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## Abstract

This research uses mapped urbanization, PESTEL analysis, Smart City projects, and socio-economic impacts to analyze the MENA region's outlook on smart mobility. Countries in the MENA region are implementing large-scale smart mobility projects to combat modern urbanization challenges such as traffic congestion, informality, and pollution. Smart mobility in MENA has the potential to solve many of the urbanization challenges facing the region as well as enhance the quality of life of its growing population. Yet the two critical factors of (a) political stability and (b) adequate financial resources are strong necessary conditions for positive long-term impact. With a forward-looking young population and vivid demographics of modern cultural development, many of the MENA countries are expected to pioneer in smart mobility systems in usage and longer-term co-production. Affordability, accessibility, and efficiently usable are important conditions for social acceptance of smart mobility systems in the MENA region, such that citizen self-interests should be aligned with country economic gains. Long term recommended strategies for smart mobility in the MENA region include (1) intensive development of electrified public transportation for mass transport, (2) expansion into uncovered geographical areas using AI monitoring systems, (3) smart mobility investments to be used as a catalyst for economic diversification away from non-renewable energy sources, and (4) smart mobility eco-friendly impacts to lead the region towards long term zero emissions. Finally, (5) a mega Arab World smart mobility railways network is highly recommended, connecting the Gulf countries to Egypt to the Maghreb region, which has the potential to accelerate the MENA region towards higher levels of livelihood and sustainability and enhance the world trade outlook at large.

## Keywords

Middle East and North Africa, Smart Mobility, Smart Cities, Urbanization, Future Outlook

JEL

O53, L91, L86, H44, R42

# Smart Mobility in the MENA Region

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## 1. Introduction

Countries in the MENA region are implementing large-scale smart mobility projects to combat modern urbanization challenges such as traffic congestion, informality, and pollution. Smart mobility in MENA has the potential to solve many of the urbanization challenges facing the region as well as enhance the quality of life of its growing population. Nonetheless, smart mobility projects in order to be successful will need political stability and adequate financial resources for positive long-term impact.

The Gulf region is at the forefront of implementing smart mobility projects which are mostly located in new smart cities. Examples include Masdar City in Abu Dhabi (UAE), Smart Dubai Initiative (UAE), and Neom Bay (Saudi Arabia). Lusail City in Qatar and Haitham City in Oman are further examples that include high-tech smart mobility projects within a holistic sustainable livelihood. Most, if not all, of these projects are having an eco-friendly objective towards net zero emissions.

Egypt is implementing a large scale New Administrative Capital with smart mobility dimensions in traffic and housing, as well as smart mobility projects in at least four other locations including New Alamein City on the Mediterranean Coast. Some countries in the MENA region are left behind. This is especially, and unfortunately, true for war torn and politically unstable countries such as Sudan, Syria and Palestine.

With a strong necessary condition that political and financial constraints are not impeding smart mobility projects, the MENA region is poised to deliver an impactful presence of digital mobility towards a positive impact for the quality of life of its citizens. With a forward-looking young population and vivid demographics of modern cultural development, many of the MENA countries are expected to pioneer in smart mobility systems in usage and longer-term co-production. Affordability, accessibility, and efficiently usable are important conditions for social acceptance of smart mobility systems in the MENA region, such that citizen self-interests are aligned with country economic gains. A pan Arab World smart mobility railways network connecting the Gulf countries to Egypt to the Maghreb region, if implemented, is poised to upgrade the sustainable livelihood of the region and the trade outlook of the world at large.

## 2. Urbanization in the MENA Region

Urban population in the MENA region is estimated to be greater than 70% of its overall population as compared to about 55% for the world average<sup>2</sup>. Such a fact has created critical and, sometimes persistent, challenges in the MENA region.

