ERTICO

DUBAI
ITS World Congress
16-20 September 2024
Mobility Driven by ITS

30TH ITS WORLD POST-CONGRESS REPORT

14,700	650+	200+	175	78
Attendees	Speakers	Sessions	Exhibitors	Countries

ORGANISED BY ERTICO ITS EUROPE

CO-ORGANISED BY ITS AMERICA, ASIA-PACIFIC ITS

HOSTED BY RTA

SUPPORTED BY DUBAI, DXB, BestCities GLOBAL ALLIANCE

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ORGANISED BY: ERTICO

HOSTED BY: RTA

ITS Dubai 2024!
Top Highlights

The Opening Ceremony, which drew an audience of over

4,000

attendees!

a truly impressive milestone.

The presence of His Royal Highness

Sheikh Mohammed bin Rashid Al Maktoum,

alongside

Dr. Michio Kaku,

the globally renowned futurist and physicist, added exceptional value.

Hear from the Participants

"A real community – everyone's here to learn, share, and make a difference together"

Photo gallery Day 1 | Day 2 | Day 3 | Day 4 | Day 5

YouTube Playlist

Impact at-a-glance

A Record-Breaking Year at ITS Dubai 2024!

PRIVATE SECTOR
59%

PUBLIC SECTOR
41%

14,700
attendees!

"Incredible turnout—over 14,000 attendees eager to shape the future of mobility!"

Joost Vantomme

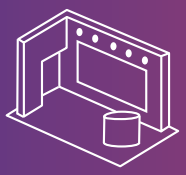
650+
international speakers

200
expert sessions

4,574
registered delegates

27
commercial partners

24
ITS national associations



17,500+ Sqm
exhibition

175
exhibitors!

showcasing the latest in Intelligent Transport Systems

78
countries!

GLOBAL PARTICIPATION

STANDOUT ACHIEVEMENTS

10
Exclusive Technical Visits: Innovation in Action

7
Demonstrations: Where Mobility Meets Reality

Who Attended ITS Dubai 2024?

Audience breakdown

56% UAE

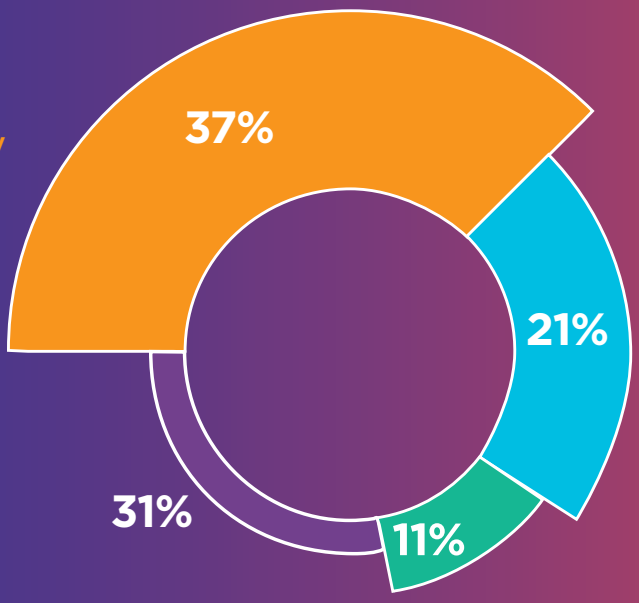
21% ASIA

17% EUROPE

6% USA, Africa & Oceania

Industry breakdown

Traffic and Transport Industry
Service Providers
Connectivity Industry
Other*



Diverse industry participation, from research to vehicle manufacturing, reflects the wide-ranging impact of ITS solutions.

Key insights:

High Delegates Attendance with

31%

of Participants.

Strong Public-Private Sector Balance:

41% Public

59% Private

Traffic and Transport Industry Represented the Largest Share of Attendees

37%

*Suppliers, Research, Vehicle Manufacturers, Users, Other.

650+ Global Voices

Shaping the Future

DISCOVER ALL SPEAKERS

Learn more

HE Mattar Al Tayer
Commissioner General for Infrastructure, Urban Planning and Well-Being Pillar - Director General, Chairman of the Board of Executive Directors
RTA

Dr Angelos Amditis
Chairman of ERTICO
ICCS/ERTICO

Ana Isabel Blanco Bergareche
Head of Department
DIRECTORATE GENERAL FOR TRAFFIC

John Davis
Director/Team Leader
CITY OF DES MOINES, IA USA / ITE INTERNATIONAL

Khaled Al Awadhi
Director
RTA

Scott Marler
Director
IOWA DEPARTMENT OF TRANSPORTATION

Roger Millar
Secretary of Transportation
WSDOT

Alexandra Reinagl
President/CEO/Owner/ Vice-President
Wiener Linien GmbH

Heping Shi
President
JIANGSU PROVINCIAL COMPREHENSIVE TRANSPORTATION SOCIETY

Dennis Walsh
Chief Engineer
TRANSPORT MAIN ROADS

Joost Vantomme
CEO ERTICO-ITS Europe andvice President of the MaaS Alliance
ERTICO

Dr. Michio Kaku
Inspirational speaker

Event Highlights

Event Summary

Learn more

Congress Proceedings

Learn more

Call for Participation:

Get Involved in the next EMEA ITS World Congress

Learn more

Driving Value for Our Partners

Our main partners:

هيئة كهرباء ومياه دبي
Dubai Electricity & Water Authority

Qualcomm | اينوك enoc | PARSONS

27
Event Partners.

View All Partners

Attendees reached via plenaries:

4,579
Attendees at Sponsored Panels.

