CONNECTED AND AUTONOMOUS VEHICLES AND SUSTAINABILITY IN SMART CITIES

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ABSTRACT

Cities being equipped with the Internet of Things (IoT), are swiftly turning into a real time manifestation. Such smart cities have initiated gigantic change in India. It has taken a vertical leap in Indian cities development. There is total transformation in life style of people, job scenario, and intermingling with their milieu. Smart cities will likely to be connected, through hordes of sensing tools and gadgets communicating one other to create a unified, smooth and assimilated know-how for citizens. Generally, the growth of smart cities as well as IoT is growing and holds the probably to progress the superiority of life for populations significantly. A smart city has a greater and intricate connectivity, calculating, and informaton handling. This connection may be physical, meaning that numerous gadgets are wired to the web/internet or each other, or cybernetic, meaning that it happens in a computer-generated space, such as wired group of people. Sustainability plays crucial role in directing CAV initiatives.

Keywords: Internet of Things, Smart Cities, Artificial Intelligence, Connected Autonomous Vehicles, Sustainability

INTRODUCTION

This study asserts the smart mobility initiatives and the imbroglios for smart cities with connected and autonomous vehicles (CAVs), and it also highlights the texts that supports why CAVs are vital for smart sustainable development as part of the intelligent transportation system (ITS). As a concept, Smart City is anything made of smart performances and works more competently and effectually. It has been theorized to use various know-hows like the IoT, Machine learning, artificial intelligence (AI), cloud computing, and along with sensing devices and other electronic instruments to accrue data. To put it in humble way, a smart city practices sensorial device-based facts collection along with convincing analytics to schematize a wide range of chores and services, addressing in dropping costs, enhancing resources' use, and reducing the influence on the Ecology and environment, hence fostering toward justifiable development.

OBJECTIVES OF THE STUDY

1. To understand the three layers of Smart city

2. To know the main offerings of the smart city

3. To study future of connected autonomous vehicles in smart city

4. To assess the impact on urban mobility

BACKGROUND ON SMART CITIES BENEFIT

Technoshift executed in these metropolises can support geographies through increasing higher competitively, refining and revamping amenities towards populaces as well as industries. The meaning of these developed geography is still developing, some things have become lucid: digitalised cities collate information and promotional technologies to progress amenity levels, people welfare, lasting sustaining, and fiscal development. The growing progression of tech know-how can make these regions with flawless state-of-the-art and greater proficiency, given the quick growth of the cosmopolitan population in the coming times. Therefore, the welfare accompanying with the expansion of these cities are concisely discussed in the following sub-sections.

REDUCED ENVIRONMENTAL FOOTPRINT

By intensifying greenhouse fumes, rubble in our seas, and garbage on our lanes, smart cities are struggling to decrease the opposing repercussions on the air and environment. Energy-evolved buildings, atmosphere polution sensing devices, and renewable energy sources give cities new tools to reduce their ecological footprint. Arraying air purity measuring sensing devices around a county, for example, can offer data to trail highest moments of low air quality, recognize the reasons of contamination and offer reasoned data that administrators require to ripen action and alleviation plans.

REFINING TRANSPORT

Linked logistics and supply chain have massive possibility to improve effectiveness, efficiency and efficacy in the region intensely. From improved road traffic supervision to the capability of civic transport travelers to trail bus or train geographical places, sophisticated technologies enable cities to make smart despite often quickly rising residents. Recent know-how such as effective traffic signals optimize road transportation movement, reducing congestion throughout topmost traffic hours. Other digitally smart transport technologies, such as astute parking management, allow cities to capitalize on added income streams. The real life applications and devices can moreover benefit through perilous and abstruse phases such as endemics to cope with requisite transport sector and the facilities accessible to operators.

A SMART CITY WITH THREE LAYERS

1. First layer of a smart city is Technology based: This consist of devices and smartphones linked via a quick communication network.

2. Second layer a smart city is Application based: Real life applications are used to transform raw data into valuable insights, create signals and exploit with technology created by app inventors and technology enablers.

3. Third layer a smart city is City-use based: In this level where the technical expertise is inculcated and used by firms and individuals at a city level or greater.

Quite a few cities are already progressing the way gaining in the trend of becoming smart cities. For novel construction site schemes and blueprint, engineers were chosen to examine the breeze current, solar penetration, and shaded areas for better construction and usage of a defensible energy framework.