Historically, such *urban challenges* have been associated with substantial increases in pollution, informality in employment and housing, rising energy demand with carbon footprints<sup>3</sup>, as well as traffic congestion and the public financing burden of expanding road and infrastructure projects. These chronic challenges have persisted in many countries of the region such as Egypt and Jordan. Additionally, high urbanization has put added pressure on poverty and widening inequality in high density cities of the region such as Cairo (Egypt), Amman (Jordan) and Gaza (Palestine). On the other hand, in other countries of the MENA region, urban challenges were absorbed financially and planned strategically. This has been especially true for the Gulf counties including UAE, Kuwait, and Qatar.

What can be seen as a *common advantage* of urbanization for most MENA countries is that high urbanization has caused better access to health and education, as well as better job prospects and a better standard of living, along with expanding circles of intellectual and cultural opportunities<sup>3</sup>. Yet, the aforementioned challenges will need to be addressed in order for the MENA region to achieve sustainability for future citizens. Smart mobility can solve many of such regional challenges when planned strategically and implemented efficiently.

### **3. Smart Mobility Projects in the MENA Region**

The MENA region has made viable steps towards addressing high urbanization and its associated urban challenges by initiating *smart mobility* and smart ecosystems to make cities more liveable<sup>1</sup>.

Smart mobility refers to an innovative system of transportation which yields more clean, more safe, and more efficient modes of transport. This can take on many different forms, including ride-sharing, substitution of car driving by public transport systems, AI-induced traffic controls, use of hybrid and electric cars, and autonomous vehicles (self-driving cars)<sup>22</sup>. Smart mobility is expected to reap a large reduction in traffic congestion, pollution, fatalities and wasted time<sup>4</sup>. Two more aspects of smart mobility are accessibility and social benefit, which means that smart mobility should be affordable to the average citizen to help achieve a better quality of life<sup>4</sup>.

However, smart mobility have no uniform regulations or fixed policy choices. The options for implementing smart mobility “*are as varied as ice cream flavors*”<sup>4</sup>– leaving cities and municipalities lots of room to find solutions tailored for their citizens.

Table 2 showcases some of the urbanization issues facing the MENA region and outlines how smart mobility systems can address them.

Within the MENA region, several successful examples on the application of smart mobility to cities have occurred recently. For example, in the **United Arab Emirates**, the *Smart Dubai Initiative* aims to revolutionize city traffic by shifting 25 percent of transportation into autonomous modes by 2030 at a reduced cost estimate of US\$6 billion a year<sup>5</sup>. Such reduced costs are annually estimated based on estimated reduction in carbon emissions, accidents, traffic waste time, and fuel costs.

The Smart Dubai Initiative is expected to be one of the region's pioneering examples of private-public partnerships in smart mobility and targets *20 to 30 minutes reduction of traffic time per day* for an average commuter<sup>1,5</sup>. Also in Dubai, the *Museum of the Future*, which opened its doors in February 2022, is showcasing smart mobility solutions and future-based AI transport systems to the general public. Additionally, two cities of the UAE, Abu Dhabi and Dubai, rank in the *World's Top 50 Smart Cities* and both cities have been ranked as the smartest cities in the Middle East and North Africa region by the Institute for Management Development (IMD) and Singapore University for Technology and Design (SUTD)<sup>6</sup>.

Abu Dhabi also has Masdar City, an eco-friendly low-carbon urban oasis near the Abu Dhabi International Airport, and is home to 40,000 residents<sup>15</sup>. The UAE's capital has also launched the *Hyundai Sonata Smart Taxi* which is based on smart AI-enabled semi-autonomous taxis with AI cameras monitoring the reaction time of the taxi driver as well as implementing digital AI passenger streaming and safety services<sup>14</sup>.

In **Saudi Arabia**, the NEOM Smart Project is planned to be a smart mega city bay area in the country's northwestern Tabuk province with *100% renewable energy* along 500 km of coastline. This smart mobility project is expected to achieve urban sustainability and is planned to provide a viable example of a clean smart area in the region with a *zero emissions* goal. NEOM is introducing a new regional mobility model with no cars and no traditional roads, such that mobility will be based on autonomous electric shuttles and on-demand high-speed underground transit system with zero carbon emissions<sup>8,9</sup>. Within NEOM, the *Sindala island*, which is one of 41 islands of the project<sup>7</sup>, will provide sustainable tourism and music festivities along a luxury beach club which will be exclusively powered by *solar and wind* energy sources.