Contacts exchanged:

+4,500
Scanned via QR.

Breakdown of attendee demographics relevant to sponsors:

78%
Decision-Makers.

41%
Public Sector Representatives.

84%
of Sponsors Satisfied with ROI.

90%
Would Sponsor Future ITS Congresses.

14,700
Event Participants

"The Congress presents an invaluable opportunity to connect, share insights, and shape the future of smart mobility alongside global leaders and innovators."

Jim Misener, Senior Director, Product Management, @Qualcomm.

"The ITS World Congress in Dubai provides an invaluable platform for innovation leaders within the ITS Community to convene, exchange ideas, and collectively chart the course towards a more sustainable and efficient future."

Jon Newhard, CEO at Yunex Traffic.

Global Engagement at ITS Dubai 2024

Over
1.5M+
saw us on social media.

120
media professionals covered the Congress across multiple outlet.

Video Views
8K
Relive the Best Moments of #ITSDubai2024.

View Here

12,806
app interactions.

Join our Network

24
media partners.

Our content sparked impressive social media engagement, driving over 103K actions, including clicks, shares, and video views.

Global Conversation Around ITS Dubai.

The Impact of ITS Dubai 2024 in Numbers

93.6% Attendee Satisfaction

89.55% Willing to Attend Again

91.5% Website Satisfaction

81% Exhibitor Satisfaction

85% Recommend

90% Speaker Recommendation

The numbers speak for themselves—ITS Dubai 2024 was an overwhelming success! High satisfaction rates among attendees, exhibitors, and speakers show our shared commitment to transforming mobility.

Thank You for Making ITS Dubai 2024 a Success!

We extend our sincere thanks to all attendees, partners, sponsors, and participants for making ITS Dubai 2024 a remarkable journey towards smarter mobility.

Birmingham
ITS World Congress
25-29 October 2027

The next EMEA ITS World Congress organised by:

ERTICO

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INTRODUCTION

INTRODUCTION

What are the means at hand to successfully address present and future mobility demands? The **2024 ITS World Congress,** under the theme 'Mobility driven by ITS', investigated the potential of Intelligent Transport Systems (ITS) to develop and enhance our mobility ecosystems towards sustainability, safety and accessibility.

Over five transformative days, Dubai became the global hub of innovation, hosting a comprehensive programme of policy discussions, strategic future sessions, technical tours, and an expansive exhibition.

The week commenced with an inspiring Opening Ceremony attended by more than 4,000 participants. A royal welcome by His Highness Sheikh Ahmed bin Mohammed Al Maktoum highlighted Dubai's commitment to becoming a leader in smart mobility. Renowned speakers, including Dr. Michio Kaku and Dr. Angelos Amditis, shared visionary insights on the future of transport, while global leaders such as Brian Cronin (U.S. Department of Transportation), Max Lemke (European Commission), and Takeru Ito (Ministry of Economy, Trade and Industry, Japan) offered diverse perspectives on the evolving mobility landscape. Additionally, the panel "ITS: What It Is and What It Can Be" featured insightful discussions led by Joost Vantomme (CEO, ERTICO – ITS Europe), Laura Chace (CEO, ITS America), and Akio Yamatoto (Secretary General, ITS Asia Pacific).

The Congress welcomed close to **15,000 participants** from **80 countries**, with over **650 distinguished speakers** contributing their expertise. A key highlight was the presentation of the 2024 Lifetime Achievement Awards to Jennie Martin (EMEA), Shailen Bhatt (USA), and Ninnart Chaithirapinyo (Asia-Pacific), recognizing their remarkable contributions to the field.

Structured around four key pillars the Congress encouraged dialogue and showcased groundbreaking solutions around:

- **Automated Mobility**
- **Clean Mobility**
- **Urban Mobility**
- **Innovations in Mobility and Logistics**

In policy discussions, strategic future and special interest sessions, as well as presentations of technical and research papers, international experts exchanged their views on harvesting promising research results and recent developments to match the user expectations and societal needs of both today and tomorrow: equitable, affordable and seamless access to mobility without fatalities or emissions.

The programme featured **over 200 sessions**, including **a Summit, 3 plenaries**, **8 international forums**, and a **MaaS/MOD Global Forum**. Topics such as mobility data, digitalisation, and sustainable transport were discussed extensively, offering participants a unique opportunity to explore emerging trends and challenges in the sector.

The Exhibition Hall served as the heart of the Congress, bringing together **over 175 exhibitors** showcasing cutting-edge technologies and innovations in autonomous vehicles, artificial intelligence, and electric mobility. This dynamic space provided an unparalleled networking opportunity, fostering partnerships among stakeholders from across the globe. Highlights included **12 live demonstrations** and **10 technical visits**, offering attendees first-hand insights into Dubai's advanced transport infrastructure and smart city initiatives.

Notable among the week's events was the **Future of Mobility Summit**, which brought together over **100 global leaders and decision-makers**. Discussions focused on aligning mobility initiatives with global sustainability goals, with key themes including social equity, data-driven policy, and technological integration. The Summit emphasised the importance of cross-sectoral collaboration and actionable solutions to accelerate progress toward a sustainable transport future.

As the Congress came to a close, participants gathered for a memorable Closing Ceremony, featuring the passing of the ITS Globe to future host cities - Atlanta, USA (2025), Gangneung, South Korea (2026), and Birmingham, UK (2027). The event concluded with an awards ceremony honoring excellence in ITS and a reflection on the innovative ideas that emerged throughout the week.

