COVER STORY

SMART MOBILITY

The changing face of Intelligent Transport Systems

Akhilesh Srivastava & Shiv Kumar

Transportation has always shaped how societies function. It determines how people commute to work, how students reach schools, how goods travel to markets, and how cities breathe, move, and grow. For centuries, mobility has evolved—from animal-drawn carts to steam engines, from early automobiles to modern aviation. Yet today, the world stands at one of the greatest transformations in mobility history. This transformation is known as smart mobility, and it is quietly redefining how humanity thinks about movement, cities, the environment, and the quality of life.

Smart mobility is not simply an upgraded transportation system, and it is certainly not limited to electric cars or digital apps. It is a deeply scientific, technology-driven, human-centered approach to transportation that uses innovation, data analytics, engineering, behavioral science, and urban planning to create transport systems that are efficient, safe, sustainable, and inclusive. Instead of asking, "How do we move faster?" smart mobility asks a more meaningful question: "How do we move better?"

The need for smart mobility is rooted in the realities of our world today. Cities battle traffic congestion, costing billions in lost productivity and millions of lives in stress and frustration. Road accidents remain among the leading causes of death globally. Urban pollution chokes cities, and transportation contributes significantly to greenhouse gas emissions. Rapid urbanization is pushing millions more into city ecosystems that were never designed to carry such load. Fuel dependency continues to burden economies and geopolitics. Clearly, traditional systems of movement cannot sustain the future. Something smarter is essential. That "something smarter" lies in the science and technology behind smart mobility, strengthened by powerful real-world transformations already underway.

At the heart of smart mobility is data and artificial intelligence. Every movement—of a bus, car, cyclist, or pedestrian—creates information. Cities like Singapore have turned this data into intelligence. Singapore's Land Transport Authority uses AI-powered traffic monitoring, adaptive traffic signals, and predictive modeling to manage roads efficiently. This helps cut congestion, reduce waiting times, and create one of the smoothest public mobility systems in the world. Helsinki in Finland uses similar predictive analytics to design policies, aiming to eliminate the need for private car ownership altogether. Engineering science drives the next pillar: smarter vehicles. Consider Norway, where electric vehicles have transformed everyday mobility. Today, the majority of new cars purchased there are electric, thanks to battery technology advancements, supportive policies, and infrastructure. In China, cities like Shenzhen run almost

History of Electric Vehicles

Electric vehicles (EVs) are often thought of as a modern innovation—but their story stretches back more than a century. From early battery experiments to today's global boom in EV adoption, this evolution reveals how technology, economics, environmental priorities, and consumer demand intersect to shape transport history.

Electric vehicle development began in the 19th century with pioneers experimenting in batteries and motors. Early innovators developed functional electric carriages by the 1890s, and for a brief period around the turn of the 20th century, EVs competed closely with steam and gasoline cars in many cities due to their quiet operation and ease of use.

In fact, in the early 1900s, more than **one-third of automobiles on U.S. roads were electric** before gasoline models became dominant due to cheaper fuel and improved engines.

Although EVs almost vanished in the mid-20th century, they came roaring back in the 1990s and especially in the 21st century as battery technology improved and climate change became a global priority. The introduction of lithium-ion batteries and pioneering models like the Tesla Roadster helped launch a new era of practical, desirable electric cars.

Today, EVs are no longer niche alternatives— they are becoming mainstream. Recent data show:

Global EV Sales Growth (2024–2025)

Metric	Value
Total EVs sold worldwide (2024)	**17 million+ vehicles**
% of new car sales that were EVs (2024)	**20–22%**
% of new car sales that are EVs (2025)	**25%+**
Estimated global EV market size (2025)	**USD 892.6 billion**
Projected global EV market (2032)	**USD 2.13 trillion**

These figures show how quickly EV adoption is accelerating worldwide—from a small share of new sales just a decade ago to a significant portion today.

EV adoption varies by country, but the overall trend is clear: EVs are rapidly gaining ground.