With the practice of AI driven systems for chauffeurs, accidents have been reduced excessively. They also have self-governing police stations, where the city people can recompense fines and report occurrences without speaking to the cop in charge. Many other cities that have cutting-edge in their way to becoming smart cities in the near future.

In a recent study, it is predicted that the worldwide IoT inclinations in the smart cities market will grow considerably from an estimation of USD 130.6B in 2021 to USD 312.2B by 2026.

THE MAJOR OFFERINGS OF SMART CITIES

As the world's population grows gradually, resources become scarce. Implementing IoT-like technology in smart cities facilitates addressing difficulties in a coexisting society.

- Better standard of life
- Improved community safety
- Salubrious health systems
- Sustainable milieu
- Stress-free administration of traffic flow
- Pecuniary development
- Enhanced power and electricity, water treatment plants, and unwanted solid and liquid waste management

Intelligent transportation systems (ITS) technology include advanced wireless, electrical, and automation components. Next, these know-hows have the potential to combine vehicles (transit, trucks, and personal automobiles), system users, and infrastructure (roads and transportation). Many ITS technologies can help to improve travels (route direction), reduce unnecessary miles travelled, intensify other modes of transportation, reduce time spent in traffic, reduce reliance on foreign oil, and improve air quality. Furthermore, when ITS technologies are practicable for system management through transit,

- Simplifying route planning and timing;
- Flattening accelerations and decelerations and stop-and-go driving;
- Reducing bottlenecks;
- Enabling pricing and demand management strategies;
- Increasing acceptance of public transportation modes;
- Adapting vehicle transmission to changing road conditions and territories;
- Managing small groups of closely spaced vehicles.

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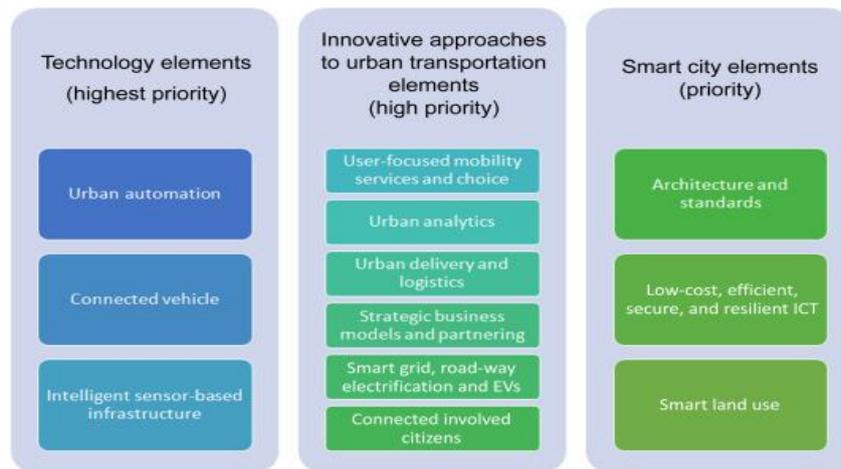
Source: Clean mobility instead of dirty traffic: some action fields on the road to a smart and sustainable city. **April, 2023)**

FUTURE OF CONNECTED AUTONOMOUS VEHICLES IN SMART CITIES

From Past decade, fuel consumption impacts of the following ITS technologies have been studied:

- Controlling traffic signals during rush hour.
- Road traffic management and surveillance,
- Instance management,
- E-toll collection (ETC),
- Tourist information,
- Transit shipment management,
- Commercial vehicle operations (CVO),
- Automobile vehicle control technology.

Nonetheless, ITS implications, including benefits, unforeseen consequences, and collective effects, remain little known. The notion of ITS first emerged in 1991, when transportation professionals predicted that e-technologies would begin to play a significant role in improving surface transportation. Then, computer, communication, and sensor technology advanced dramatically, and ITS technologies developed in motorway and transit operations worldwide.

⌘ **ITS deployment can be divided into three phases:**

- Stage 1: Evaluate and implement early ITS technology (building blocks).
- Stage 2: Integrate early ITS technologies.
- Stage 3: Create a comprehensive system of ITS technology.

Disadvantages in a Smart City Concept

Smart cities require a significant number of sensors, batteries, and wiring to provide power support. This presents a significant challenge due to the vast amount of raw materials needed

to connect these sensors to the electrical grid. Additionally, responsible data management is crucial for the functioning of smart cities, as it requires a large amount of anonymous information. To ensure the success of smart cities, responsible data management systems and regulations must be developed and implemented.