A team of ten internationally renowned rapporteurs, appointed by the European Programme Committee, captured the key messages and outcomes of the Congress, exhibition and demonstrations. Their work spanned over the entire Congress Programme and helped to compile this Congress report.

This Congress report captures the remarkable achievements, insights, and milestones of the 30th ITS World Congress in Dubai. It serves as a testament to the strength of the global ITS community and its commitment to advancing intelligent transport systems.

Part 2 of this report provides a **summary of the Congress proceedings**. **Part 3** addresses the **High-Level Programme** and reviews the **main outcomes**, whereas **Part 4** focuses on the **Strategic Future Sessions, Special Interest Sessions**, as well as **Technical and Research Paper sessions** categorised by the Congress pillars. **Part 5** reports on the '**Future of Mobility' Summit**, and **Part 6** provides an outlook on '**What will happen next?**'.

The marvellous team of rapporteurs and my predecessor Eric Sampson deserve my sincere thanks for their splendid work and support: Eric's advice – based on his extensive experience – was always available to me when needed to ensure the accustomed quality of Congress reporting. The report could not have happened without the contributions of this fabulous team of ITS experts:

Emily Bobis	Urban Mobility / Innovations in Mobility and Logistics
Darren Capes	Automated Mobility / International Forums
Pete Costello	Clean Mobility
Paula Claytonsmith	Urban Mobility
Carol Kuester	Host sessions / 'Future of Mobility' Summit
Risto Kulmala	Automated Mobility
Tomi Laine	Innovations in Mobility and Logistics / Plenaries
Tim Morris	Automated Mobility / Innovations in Logistics
Carol Schweiger	Urban Mobility
Oliver Teall	Plenaries / Forums

Let me express my thanks also to the moderators and note-takers for the 'Future of Mobility' Summit. Last but not least was the support from my colleagues from ITS America, ITS Asia-Pacific, ERTICO, the RTA Host team and MCI. They were indispensable in generating this report – a big 'Thank You' to all of them, too.

Wolfgang Höfs

Chief rapporteur

Brussels, November 2024

KEY INSIGHTS AND OUTCOMES

KEY INSIGHTS AND OUTCOMES

'**Mobility driven by Intelligent Transport Systems**' was the theme of the ITS World Congress Dubai '24, which was built on four pillars, each looking at mobility from a different perspective:

- Which advantages will be reached by higher levels of **automation**?
- How can we fulfil mobility demands using **cleaner** modes?
- What kind of specific challenges need to be addressed in **urban** environments?
- Which further **innovations** for mobility and logistics are under preparation?

The **Automated Mobility** pillar was once again prominent, with about 30 Strategic Future and Special Interest Sessions (SFS/SIS) and 50 papers. The sessions featured the crucial role of **Regulatory Frameworks** and **International Collaboration**.

The value of sharing experiences, learnings and challenges featured prominently in sessions, converging in the concept of '**Share globally to benefit locally**'.

For system developers and the vehicle industry, the domain is definitely global but **use cases** have substantial regional and even national differences. It is interesting to observe that, in Dubai, about 40% of papers on the automated mobility topic originated from the Asia/Pacific region.

Shared and **on-demand services** such as automated ride-pooling and integrated public transport services in cities and rural areas were addressed. Remote management was classified as an integral part of these services.

The nuanced interplay between society, economics, and cutting-edge technology was explored, and strategies of public authorities for the deployment and integration of automated mobility services were discussed.

The safety of automated driving remains a key issue. Societal acceptance and impact were identified as key deployment prerequisites. The pace of deployment for automated cars and trucks has been much slower than initially foreseen, and no standard business model exists for the most effective way to speed up deployment and generate the promised economic and social benefits.

Many new ideas were brought up in paper sessions:

- Compliance with road traffic laws
- Infrastructure platform services for HD maps

- Integration of generative AI and use of Large Language Models (LLMs) to train automated driving systems
- The concept of maritime ITS, including autonomous ships.

Key issues identified to bring forward automated mobility systems are:

- Interoperability
- Security and reliability
- Regulatory compliance
- Economic benefits and facilitated financing.

Discussions on **technologies** for sensing or performance comparisons of different communication technologies did not attract similar attention as in previous sessions. At the same time, the sensing technologies were prominent in the exhibition – a clear proof of progress.

The **Clean Mobility** pillar featured in all 15 sessions, including a very comprehensive host session on 'Energising the Future: Innovations in Clean Mobility and Intelligent Systems'. Whilst Automated Mobility addresses a specific ecosystem and Urban Mobility focuses on infrastructure, this topic addressed cross-cutting elements which – at least to a certain extent – make use of the former two.

Clean Mobility has emerged as a crucial aspect of sustainable urban development and mobility at large, driven by the need to reduce greenhouse gas emissions, improve air quality and address climate change.

The field is characterised by the integration of electric vehicles (EVs), alternative fuels, ITS and mobility services aimed at minimising the environmental impact of transport.

Services and tools helping to achieve these goals were presented under the headings 'Emissions' and 'Electric vehicles and their charging'.

The discussion revealed that Clean Mobility is undeniably moving forward, driven by **increasing electric vehicle adoption** and **technological advancements**, strategic **policy initiatives** and increased **awareness** of the need for sustainable transport solutions.

However, the pace of progress is constrained by several factors, including cybersecurity risks, consumer behaviour, infrastructure challenges and regulatory complexities.

Recent developments and ongoing trials were demonstrated, showing that the journey towards fully realising Clean Mobility is complex but also filled with opportunities to create a cleaner, more sustainable future. Actions such as:

- technological advancements,
- policy support,
- corporate commitments, and
- increased investments

will pave the way to cleaner mobility solutions and their accelerated roll-out.