Here's a snapshot of EV adoption rates in key markets:

Country/Region	EV Adoption (% of New Cars)
Norway	**~80%+**
China	**~50%** (2024)
Global average	**20–25% (2024–25)**

Notably, China alone accounts for a **majority of global EV sales,** reflecting aggressive electrification policies and strong manufacturing capacity.

Global	EV Sales Share (2025)
China:	56.5%
Europe:	20.1%
USA:	10.2%
Rest of World:	13.2%

India's EV story is gaining momentum, especially in the past few years. While adoption is not yet as high as in China or Europe, India's growth is notable—especially given its large population and transportation needs.

Key India EV Data (2024–2025)

Statistic	India EV Market
FY2024–25 EV sales	**~1.97 million** vehicles
EV market penetration (2024–25)	**~7.5% of total vehicle sales**
India cumulative EV sales (end of FY2025)	**~6.16 million** units
Growth in passenger EV sales (Oct 2025)	**57% YoY increase**
EV two-wheelers market share	**~6.2% of all 2W sales**

These figures show that although EVs are still emerging in India, the adoption trajectory is strong—with significant growth in two-wheelers, three-wheelers, and electric passenger vehicles.

Global vs. India EV Adoption

Global EV Adoption Over Time
2019: ~9% of new car sales
2024: ~20–22% of new car sales
2025: ~25%+ of new car sales
(Trend: Strong upward global adoption)
India EV Adoption (2024–25)
~7.5% of total vehicle sales
Rapid growth in 2W EV segment
Increasing passenger EV registrations
(Trend: Growing but emerging)

The data clearly show that electric vehicles have moved from niche to mainstream in just a few years. Where EVs once accounted for a tiny fraction of auto sales, they now comprise a **significant share—more than one in four new cars globally.** In India, although EV adoption is at an earlier stage, growth rates are strong and supported by policy pushes, infrastructure expansion, and rising consumer interest.

The history of electric vehicles is not only a story of technological progress—it's a global transformation in how humanity moves. From early battery experiments to today's rapid adoption, EVs are reshaping automotive markets, energy systems, and environmental strategies around the world. ❂

Smart Mobility in India: some thoughts

India is experiencing rapid urbanization, rising vehicle ownership, traffic congestion, pollution, high accident rates, and growing energy demand. Traditional transportation systems are insufficient for future needs. Smart mobility—integrating technology, public transport modernization, electric mobility, intelligent systems, and urban planning—offers a transformative pathway for sustainable growth, economic efficiency, and improved quality of life.

National Policy Foundation
- **National Electric Mobility Mission Plan (NEMMP)**
- **FAME I & II (Faster Adoption & Manufacturing of Electric Vehicles)**
- **National Urban Transport Policy**
- **Smart Cities Mission**
- **National Parking Policy Draft**
- **National Digital Mobility Mission (emerging initiatives)**

These frameworks collectively promote EV adoption, intelligent transport systems, clean mobility, sustainable urban design, and digital integration.

Key Smart Mobility Pillars in India

1. Electric Mobility Transition
- FAME-II incentives for EVs and buses
- Large deployment of electric buses across states
- Growth in electric 2-wheelers and 3-wheelers
- Expansion of charging infrastructure

Policy Impact
- Reduced emissions
- Lower energy imports
- Economic stimulus for EV manufacturing
- Cost advantage for citizens over time

2. Metro Rail & Mass Rapid Transit
- Operational metros in Delhi, Mumbai, Bengaluru, Hyderabad, Chennai, Pune, Kochi and more
- Modern ticketing systems, integration, and expansions

Policy Impact
- Reduced road congestion
- Efficient mass transit backbone
- Cleaner urban environments

3. Intelligent Transport Systems (ITS)
- AI-enabled adaptive traffic lights
- CCTV and automated violation monitoring
- Electronic tolling (FASTag)
- Highway Automated Traffic Management Systems