Additionally, a NEOM Bay Airport will apply clean air mobility systems with a passenger capacity of 20 million by 2030 with two runways and 22 airplane bridges per terminal. The airport has a prime logistics location as it links three countries: Saudi Arabia, Jordan and Egypt. Also in Saudi Arabia, in its capital city of Riyadh, a multibillion dollar public transit project is underway with *driverless trains* and AI-induced adaptive traffic signals and operations<sup>1</sup>.

In a country like **Egypt**, which has the largest population in the Arab World, chronic social problems include hyper-inflation, forex shortages, congestion, pollution and informality. To overcome some of these problems and to reduce pressure on existing cities, Egypt has embarked on establishing the *New Administrative Capital* which is the first completely designed mega smart city in the country. The new capital city is expected to house 7 million people, out of an estimated population of 110 million citizens, and includes smart mobility systems in traffic and public transport. The city's smart infrastructure includes AI-induced congestion sensors as well as optical fiber infrastructure connecting every building using FTTX technology.

The smart capital will be housing most government ministries and authorities, to be pulled-out of the old city of Cairo. It will also house most foreign embassies and new smart educational centers with international university partnerships. The city has a smart CCTV-based surveillance system<sup>16</sup> to detect crime and enhance safety particularly for women and children. A smart

operations center manages the city traffic lights and signals and provides real time notification of open gates<sup>17</sup>. The smart mobility dimension of the city includes several technologically savvy objectives such as low carbon footprint towards zero emissions, smart parking systems and enhanced micro-mobility (two-wheeled) vehicles performance, smart sales ticketing and MaaS (mobility as a service) through joint digital channels of infrastructure.

Albeit being an enormous endeavor, the New Administrative Capital of Egypt is modelled after the successful launch of smaller smart cities and smart mobility networks across the country. These include smart mobility systems in New Alamein City, Egypt International City of Olympics, and Borg Al-Arab Technology Park<sup>17</sup>.

Other countries in the MENA region are also implementing smart urban and mobility systems<sup>19</sup>, such as Lusail City in **Qatar**, Sultan Haitham City in **Oman**<sup>15</sup>, and others. War-torn and occupied countries in the MENA region (such as **Sudan** and **Palestine**) have been left behind, but most stakeholders agree on a path towards eco-friendly mobility systems. The digital divide within the MENA region is mostly based on the dual constraints of politics and financing, and accordingly, the **Gulf region** is comparatively ahead of the curve so far.

#### 4. Smart Mobility Challenges for the MENA Region

There are challenges facing the MENA region in terms of sustainability and smart mobility systems<sup>10,11,12,13,18</sup>.

These challenges can be summarized as follows:



(1) Countries in the the MENA region must strengthen the existing data accuracy and harness information and digital infrastructure across more geographical space, with the long term goal of achieving an acceptable digital way of life for all citizens.

(2) Countries in the MENA region should absorb social resistance to change by creating affordable, accessible, and efficiently usable smart mobility systems for the average citizen, with an eye towards better quality of life by mapping citizen self-interest to social benefits.

(3) Countries in the MENA region are (3) recommended to develop a monitoring framework to assess and monitor progress using ESG (environmental, social and governance) metrics and standards using Key Performance Indicators for both processes and outcomes of smart mobility systems.

(4) Countries in the region can develop more regional cooperation in smart mobility, such as implementing a mega regional collaborative smart mobility project for the entire MENA region, which can be in the form of smart mobility across regional airports, driverless trains across and within MENA countries, AI-induced autonomous vehicles consumption with free intra-regional trade with no tariffs, and further allowing for a lowered “green interest rate” loan framework and/or Islamic partnership financing for smart mobility investments.

(5) Countries in the MENA region should expand on an educated human resource supply of experts in production, usage, and monitoring of smart mobility systems using smart education and training methods, with continuous innovation as a key driver to the growth of smart mobility.