This year, the number of submissions on **Urban Mobility** has exceeded those on Automated Mobility: 29 SFS/SIS sessions were organised and 86 submissions were presented in 20 paper sessions. The use of **Digital Twins** gained more attention than in past Congresses.

Overall, five major areas were addressed in the discussions:

- **Artificial Intelligence (AI)** is increasingly used in traffic management, image recognition and prediction;
- **Migration** towards Vehicle-to-Everything (V2X) communication technology is progressing;
- Discussions about **equity, diversity, accessibility, inclusion and mitigating bias** in mobility services continue; and
- **Data sharing** and **exchange** are necessary to harvest the full potential of ITS tools.

One of the most popular Urban Mobility subtopics was Artificial Intelligence for several ITS applications, such as:

  - Advanced pedestrian detection, adaptive traffic control and enhanced decision support for integrated corridor management;
  - Tools for Sustainable Urban Mobility implementation such as connectivity, floating car data and analysis tools;
  - Driver behaviour and societal acceptance of new mobility services.

Innovations in Mobility and Logistics were presented in 49 sessions, providing evidence that we work in a high-innovative sector driven by increasing demand for future-proof solutions for passenger and goods transport.

What are the main insights gained during Dubai ’24?

- Mobility is trending towards **highly automated, data-driven, digitally integrated,** and **proactive systems.** Emphasis is on data sharing, Artificial Intelligence, and removing blackspots in location-based data, but also equity.

- **Data-driven solutions** were certainly front and centre of the technical sessions. A session on traffic flow optimisation also called out the importance of applying traffic management theory to gain full value from the data gathered.

- The **amount of data** and the number of related stakeholders is **rapidly increasing**. This pinpoints the need for an analytics platform to process raw data, create an accurate situational awareness picture and provide short-term predictions.

- **Digital twins** are a hot topic, creating great opportunities but are still a 'work in progress' in many fields.

- **AI applications** have been under development worldwide and the first results are promising, e.g. for detecting vulnerable road users and transit fare evaders as well as potentially fatal road user behaviour. They have really taken a step forward since last year's ITS World Congress in Los Angeles. No off-the-shelf AI applications have been featured yet, but some applications are already in the pilot phase.

As usual, **freight transport** and **logistics** topics were underrepresented. However, special interest was raised in a report exploring new service strategies using **Unmanned Aircraft Solutions (UAS)** for cargo transportation to remote areas, e.g. towards islands in Taiwan.

A new ERTICO Innovation Platform on **ITS-Driven Innovative Aerial Services** (IDI) was launched to accelerate the deployment of advanced mobility services delivered by unmanned aircraft.

Finally, improvements in communication technologies, such as **6G communication,** raised interest in enhancing services in areas with poor data signals (rural or high-density urban areas). Service providers have begun to elaborate on the business potential of such solutions.

Again, the Congress was the international focal event to discuss how to fulfil growing mobility needs in an efficient, sustainable and safe way. Experts from around the globe met policymakers, demonstrated research results and solutions, exchanging knowledge and ideas.

HIGH LEVEL PROGRAMME

The High-Level Programme featured plenaries, international and regional forums, as well as host sessions. Plenaries aimed at providing a platform for senior executives to present their views on the 'Mobility of the Future'. International forums provided space to address opportunities for global cooperation, whereas regional forums focused on regional peculiarities. Host sessions were organised by the Congress host and featured topics of special interest to the Middle East region.

3.1 Plenaries

In three plenaries, global decision-makers discussed how the necessary mobility transition towards safe and resilient ecosystems can be achieved for all transport modes.

3.1.1 PL 1: Safe, Trustworthy and Resilient Mobility Ecosystems in Changing Times

Moderator:	**Young Tae Kim**, Secretary General, International Transport Forum (ITF), France
Keynote speaker:	**Jim Misener**, Senior Director, Qualcomm Technologies, Inc, USA
Panellists:	**Susanna Zammataro**, Director General, International Road Federation (IRF), Switzerland
	HE Abdullah Al Marzouqi, Director General, Abu Dhabi Mobility, UAE
	Markus Oeser, President, Federal Highway Research Institute (BASt), Germany
	Joanna Pinkerton, Senior Vice President, HNTB, USA
	Takeru Ito, Director for Mobility Digital Transformation Office, Automobile Division, Manufacturing Industries Bureau, Ministry of Economy, Trade and Industry, Japan.

This plenary aimed to consider the different links in the mobility chain, including the role of artificial intelligence as a means to improve the safety and resilience of our transport systems.

Young Tae Kim, Secretary General for the International Transport Forum, kicked off the session by setting the stage for the discussion regarding safe, trustworthy and resilient mobility ecosystems.

Jim Misener from Qualcomm Technologies started his keynote speech by addressing the importance of connectivity, as the number of vehicles has reached 350 million globally. Connectivity is at the heart of many state-of-the-art services, and it should be robust and resilient enough to function in the face of different large-scale emergencies or natural disasters. When it comes to automated vehicles, there is a higher requirement for trust in connectivity.

There is a huge need for standards developed by a wider community of different players. Generative AI will be a stimulant for development, as it enables customisation of in-car automated systems for personalised needs and constant improvement of the advanced driver assistance systems (ADAS) algorithms. Jim finished his speech by stating that the interface between the road operator and car driver used to be the car tyres but will become communication networks in the future.

