear procedures for reporting accidents and emergency response services.

h) Conduct periodic vehicle inspections.

i) Regularly assess the security and cybersecurity measures of smart infrastructur

8.Challenges.

- **E-waste generation**: Using digital systems and electronics presents significant challenges in waste management. Electronic waste is the fastest-growing waste production due to the rising demand for electronic devices. According to the United Nations, e-waste generation has surged, reaching 53.6 million metric tons in 2019, marking a 21% increase since 2015. Furthermore, projections suggest that e-waste generation will continue to rise, potentially reaching 120 million metric tons by 2050 (Ghulam & Abushammala, 2023). This poses a significant risk for the authority as it introduces a new problem that could have far-reaching implications for the environment in Konza City. Electronic waste contains toxic components and contributes to greenhouse gas emissions, with digital devices like desktops and smartphones accounting for up to 31% of these emissions (Ghulam & Abushammala, 2023). It is imperative for the authority to implement effective strategies to manage electronic waste, mitigating adverse impacts on both human health and the environment for Konza City residents.
- **Data Privacy Issues** : The utilization of big data raises ethical concerns regarding data usage. The Kenya Data Protection Act mandates data controllers and processors to handle data legally. This legislation compels organizations acting as data controllers and processors to seek

consent from consumers and inform them about how their data is being utilized. Failure to adhere to ethical practices in big data usage can result in ethical dilemmas for the authority. Establishing robust protocols, standards, and regulations to foster responsible data use and enhance accountability is essential.

- **Budget Constraints**: Securing adequate funds for developing smart mobility systems poses a challenge, particularly for developing countries. The substantial capital required for investing in smart mobility systems presents financial constraints that must be addressed.
- **Stakeholder Coordination Difficulties**: ITS initiatives involve numerous stakeholders, and poor coordination can result from a lack of cooperation and effective communication among these stakeholders. To address this issue, the authority should establish a well-defined organizational structure that clearly outlines the roles and responsibilities of each stakeholder.
- **Keeping Pace with Technological Advancements**: The authority may encounter challenges in keeping up with the latest technology, as prolonged use of ITS systems may lead to obsolescence. To address this, it is essential for the authority to strike a balance between utilizing current technologies and planning to integrate newer technologies in the future. This strategy will ensure the long-term sustainability of technological advancements for Konza City.

Conclusion

Smart mobility systems are crucial for enhancing Konza City's transportation landscape. Like many urban areas, the city grapples with transportation challenges, from traffic congestion to environmental impacts. Traditional transportation systems exacerbate these problems. By embracing smart mobility systems, Konza City can establish a sustainable transportation framework that enhances residents' convenience and mitigates the environmental toll of transportation. This shift aligns with global trends, as smart cities worldwide adopt these systems to tackle urban transportation issues.

Moreover, the vehicle industry is undergoing a transformation, with a growing focus on transitioning from fossil fuel-based vehicles to electric vehicles (EVs). This global shift includes commitments to phase out traditional vehicles by 2050.Considering these trends and the city's need for efficient, environmentally friendly transportation, integrating smart mobility systems is not just beneficial; it's essential for Konza City's sustainable growth.

This research paper outlines recommendations for a comprehensive smart mobility integration framework. This approach covers infrastructure development, data management, regulatory frameworks, user engagement, and monitoring and evaluation. Following these recommendations will ensure practical and efficient implementation. By adopting this holistic framework, Konza City can create a modern, user-centric transportation network that prioritizes residents' well-being and environmental sustainability. It represents a pivotal step toward transforming the city into a smart and forward-thinking urban centre.

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