Policy Impact
- Improved traffic efficiency
- Reduced human bias and corruption
- Better law enforcement and safety

4. Shared & Digital Mobility
- Ride-sharing platforms: Ola, Uber, Rapido
- Dockless bikes and e-scooters: Yulu, Bounce
- Integrated digital platforms for ticketing and travel planning

Policy Impact
- Reduced private vehicle dependence
- Improved last-mile connectivity
- Affordable mobility access

5. Smart City Mobility Innovations
- Integrated Command & Control Centres (ICCCs)
- Smart parking systems
- Bicycle lanes & pedestrian reforms
- Award-winning examples: Kochi, Indore, Surat

Policy Impact
- People-centric urban transport
- Enhanced safety & convenience

6. Bus Rapid Transit Systems (BRTS)
- Successful implementations in Ahmedabad, Indore, Surat, Pune, Rajkot

Policy Impact
- Affordable mass transport
- Lower city congestion

entirely electric public bus fleets, significantly reducing emissions and improving air quality. London has introduced electric taxis and Ultra-Low Emission Zones that encourage cleaner transportation choices. These examples show that electric mobility is no longer an experiment but a reality shaping the planet's future.

Communication technology makes mobility truly intelligent. Japan and South Korea are pioneering **Vehicle-to-Everything** (**V2X**) communication technology where cars communicate with other vehicles, road infrastructure, and traffic control centers. In the United States, pilot smart-highway projects enable connected vehicles to receive warnings about potential collisions, black ice, or sudden braking ahead. These advances reduce human error and pave the way for autonomous vehicles, shifting mobility from human reaction to intelligent anticipation.

Then comes Intelligent Transport Systems (ITS), the silent brain behind smart mobility. A striking example exists in **Barcelona,** where smart traffic lights, real-time passenger information systems, electronic parking guidance, and central control centers make transportation highly efficient. Copenhagen uses similar systems along with cycle-priority signaling, making it

7. Logistics & Freight Modernization
- GPS truck monitoring
- Dedicated Freight Corridors
- Port digitalization

Policy Impact
- Lower logistics cost
- Greater national competitiveness

Challenges & Concerns
- High infrastructure investment requirements
- Uneven adoption across states
- Charging infrastructure gaps
- Behavioral resistance to public/ shared transport
- Cybersecurity and data privacy risks
- Need for skilled workforce and maintenance support
- Rural–urban mobility disparity

Recommendations

A. Strengthen EV Ecosystem
- Expand national charging network, including rural corridors
- Encourage battery recycling and local manufacturing
- Promote EV financing support mechanisms
- Incentivize public transport electrification

B. Enhance Public Transport Integration
- National Mobility Card implementation across states
- Unified mobility platforms (Mobility-as-a-Service)
- First and last-mile connectivity funding

C. Scale Intelligent Transport Systems
- Nationwide ITS standards and deployment roadmap
- Data-sharing protocols between states and agencies
- Mandate ITS for Tier-1 and Tier-2 cities

D. Citizen-Centric Urban Mobility Reform
- Prioritize walking and cycling in planning
- Introduce congestion pricing where applicable
- Promote smart parking policies
- Inclusive mobility for elderly and differently-abled

E. Governance, Skills & Innovation
- Dedicated National Smart Mobility Mission Authority

- Industry–academia–startup innovation partnerships
- Mobility workforce training programs
- Indigenous technology development under "Make in India"

Suggested Implementation Roadmap

Short Term (1–3 Years)
- Accelerate EV incentives
- Deploy ITS in key metros
- Expand electric buses
- Build charging corridors

Medium Term (3–7 Years)
- Pan-India smart city mobility integration
- Widespread metro and BRT expansion
- Unified digital mobility platforms
- Strong cybersecurity frameworks

Long Term (7–15 Years)
- Autonomous mobility readiness
- Full smart city mobility ecosystems
- Carbon-neutral transport networks

Stakeholders
- Government of India (MoRTH, Urban Affairs, Power, Heavy Industries)
- State & Municipal Corporations
- Metro & Transport Authorities
- Startups & Private Sector
- Academia & Research Institutions
- Citizens & Civil Society

Smart mobility is not only India's transportation strategy—it is India's development strategy. ✿

---

one of the world's leading cycling cities. Meanwhile, London's Oyster card system and Singapore's unified mobility payment platforms demonstrate how integrated ticketing and transport networks change the everyday travel experience.