Moving on to the panel discussion, moderator Young asked the panel for a short impact statement. Al Marzouqi argued that, as the world is changing fast, cities need to work hard to address upcoming challenges regarding safety, congestion and the environment, at the same time enabling growth. Pinkerton said that, as we are living in extraordinary times, we need to reimagine how we use the physical infrastructure together with new smart systems. Zammataro pointed out that there are three key elements needed: integration of legacy systems into new ones, finding the right people with the right skill sets and developing inter-agency processes. Ito explained that Japan has formed a new digitalisation strategy for the automotive industry addressing topics such as robot taxis and the workforce shortage affecting the Japanese economy. Oeser asked, as we are completely changing our mobility to more digital, connected and automated, are these new systems robust enough to stand different disaster scenarios, as citizens will become more and more reliant on the technology?

The moderator then moved the discussion to the tools, regulations and standards needed. Al Marzouqi pointed out the importance of tools that help in the understanding of human behaviour. It is also important to ensure the maturity of new solutions before scaling them up from POC to production level. Pinkerton addressed the importance of a regulatory framework that enables innovation for questions such as privacy or AI. In the US, national regulatory frameworks are key in these critical topics. Zammataro said that there is a need for a policy framework for data sharing, showing the decision-makers how they should enable this. She listed six key values: collaborative approach, commitment to sharing value, skills development, harmonisation of data sharing models, building trust and incremental adaptive policy making. Ito pointed out the importance of setting ambitious goals and maintaining close cooperation between government and industry players. Oeser pointed out that roads used to be rather simple structures but, as new systems are implemented, fallback solutions are needed for scenarios where power supply and communications networks are shut off.

The next topic for the panel was how we can harness and integrate elements to ensure a resilient mobility system. Pinkerton proposed to focus on people and the economy. She also stressed the importance of proactiveness and prediction abilities. Zammataro agreed on the importance of proactivity and prediction, which can generate massive savings in terms of safety, resources and money. Al Marzouqi highlighted their own mobility strategy, that integrates several topics such as new energy sources, enhancement of cycling and public transport, last-mile services and automated vehicles. The idea is to offer several possibilities and let people choose the best option for themselves. In Japan, the government and the industry have realised the importance of semiconductors and are investing in new types, as well as in the reliability of the semiconductor supply chain. Oeser pointed out that, in Germany, positive road safety development has recently stagnated and there has

been more potential in proactive road safety analytics where new solutions, such as AI, are used to analyse data near-misses and develop infrastructure proactively before accidents happen.

Finally, the moderator asked the panel for key takeaways, which are:

- A sense of urgency – it is time to act now
- The importance of public-private partnerships
- That the happiness of people is a duty of public sector players
- Rather than looking at problems, look at opportunities to learn, grow and deliver value to people.
- ITS that is efficient, robust, sustainable and inspires young people and brings new minds to the sector is essential, moving forward.

3.1.2 PL 2: ITS Beyond the Road: Interconnecting All Transport Modes

Moderator:	**Laura Chace**, President and CEO, ITS America, USA
Keynote speaker:	**Burhan Al Hashemi**, Enoc, United Arab Emirates
Panellists:	**Erwin Verstraelen**, Vice President Innovation, Ports of Antwerp & Bruges, Belgium
	Sarah Sharples, Chief Scientific Adviser, Department for Transport, UK
	Tina Wagner, Director-General for Transport, Ministry of Transport and Mobility Transition, City of Hamburg, Germany
	Firas Ibrahim, Director, Office of Research, Development and Technology, U.S. Department of Transportation, USA
	Meng-Fen Wun, Chair, Taiwan Telematics Industry Association; Chair, Taiwan Drone Alliance; Former Vice Minister, Ministry of Transportation and Communications, Chinese-Taipei

This plenary aimed to discuss some of the hallmarks of innovation in ITS as its scope expands beyond the road. The discussion focused on balancing the development of new tools in a single transport mode with fully integrated cross-sectorial solutions across all modes.

The session began by announcing the regional winners of the ITS Industry Hall of Fame:

- *EMEA:* **Swarco**, for the company's focus on sustainability and contributions to the evolution of mobility.

- *Asia-Pacific:* **Mass Rapid Transit (MRT) Jakarta**, for their innovative ticketing approach and efforts to enhance passenger experience.
- *America:* **Spoke**, for their solution that helps to enhance safety for vulnerable road users, such as cyclists, using V2X technology.

Keynote speaker **Burhan Al Hashemi** set the scene by talking about how ITS can help to connect transport modes. His view is that intelligent transport systems are no longer a luxury but a necessity if we are to meet our sustainability objectives. Al Hashemi referenced the development and trials of solutions such as autonomous drones, smart ports and urban air mobility as drivers for growth. He drew connections between regional ITS projects such as the Dubai air taxi project, the UAE Energy Strategy 2050 and his own organisation Enoc's investments in sustainable fuels.

Themes emerging from the panel discussion included:

- Modernisation of ageing infrastructure to increase efficiency and capacity
- Integration across transport modes and breaking down siloes to take a whole system approach
- Improving transport sustainability through modal shift
- Improving transport safety.

Erwin Verstraelen talked about transparency as the foundation for innovation and improved efficiency in ports, referencing promising innovations implemented in Antwerp and Bruges such as remote operations for ships to tackle labour shortages in the sector.

Sarah Sharples highlighted the greenhouse gas emissions from transport as one of the big challenges, contributing to 28% of all UK greenhouse gas emissions. She added that the challenge is often knowing when to maintain existing ageing infrastructure versus when to improve it, seeing an opportunity in technology such as digital twins to analyse whole transport systems and understand end-to-end journeys. She referenced the government-funded innovation competitions in the UK in areas such as AI traffic prediction in the Port of Dover as a driver for change.