Forces transforming mobility

According to an annual consumer survey by Mckinsey Center for Future Mobility (2022), respondents are open to shifting their transportation habits:

- ✆ 30% of the respondents intend to increase the use of E-Bikes, E-Scooters, or shared mobility
- ✆ 46% of the respondents intend to replace their private vehicles with other mode of transportation in the coming decade
- ✆ 70% of the respondents are intending to use shared autonomous vehicles

In 2020, the transportation industry accounted for 20% of total greenhouse gas emissions, with more than 40% originating from private automobiles. To promote greener mobility, over 150 cities have implemented measures to reduce private mobility, such as raising awareness about emissions from private vehicles, limiting the number of private vehicles in cities, or providing financial incentives to use more environmentally friendly transportation.

Urban Delivery and Logistics

According to a report by Technical Group on population projections, the urban population of India is likely to increase by 38.2% as compared to 31.8% in 2011. This will lead to denser population, traffic congestion, pollution, parking issues, and putting pressure on urban logistics by consumers due to growing dependency on E-Commerce as smart cities are going to be centers of trade and commerce. In order to decongest the already choking network, the government and other agencies are collaborating on efforts towards urban delivery and logistic system. The Indian government has introduced Freight Smart Cities which intends to increase the urban freight efficiency thereby reducing the cost involved in logistics. Focus will be on integrating the existing system of distribution and warehousing thereby reducing traffic, carbon footprint, and high cost in logistics. These efforts will meet the increasing E-Commerce sector thereby generating scope for employment and simultaneously boosting economic competitiveness.

For our planet which is hugely impacted by the carbon footprint, Green Logistics is not a choice but a growing necessity. Warehousing Facilities are encouraging use of E-Equipment. Initiatives by bodies like CII and subsidies by the GOI, use of eco-friendly and renewable resources are getting promoted. The big challenge lies in wide acceptance of these schemes and building a green network, while the support system is getting created.

Clean mobility instead of dirty traffic: some action fields on the road to a smart and sustainable city, **April, 2023)**

Mobility is experiencing unprecedented transmutation of the era, with dynamic and multifarious implications that are unique. KPMG firm is working with transnational and worldwide organizations to find vantage of the new prospects ahead.

The future Scenario of Mobility

It's now widely accepted that by 2030, mobility, especially in large urban areas,

Source: KPMG Survey 2019

Transforming the mobility landscape

The forthcoming aspects of mobility being propelled by three key techsavvy and innovative trends: e-vehicles, connected vehicles and Mobility-as-a-Service(MaaS). We must understand How patrons and corporates can grab the benefits and captures the value from this mobility transformation. The automotive, self-propelled transport and widespread mobility market is enduring a revolutionary PESTLE shift, primarily shifting the way individuals and merchandises are moved. Numerous segments, beyond locomotive, automobile and transport, are being messed up through disruption, with attractive novel markets evolving, current ones uniting, and others diminishing and possibly waning. New players and unicorns are perplexing occupants, who build defensible sustaining market positions.