Public transportation modernization forms the backbone of this revolution. **Tokyo** operates one of the world's most punctual metro systems, supported by precise scheduling technology, predictive maintenance, and human discipline. **Dubai** uses AI to optimize bus routing while maintaining one of the most advanced metro systems, largely automated.

In **India,** cities like Delhi, Bangalore, and Mumbai increasingly deploy GPS-enabled buses, contactless ticketing, Metro networks, and integrated transport apps that help passengers track real-time movement. The Delhi Metro's introduction of Women-Only coaches, information systems, and structured travel environments shows how human sensitivity meets technology in smart mobility.

Energy science supports smart mobility's sustainability mission. The Dutch city of **Amsterdam** has created widespread EV charging infrastructure and renewable-powered mobility systems. In the United

ITS INDIA FORUM
Think Tank on Intelligent Transportation System

https://itsindiaforum.com/

India today stands on the brink of a remarkable mobility transformation. As our cities expand, our roads stretch further, and the movement of people and goods grows more complex, the nation faces a defining question: how do we build transportation systems that are not only larger, but smarter? This is where the story of **ITS India Forum** begins—an organization that has emerged as a national thought leader, guiding India toward an intelligent, technology-driven mobility future.

ITS India Forum is more than an institution; it is a collaborative force. It brings policymakers, government authorities, scientists, industry innovators, technology leaders, researchers, and transport professionals onto a single platform, united by a shared mission: to shape a future in which mobility is safer, more efficient, environmentally responsible, and deeply people-centric. In a country as vast and diverse as India, that mission is both ambitious and essential.

At its core, the Forum believes that transportation is not merely about moving vehicles; it is about empowering lives, strengthening economies, connecting communities, and safeguarding the planet. Intelligent Transport Systems—data-driven, digitally enabled mobility technologies—lie at the heart of this effort. Whether it is reducing congestion on crowded roads, improving traffic discipline, enhancing commuter comfort, enabling seamless public transport, or promoting clean mobility, the Forum works to ensure that innovation meets real-world needs.

What makes ITS India Forum truly impactful is its ability to bridge thought and action. It works closely with national ministries, state authorities, city governments, and industry partners to shape policy frameworks and technology standards that can support India's evolving mobility ecosystem. Through national conferences, expert roundtables, technical dialogues, and capacity-building initiatives, the Forum nurtures informed decision-making and builds the skills needed to deploy smart mobility at scale. Discussions on AI-enabled traffic management, digital tolling, connected vehicles, road safety innovations, logistics optimization, and smart infrastructure are not just academic exercises—they become actionable roadmaps for India's future.

India's smart mobility journey is also deeply connected with global innovation, and here too, ITS India Forum plays a crucial role. Its induction into the prestigious **ITS Asia-Pacific community** marks a milestone, placing India alongside leading nations shaping the next generation of mobility technologies. Through participation in international platforms such as the ITS World Congress, the Forum ensures that India's perspectives, innovations, and challenges contribute meaningfully to global mobility discourse. At the same time, it brings international best practices back home, adapting them to India's unique social, technological, and infrastructural realities.

Science and research are integral to the Forum's identity. By collaborating with premier national research institutions, it strengthens India's capabilities in emerging areas such as AI-based transport analytics, connected and autonomous mobility ecosystems, enforcement and safety technologies, and digital transport infrastructure. These partnerships help transform scientific insight into practical solutions, ensuring that innovation does not remain locked in laboratories but translates into safer streets, smarter cities, and better mobility experiences for citizens.