Tina Wagner built on this by pointing to the City of Hamburg's climate protection strategy to become almost carbon neutral by 2045. She sees the modal shift as a big part of this, with the city aiming for 80% of all trips to be made by 'sustainable modes' by 2030 while recognising they still have some way to go to achieve this. One of their biggest blockers is the sectoral focus of current transport management, making the integration of different modes a challenge.

Firas Ibrahim turned the conversation towards safety, referencing the estimated 1.2 million annual deaths on roads across the world. His view was that ITS solutions such as vehicle-to-infrastructure communications (V2I) exist and can save lives today. From a multi-modal perspective, he agreed with the need for a system-wide view, stating that artificial intelligence (AI) can help us get to this point but that we need the digital infrastructure to enable it. He also agreed on the need to break down silos and stop thinking in terms of 'road authorities' or 'rail authorities' but conceded that this was not an easy task.

Meng-Fen Wun added that Taiwan has a very high incident rate and poor driver behaviour, which impacts negatively on road safety. He put forward that ITS needs 'eco-system thinking' across modes to help integration and sees 5G (and beyond) as an enabler for the use of ITS technology and AI. He referenced pilot projects for V2I taking place in some parts of Taiwan, but that the cost is often prohibitive for more rural areas.

In the question-and-answer session, the panellists discussed data as an enabler, agreeing that most of the data we need to improve transport systems already exists but blocks remain around data sharing, particularly with private companies looking to profit from their data. They also discussed the challenges of a 'one size fits all' mindset across transport modes that have very different constraints, for example in the electrification of road vehicles versus trains.

Finally, the panellists touched on wider challenges such as cyber security, data privacy and regulation in enabling and encouraging modal shift. The consensus was that we have the data, we have the tools and now is the time to 'roll up our sleeves' and create the change.

3.1.3 PL 3: Accelerating Mobility Transition Towards Smarter and more Sustainable Cities

Moderator:	**Zeina Nazer**, Co-founder, Cities Forum, UK
Keynote speaker:	**Mohammed Al Mudharereb**, CEO of Corporate Technology and Smart Services, RTA, UAE
Panellists:	**Faysal Ali,** Vice President-Design & Planning Studio, Parsons Corporation, UAE
	Jon Newhard, CEO, Yunex Traffic, Germany
	Ramin Massoumi, Global Solutions Director – Mobility, Arcadis, USA
	Yandong Fan, Head of Strategy and Planning, Transurban, Australia
	Addison Ferrell, Skyports

This plenary focused on sharing views on priorities, best practices, evidence of outcomes and lessons learned from different cities around the world, including the public as well as the private sector, from political decisions to concrete change and solutions. Panellists discussed experiences from pioneer cities and communities that can be widely applied to drive the shift towards smart and sustainable cities.

Keynote speaker **Mohammed Al Mudharereb** opened the session by referring to smart cities as a 'lighthouse of hope' to deal with the challenges of increasing urbanisation and population growth, with ITS at the core. He referred to the increasing autonomy and connectivity of vehicles and AI-driven traffic management as drivers of the growth of the ITS market globally. He pointed to the Dubai autonomous metro and

the RTA traffic management command and control centre as examples of global leadership in this area. His closing message was that the price of inaction is too high, the benefits are clear and we have the technology to achieve them.

Faysal Ali used the analogy of the human body, referring to ITS as the 'nervous system' for prosperous and thriving communities that need to be connected. As we are building cities for people, not cars, we need to focus on user experience. He sees decision-making driven by real-time data as the core of ITS, which can bring efficiency improvements leading to economic benefits.

Jon Newhard agreed with the importance of user experience, alongside increasing sustainability and electrification of mobility. He sees opportunity in cloud and edge computing to help us solve complex problems but cautioned that these are enabling technologies. We therefore first need to ask ourselves what we are trying to enable, which requires thought and good policy.

Ramin Massoumi used the example of a smart home thermostat to illustrate the benefits of 'smart city' technology. He believes our transportation systems need to be more dynamic and based on demand to be more efficient, while always keeping in mind 'the why'. He summarised this by bringing the conversation back to thriving communities, saying we are ultimately serving the public who want access to high-quality jobs and services.

Yandong Fan referred to the combined challenge of growing populations and ageing infrastructure, relevant to cities in Australia and across the world. He discussed the potential of public and private sector partnerships to deal with challenges like traffic congestion under constrained budgets. He brought up the topic of road user charging, saying this needs to be fairer to the public, before pointing to examples of collaboration in his home city of Melbourne, such as the Westgate tunnel, aiming to take 9,000 trucks a day off of residential roads.

Addison Ferrell spoke about the practical challenges of electrification of transport infrastructure, particularly the air taxis being piloted in Dubai. Bringing 1-2 MW of charging infrastructure to a site that was not designed to cater for this is 'non-trivial' from both a technical and regulatory perspective. Similar challenges are being faced by those electrifying ground transportation.

The panellists went on to discuss the multiple layers of sustainability, the need to future-proof ITS infrastructure to avoid multiple replacements and the importance of digitising assets for predictive asset management. Similar to other sessions at this year's congress, the panellists tended to conclude that the technology of the future is already here, the effort now should be on reaping the benefits.

3.2 International and Regional Forums

The forums aimed at providing opportunities to discuss a broad range of challenges for future mobility ecosystems, present research and deployment programmes addressing these challenges and tools and services developed to provide solutions.