(6) Countries in the MENA region are urged to update and coordinate their legislative frameworks by encompassing rules and standards that ensure an open platform, while allowing for system modularity and non-chaotic openness as enhanced by social and cultural standards and information accuracy.

**Table 1: Quick PESTEL Analysis of Smart Mobility in the MENA Region**

<b>Factor</b>	<b>Impact on Smart Mobility</b>
<i>Political</i>	Government policies are supportive of smart mobility systems, especially in the Gulf region. Other countries, such as Egypt and Jordan, are implementing smart mobility in select areas as a strategy of moving out of existing social pressure of informality and congestion. War torn countries are left behind.
<i>Economic</i>	Smart mobility will deliver better transport efficiency, reduced carbon imprints, less pollution and congestion, but will require digital infrastructure which is difficult and costly in rural and remote areas. Smart mobility is a strategic factor in economic diversification away from traditional hydrocarbons.
<i>Sociocultural</i>	There is a high level of youth acceptance towards smart mobility, accompanied by social resistance to change by the more elderly population. Mapping citizen self-interest to social benefits is key, hence smart mobility must be affordable, accessible and efficiently usable by the average citizen. Real-time connectivity is needed to overcome social resistance and achieve better quality of life into a sustainable future for the region.
<i>Technological</i>	Once the financial resources needed for technological infrastructure and digital AI adoption are met, smart mobility in the MENA region will fast track into the future. Implementing 5G, vehicle-to-vehicle (V2V) communication, autonomous vehicles (AV), and electrical public transport are expected. However, only the Gulf countries possess such financial flexibility and degree of freedom. Other countries will have to weigh-in other priorities vis-a-viz smart transport and implementation at scale will be difficult.
<i>Environmental</i>	Smart mobility is addressing pollution and long term zero emissions in select areas. Widespread mass transport of electrified public transportation is feasible, and ride-sharing is expected to be more common, whereas micro-mobility (two-wheel vehicles) is not expected to be an easy challenge.
<i>Legal</i>	There is an urgent need for updated legislative reform with the purpose of enhancing consumption and production of smart mobility systems, as well as reduction of trade barriers. New insurance regulations are needed. Data privacy concerns and information accuracy are challenges.

## 5. Long Term Strategies in Smart Mobility for the MENA Region



Towards the long term, the MENA region should implement<sup>20,21</sup>:

- (1) Intensive development of electrified public transportation for mass transport, as well as enhancement of smart micro-mobility (two-wheel vehicles) in certain areas,
- (2) Ride-sharing expansion into uncovered geographical areas, especially rural areas, as accompanied by AI surveillance safety and monitoring systems,
- (3) Smart mobility investments as a strategic element of economic diversification,
- (4) E-mobility investments as a catalyst in the transition to renewable energy.