The importance of ITS India Forum becomes even clearer when viewed through the lens of India's long-term aspirations. As the nation advances toward Viksit Bharat 2047, mobility will determine how efficiently our economy grows, how sustainably our cities evolve, and how equitably opportunities reach every citizen. Intelligent transportation is not just a technological agenda—it is a developmental imperative. By guiding policy, enabling collaboration, nurturing innovation, and aligning India with global thought leadership, ITS India Forum is helping build the backbone of that future. ✺

States, Tesla's Supercharger network and energy storage innovations support long-distance electric travel. Meanwhile, Japan's experimentation with hydrogen fuel-cell vehicles, especially in Tokyo, adds another scientific dimension to mobility's future energy story.

Cybersecurity and safety science remain essential. As transport becomes digital, countries like Israel have become global research centers in automotive cybersecurity. Their systems help prevent hacking of connected cars and ensure transport networks stay secure.

However, smart mobility is not purely about technology. It is also about planning cities more intelligently. **Vienna** and **Copenhagen** redesigned urban spaces to prioritize cycling and walking, making their cities healthier and more livable. **Bogotá** transformed travel culture with extensive bus rapid transit (BRT) lanes, providing affordable, fast urban travel. Behavioral science supports these shifts by studying why people prefer private vehicles and how to encourage eco-friendly habits through incentives, awareness, and better user experience.

One of the most compelling real-world stories of smart mobility lies in healthcare and emergency response. Cities such as **Bangalore** and **Chennai** in India experiment with "Green Corridors" for ambulances, where smart coordination clears traffic lights along emergency routes. This integration of data, traffic control, and human intent has saved countless lives. Similar ideas operate in London and Singapore, showcasing the humanitarian dimension of mobility technology.

Environmental science remains the heart of smart mobility. Cities like Paris and Madrid now restrict high-pollution vehicles from entering central areas. China has aggressively deployed electric two-wheelers and buses to combat pollution. In India, electric rickshaws and urban e-buses are gradually redefining public mobility, especially in Delhi and Kolkata. These developments are not just technological—they are public health investments.

Despite immense promise, challenges remain. Technology requires investment. Developing nations face budget limitations. Cybersecurity and data privacy demand constant vigilance. Infrastructure rollout takes time. Workforce training and public adaptability are essential. Yet, with determined leadership, innovation, and global collaboration, these challenges are being steadily addressed.

Even with these hurdles, there is no doubt where the world is headed. Artificial intelligence continues to advance. Batteries are becoming lighter, cheaper,

and more powerful. Communication systems grow faster. Renewable energy adoption increases. Cities are redesigning themselves with sustainability in mind. Smart mobility will only grow stronger.

Ultimately, smart mobility is not just about cars, buses, or infrastructure. It is about improving human lives. It is about reclaiming hours lost in traffic. It is about ensuring a child breathes cleaner air on their way to school. It is about safer roads, dignified travel, and equitable access to movement. It is about a world where mobility does not damage the planet, but harmonizes with it.

Smart mobility is not only a technological revolution—it is a social, scientific, and ethical evolution. It transforms transportation from chaos into intelligence, from pollution into sustainability, from isolation into connection. It builds cities that breathe easier, societies that move efficiently, and futures that are cleaner, safer, and beautifully interconnected.

In the simplest words, smart mobility is not just about moving faster—**it is about moving smarter, living better, and building a future where transportation serves humanity, not the other way around.** ◆

Dr. Akhilesh Srivastava is a prolific speaker and an internationally recognised expert in Intelligent Transport Systems (ITS), He is currently the President of the ITS India Forum. He can be reached at president@itsindiaforum.com.
Dr Shiv Kumar *is a prolific writer on various matters of applied sciences & technology. He is currently Director General at ITS India Forum, a think tank on Intelligent Transport Systems. He can be reached at shivksharma@hotmail.com*