3.2.1 IF 1: Data and AI for Future Mobility: What's at Stake?

Moderator:	**Martin Russ**, Managing Director, AustriaTech – Federal Agency for Technological Measures Ltd, Austria
Keynote speaker:	**Christian Haas**, CEO, UMovity (Econolite & PTV Group), Germany
Panellists:	**Max Lemke**, Head of Unit, European Commission DG CONNECT, Belgium
	Stephanie Leonard, Head of Government and Regulatory Affairs, TomTom, Belgium
	Sanjeev Ghate, CEO, Mobilisights (Stellantis), USA
	Erik Dietz, President and COO, Michelin Mobility Intelligence, North America, USA
	Mike Rudge, Chair and President, ITS New Zealand, New Zealand

AI has the potential to revolutionise the mobility industry by enhancing connected and automated vehicle services, improving traffic management, personalising Mobility as a Service (MaaS), and optimising electromobility infrastructure and battery use. However, concerns about data privacy, safety, security and the carbon footprint of AI remain significant. The European Union has implemented regulations like the Data Act and AI Act to address these issues, though some worry these regulations might hinder innovation.

In this session, the panellists discussed:

- The need for trust and regulation underpinning data ecosystems
- Data quality and standards
- Business models and performance indicators
- The role of AI and data in the safety and efficiency of mobility.

Keynote speaker **Christian Haas** set the scene by talking about the history of AI since the 1960s, as well as its use today in enabling ITS solutions and autonomous vehicles. His message was that data is the fuel for all AI systems and, therefore, at

the heart of the 'AI revolution'. In the context of the ongoing convergence between planning and real-time systems, AI can enable the optimisation of traffic flows and predictive maintenance of infrastructure in mobility systems but only if the data that underpins it is in place. Christian's call to action was to prioritise investment into robust data infrastructure to enable AI, with the ultimate aim of getting more value from the physical infrastructure we have today and creating the building blocks for smart city ecosystems.

In the forum discussion, the participants tended to agree with Haas's view that AI has huge potential to improve mobility but had differing perspectives on the key challenges and opportunities, which contributed to a rich debate.

Gaining the trust of data owners, users and sharers emerged as a key topic, with **Max Lemke** stating the need for the right balance between regulation, to ensure the appropriate use of data, and innovation, to enable the outcomes we are aiming for by using AI tools. He pointed to the European Commission's regulation on the use of AI as a pioneering example in this area.

Erik Dietz agreed on the importance of trust, adding that the aim should be to maintain individual rights and privacy (a particularly hot topic in the United States) without giving up potential safety and efficiency gains. He pointed out that users of AI systems need to be careful about the potential for re-identification when combining data sources that have previously been anonymised, to maintain trust that data is secure and to protect privacy.

Sanjeev Ghate reiterated this point by saying that all eco-system partners need to trust the AI and data systems and that this trust is 'the bedrock without which nothing useful will be built'. Ghate went on to talk about the importance of quality and harmonisation of data against standards to enable its easy use by those creating AI-driven services in the mobility sector. The panellists discussed how data used by AI systems need to be representative and of the right quality while recognising that they will never be perfect. Data biases and imperfections can be mitigated but not eliminated.

Stephanie Leonard brought a commercially focused perspective to the panel, talking about the need for a sound business model for converting data into useful information. She discussed the need to focus on sectoral use cases rather than generalised AI, and that, without the use of AI tools, both the sustainability goals and competitiveness of the ITS industry are at risk.

Mike Rudge brought the conversation back to the purpose of mobility systems as a whole, stating that mobility is about making society work. His view was that AI and data create opportunities but that we need to avoid the introduction of new risks. He proposed the need for more conversation around consistent Key Performance Indicators (KPIs) to reflect the various targets around safety, efficiency and sustainability of mobility and avoid starting with the data and ending up with the wrong solution. **Leonard** countered that, while a valid point, she feels the ITS industry is already delivering on this.

Safety was naturally a core part of the conversation. **Dietz** pointed towards the c.42,000 lives lost annually to road traffic incidents in the United States as a wake-

up call for the industry. **Leonard** talked about generative AI being the game changer, and **Rudge** commented that AI and data give governments more tools to measure and manage the safety and efficiency of road networks.

In summary, the forum participants agreed on the potential of AI and data to improve safety, efficiency, equity and sustainability of mobility but provided a warning on the risks of losing the trust of all data ecosystem members, imperfections and biases of underpinning data, and the need for sound commercial business models and outcomes to justify investment.

3.2.2 IF 2: Harnessing Intelligent Transportation Systems for Safe and Sustainable Futures

Moderator:	**Selika Josiah Talbott**, Founder & CEO, Autonomous Vehicle Consulting, USA
Keynote speaker:	**Brian Cronin, Director**, Director, Intelligent Transportation Systems Joint Program Office, U.S. Department of Transportation, USA
Panellists:	**Mina Sartipi,** Director of CUIP, University of Tennessee, Chattanooga, USA
	Tracy Larkin-Thomason, Director, Nevada Department of Transportation, USA
	Abbas Mohaddes, Chairman of the Board, Umovity, USA
	Ronald Wu, Special Assistant to President, HwaCom Systems Inc., Chinese-Taipei
	Angelos Amditis, Chairman of the Board, ERTICO/ICCS, Greece

The forum provided an in-depth exploration of the transformative role of ITS and emerging technologies in advancing safety and sustainability in transportation networks. Participants examined how these technologies can address long-standing challenges in safety, environmental sustainability and economic resilience by delivering innovative solutions that revolutionise the way transportation systems operate.