Amongst sustained populace progression, sprawling urbanization and recent ecological anxieties, innovative systems of mobility are critical to backing up tomorrow's micro-politan centers and financial movements. Ultra-modern mobility systems undergo overcrowding, disorganization, mishaps and higher prices. But the imminent promises opportune, protected and commercial mobility, with not as much of influence to wellbeing and the atmosphere.
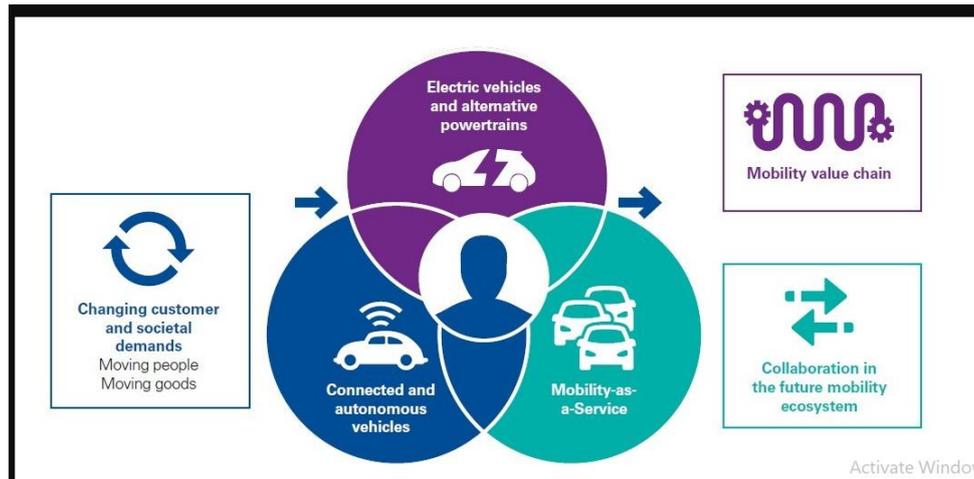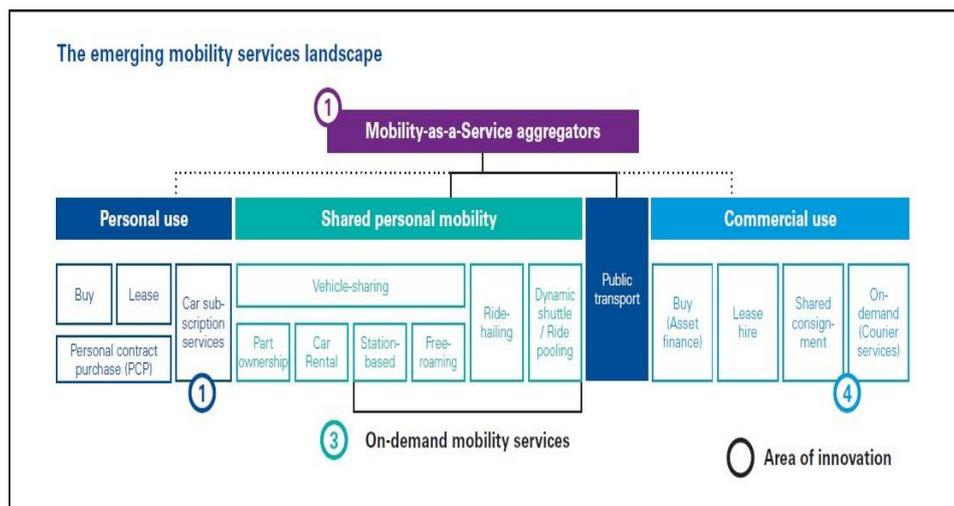
Source: KPMG Survey 2019

The acceptance of value will also shift, and we believe diverse business models are developing. For example, with OEMs, we perceive two central epitomes: 'Metal smiths' building up ever more refined hardware (i.e., vehicles), alongside a new model, the 'Grid Master'. The latter would not only build vehicles but also offer hordes of value-adding consumer services. As with all disorderly disruption, we suppose there will explicitly be winners and losers.

However, the roll-out could differ considerably at both a national and city level depending on the degree of urbanisation, domestic choice, present options, groundwork, and, of course, indigenous policies. Management support considerably impacts all three disruptive trends. It also impacts the form and speed of development of the new environment.

From car ownership to Kinesis as a Service

In many markets, we see a distinct shift in the way consumers perceive mobility, particularly in their attitudes towards vehicle ownership.This trend is particularly visible in metropolitan areas, where people have more mobility options.According to KPMG's survey, 39% of surveyed consumers agree that vehicle ownership will decline by 2025, indicating that more than 45% of car owners already know they will no longer want to possess a vehicle.These oscillations can be attributed to the demand for consumer'mobility-as-a-service' as an alternative to ownership. Most especially over and done with the emergence of on-demand private car hire organizations such as Uber and Ola, which have quickly become trite in cities worldwide.Mobility-as-a-Service (MaaS) is an emerging concept for how people and businesses transition away from car ownership and towards service-based transportation. In this view, MaaS encompasses both multi-modal expansion in transportation modes and on-demand mobility. In the overall backdrop of mobility we highlight four areas where organisations are innovating to create new business and service models: Multimodal MasS Aggregation, Car Subscription Services, On Demand Mobility, and Commercial Vehicle Innovation.

Source: KPMG Survey 2019

Multimodal MaaS aggregation

Although these services are traditionally limited to public transport, new, integrated private/public models are emerging. MaaS Global operates a MaaS platform in Helsinki, Finland, and is also trialling a framework in other countries, including the United Kingdom. The company has launched a travel product called Whim, which requires a monthly subscription. Customers can use a single app to plan and pay for individual trips by rail, bus, taxi, car rental, and bike sharing, or they can buy a 'all-in' subscription that covers all of their transportation needs in the city for a set amount. Many cities throughout the world that are referred to as smart cities have implemented some form of MaaS technology. Despite these exciting advancements, public officials continue to compete to balance the user experience provided by MaaS, with programme goals of economic success, societal inclusion, space optimisation, environmental gain, and civilian health and wellness. MaaS has a huge opportunity to replace company cars, but this will necessitate significant tax changes. KPMG's MaaS Requirements Index helps workers and authorities to understand the primary degree of regulation and course of action required to achieve their objectives, while harmonising the business requirements of operators.