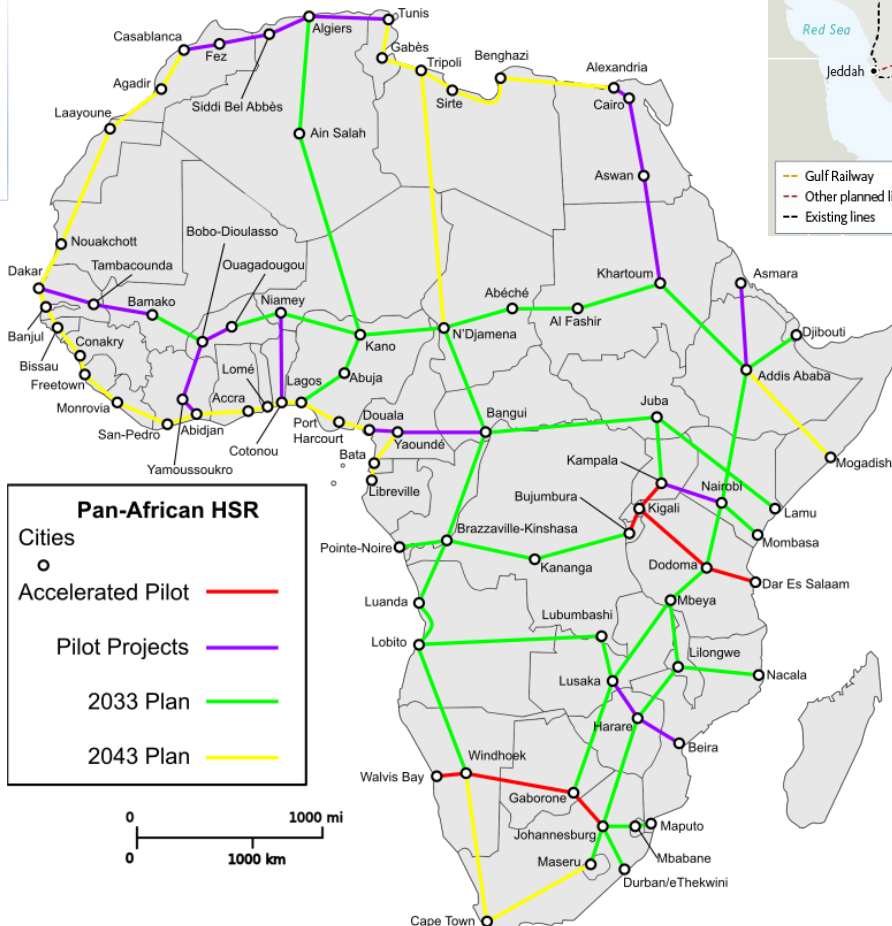
**Map 1**  
Potential Egypt-Saudi  
railway connection



**Map 2**  
Gulf Railways Network



**Map 3**  
African  
Union  
Railways  
Project





**Table 2: Urbanization and Smart Mobility Impacts in the MENA Region**

<b>Urbanization Issues of the MENA Region</b>	<b>Smart Mobility Impact on Better Quality of Life</b>
<i>Youth population</i>	Positive- due to youth preference towards smart mobility
<i>Rising energy demand</i>	Neutral to Positive- due to better accessibility if affordable
<i>Pollution and Carbon footprint</i>	Positive- due to reduced carbon emissions
<i>Traffic congestion</i>	Positive- due to less traffic congestion by smart mobility
<i>Infrastructure financing</i>	Negative- due to high opportunity costs of financing
<i>Poverty</i>	Neutral- due to digital divide yet has employment potentials
<i>Widening inequality</i>	Negative- due to probable intensification of inequality based on lack of infrastructure in poor and rural areas
<i>Informality in employment</i>	Negative- due to job displacement
<i>Informality in housing</i>	Neutral- due to persistence of affordable housing challenge
<i>Access to health</i>	Positive- due to more accessibility at digital scale
<i>Access to education</i>	Positive- due to more accessibility with open knowledge
<i>Pressure on quality of life</i>	Positive- due to enhanced quality of life (long term)
<i>Transport cost</i>	Neutral- due to cost variations stemming from E-shuttles and ride-sharing (positive) as compared to new smart cars which are more expensive (negative)
<i>Transport time</i>	Positive- due to reduction of time wasted in traffic
<i>Data privacy</i>	Negative- data privacy and information accuracy concerns
<i>Safety</i>	Neutral to Positive- due to video and voice surveillance in smart mobility (positive) yet with risk of hacking (mildly negative due to low probability of occurrence)
<i>Public transport</i>	Neutral to Positive- due to more clean transport of the masses (positive) yet includes infrastructure financing constraints (negative for less rich countries)
<i>Accident fatalities</i>	Neutral- due to less frequent fatalities (positive) yet potential for more severe fatalities per accident (negative)
<i>Parking</i>	Positive- due to more digital accuracy and real-time data for parking location and parking space availability

These long term strategies will need to be coordinated across time and geographical space, and will need political stability and financial resources for digital and road infrastructure. Affordability, accessibility, and efficient usage of smart mobility systems by the average citizen of the region is a key factor for the success of those strategies, with citizen self-interest mapped to country economic gains. Governance and updated regulations are prerequisites for smart mobility systems of the MENA region to have a socially acceptable impact at mass scale.

Also, it is highly recommended to implement an economically feasible *mega Arab World smart railways project*, for both passenger and freight routes, connecting the Gulf region to Egypt and North Africa until the Maghreb region (see Maps above). This can be an accelerated

smart mobility project connecting several ongoing mega projects: the North African high speed railway project of the African Union<sup>24</sup>, with the Egypt-Saudi causeway<sup>23</sup> through the Salman Bridge via Tiran Island to Neom Smart city in Tabuk in Saudi Arabia, which would then connect with the Gulf Cooperation Countries smart railways network<sup>25</sup> and other countries. This ambitious smart mobility project in the MENA region, if implemented, will transform the sustainability, tourism, trade, and logistics of the region to a whole new standard, and will elevate the socio-economic status of the region towards a sustainable smart mobility future and will significantly contribute to economic and trade gains for the world at large.

## 6. Investments, Market Size, and Market Players

The MENA region invested about \$2.3 billion in smart mobility projects on an annual basis during the past several years<sup>26</sup>, compared to a world investment estimate of \$122 billion. The forecasted compound annual growth rate (CAGR) for smart mobility investments is at 15.2% for the medium term<sup>27</sup>. Whereas MENA investments in smart mobility have accelerated during the past several years, yet the region's population stands at 6% compared to the world as compared to the region's smart mobility investment of 2% compared to the world. Nevertheless, such a comparison hides the fact of smart mobility concentration in select countries of the MENA region, especially in the Gulf countries.

Smart mobility investments in the MENA region are mostly connected to new mega smart city initiatives amassing an estimate of \$40.4 billion by 2030 inclusive of real estate construction, road and bridge infrastructure, smart buildings and utilities, AI systems, and automated drones<sup>28</sup>.

The market size opportunity for the segment of smart mobility investments is estimated at \$250 billion<sup>27</sup> globally by 2030 as compared to MENA's \$6 billion size estimate. The market players, in the medium term, are based in six major countries:

- **China** (*Huawei Technologies, Tencent, Alibaba, and Systra*)
- **France** (*Thales Group, Alstrom, Capgemini, and Atos*)
- **Germany** (*Siemens AG, SAP, and Bosch*)
- **India** (*LTIMindTree*)
- **Japan** (*Hitachi, Toshiba, and Fujitsu*)
- **USA** (*GE, IBM, Cisco, Cognizant Technology, and Cubic Corporation*)

Accordingly, the MENA region will need to establish strategic partnerships with these countries and companies over the next 5 to 10 years in smart mobility investments. Not only that, but also the expected growth of new AI start-ups especially in India and China as part of the newly expanded BRICS alliance, alongside an expected surge in mergers & acquisitions within the global smart mobility market, should be carefully taken into consideration in long term planning by MENA countries.

## 7. Conclusion

This research has used urbanization challenges, PESTEL analysis, and socio-economic impacts of smart mobility, with Smart City applications and various country examples, to showcase the MENA region's outlook on smart mobility.

In general, it is seen that smart mobility in MENA has the potential to solve many of the urbanization challenges facing the region as well as enhance the quality of life of its growing population. Yet, political stability and adequate financial resources are strong necessary conditions for positive long-term impact. Accordingly, some countries are left behind.

Affordability, accessibility, and efficiently usable are critical operational conditions for social acceptance of smart mobility systems in the MENA region. In retrospect, citizen self-interest should be mapped to country social gains in order for smart mobility projects to be successful.

Long term strategies for smart mobility in the MENA region include intensive development of electrified public transportation for mass transport, expansion into uncovered geographical areas using AI monitoring systems, smart mobility investments to be used as a catalyst for economic diversification away from non-renewable energy sources, and smart mobility eco-friendly impacts to lead the region towards long term zero emissions.

Very importantly, a mega Arab World smart mobility railways network is highly recommended, connecting the Gulf countries to Egypt to the Maghreb region. If implemented, this mega smart mobility project will be able to accelerate the MENA region towards higher levels of livelihood and sustainability and has the potential to enhance the trade outlook of the world at large.

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