Cars Subscription Services

New car subscription businesses have shown signs of creativity. Traditional personal agreements or long-term leasing provisions are being replaced by more resilient monthly contracts that combine insurance coverage, repair costs, and other charges into one comprehensive price that can be accessed online. With customers increasingly willing to forego personal car ownership in favour of more flexible access, subscription services may provide a balanced solution for individuals who still require prompt access to a vehicle and the flexibility to change models or discontinue use. Independent platforms are providing novel subscription arrangements and experimenting with new revenue and operational methods. For OEMs, these schemes represent an opportunity to keep customer connections while regaining control from on-demand platform providers.

On Demand Mobility

Private rental car drivers are increasingly admired for their demand-driven approach. They provide consumer connectivity, individual account-based expenses, sophisticated routing systems with algorithms, and a large pool of drivers that can be paid for in advance or on

account. Nonetheless, ride-hailing isn't the only on-demand option. We've seen a lot of interest in car-sharing initiatives. Another revolution is vibrant shuttle services, also known as demand responsive transit (ViaVan), which combine mass transit elements with dynamic routing. Saturation of such services is only projected to increase with the introduction of autonomous vehicles (AV), which will coincide with a significant decrease in car ownership, particularly in urban and suburban areas. Approximately half of the cost of on-demand private hire vehicles is shared with the driver, and as a result, we estimate that an AV MaaS facility might be up to 50% cheaper than private vehicle ownership after a decade.

Commercial Vehicle Innovation

While traveller transport is frequently highlighted when discussing the benefits of mobility, profitable cars and logistics should not be forgotten, given their considerable financial and sustainability impact. There has been a significant shift in business models, with the advent of peer-to-peer logistics platforms and consignment sharing, as well as new modes such as drone delivery. While alternative fuels, connectivity, and automation will eventually influence the majority of the supply chain, we anticipate an initial concentration on low emissions for heavyweight vehicles. Companies like Starship Technologies, which use self-governing robotic delivery pods, are shaking up the future of metropolitan logistics. In these four focus areas, we expect to see cumulative modernization and exploration into novel business models, which should attract venture capital and speculation. However, we believe that true transformation will occur when agility services are combined with autonomous technology, resulting in an integrated and automated transportation environment.

DISCUSSION

After nearly a decade and a half, the possibilities presented by Connected and Autonomous Vehicles seem limitless. In this study, we have seen how smart cities will become the standard for emerging countries. This conceptual research paper on smart cities addresses a variety of topics. Futuristic technologies can be a valuable asset in achieving our environmental goals. Electrical facility-based transformation is an important step towards achieving zero emissions by 2050. Eliminating disperse smoke from roadways will significantly advance air superiority in cities.

Furthermore, the advancement of smart cities may achieve assets shrewdly to become frugally sustainable, energy independent, and attentive to its residents' excellence in life and requirements, growing in tandem with revolution and digital upheaval while remaining a sustainable and striking reality. CAV will become the standard in Smart cities, improving commuting for citizens significantly.

CONCLUSIONS

Internet-based autonomous driving vehicles also provide new options for those with motorised disabilities, such as the expanding elderly population, the physically challenged, and underserved minority groups. It is expected that moving through transport as a service will reduce the cost of a ride by a portion of the price of a civic transport ticket, so helping to reduce social discrimination. Similarly, the implementation of CAVs can provide significant benefits to the society. Significant indications for optimising the service of CAVs in urban regions include (1) increased traffic flow and mishaps, (2) transportation expenses, (3) total parking space, and (4) energy consumption and journey time. A pleasant city should be peaceful, clean, and full of green spaces. Cars, as we know, harm all of these elements. Autonomous driving technology will have a significant impact on road safety and environmental sustainability as it advances. The AV revolution has the potential to create a future of smooth and predictable traffic, as well as more efficient public transport. As a result,

city residents will have more available area to use. Furthermore, there would be fewer risks for hikers and cyclists, who face numerous challenges in urban settings. All of the benefits of self-driving cars and smart cities have the potential to significantly improve the standard of living for large numbers of people while also improving environmental sustainability. Future cities will need to become digital hubs.

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