Central to the discussion was the potential of ITS to optimise traffic management, enhance mobility and reduce accidents while simultaneously lowering environmental impacts through reduced emissions and energy efficiency. Panellists emphasised the importance of applying these technologies across diverse settings, tailoring solutions to meet the unique needs of both urban and rural communities. This approach ensures equitable access to safer and more sustainable transportation systems for all populations, particularly underserved and vulnerable groups.

The session also explored actionable strategies and best practices for designing transportation systems that are not only safe and resilient but also equitable and environmentally conscious. These strategies include harnessing data analytics and artificial intelligence for predictive safety measures, fostering public-private

collaborations and prioritising investments in clean and sustainable infrastructure. Panellists highlighted the importance of comprehensive stakeholder engagement involving policymakers, technologists, urban planners and community representatives to ensure the broad applicability and success of these solutions.

In conclusion, the forum underscored the critical role of ITS and emerging technologies in shaping the future of transportation. By leveraging these advancements, stakeholders can design smarter, safer, and greener mobility systems that prioritise safety, sustainability and equity, paving the way for a more connected and resilient future.

3.2.3 IF 3: Innovations for Integrated ITS

Moderator:	**Xiaojing Wang**, Chairman, China ITS Industry Alliance, China
Keynote speaker:	**Steven Lui**, President of ITS Hong Kong and Technical Director of AECOM, Hong Kong
Panellists:	**Darren Capes**, Senior Manager, Department for Transport, UK
	Fred Kalt, President, ITS Singapore, Singapore
	Akhiles Srivastava, President, ITS India Forum, India
	Alasdair Cain, Director of Research Development and Technology Coordination, U.S. Department of Transportation, USATaipei
	Kurtis McBride, CEO, Miovision, Canada

The forum focused on recent global advances and innovations in integrated ITS, highlighting developments such as on-demand mobility services for seamless travel, integrated service systems for transportation hubs, multimodal transportation and logistics integration systems. These innovations aim to enhance the efficiency, resilience and cost-effectiveness of transportation networks while addressing evolving societal needs.

Key discussions centred on the cost-effectiveness of these integrated systems, evaluating their ability to deliver high-value solutions without imposing excessive financial burdens. Participants also explored the efficiency and resilience of these systems, emphasising their potential to generate significant social benefits, such as reduced travel time, improved accessibility and enhanced safety.

The forum further examined the types of innovations that gain widespread acceptance and satisfaction among both the public and management authorities. Examples included user-friendly multimodal platforms, environmentally sustainable logistics solutions and technologies that streamline operations at transportation hubs. These advancements underscore the importance of aligning technical feasibility with user expectations and regulatory requirements.

Looking ahead, panellists discussed the future directions for innovation, such as greater integration of artificial intelligence, data-driven decision-making and

enhanced collaboration between public and private sectors. Emphasis was placed on creating adaptable and scalable systems that can meet the needs of diverse populations while addressing emerging challenges like climate change and urbanisation.

In summary, the forum underscored the transformative potential of integrated ITS in shaping more efficient, resilient and user-centred transportation ecosystems, providing a blueprint for future advancements in mobility and logistics.

3.2.4 IF 4: Using AI in ITS – What is the Impact?

Moderator:	**Monali Shah**, C-level, Google and Inflowai
Keynote speaker:	**Shailen Bhatt**, COO and Senior Vice President, AtkinsRealis
Panellists:	**Garett Eucalitto**, Commissioner, Connecticut Department of Transportation, USA
	Craig Hutton, Associate Assistant Deputy Minister, Policy Group, Transport Canada, Canada
	Scott Marler, Executive Director, Iowa Department of Transportation, USA
	Tim Chen, President, TMS Technologies CO., LTD, Chinese-Taipei
	Doug Priest, Public Transportation Lead – Microsoft Worldwide Government, Microsoft, USA

This forum aimed to cut through the hype around AI to explore the aspects of our transportation systems that would most benefit from its application.

Keynote speaker **Shailen Bhatt** set the context of the session, talking about the potential for AI within ITS to help save lives on roads when deployed at scale. He sees AI as a way to understand why incidents are happening and how to prevent them, as well as being a driver for sustainability by modelling risks such as fires and flooding. His ending statement was that it is not possible to consider the future of mobility without considering the potential and impact of AI.

Monali Shah, the session moderator, introduced the 'types of work' AI can improve: getting insights out of data, automation of repetitive tasks and better service delivery. She went on to present the AI 'mission impacts' of more proactive safety, resilient systems, workforce satisfaction and constituent engagement, before passing on to the panellists for their views.

Garett Eucalitto talked about AI as an opportunity to address the Connecticut Department of Transportation's new mission statement of 'improving lives through transportation'. He referenced the challenges of fiscal constraints and labour shortages, which affect many public authorities in the US and beyond, that AI has the potential to mitigate. He presented the challenge of data needing to be clean, authoritative and mature to be able to use AI tools, giving the example of incorrect

data inputs from employees who may not be 'data literate' leading to skewed analysis and decision-making.

Craig Hutton focused on the policy development process and how AI can help tie this back to practical implementation when targeting goals such as safety and resilience. Challenges faced by Transport Canada include supply chain management, managing increasing freight movements and disruptions due to cyber security threats and labour shortages. He sees potential in the predictive value of AI to help set the right key performance indicators and pursue these via policy.

Scott Marler built on this point, stating that, in Iowa, the Department of Transportation is looking to connect strategies more directly to technologies such as ITS and AI. Critically, this is not 'technology for technology's sake' but starts with a clear purpose, such as improving safety. He sees the impact of AI in three areas: connecting disparate data sources, understanding patterns and predictions and increasing the speed of data insights. He referenced the use of AI in wrong-way driver monitoring as a practical example of these benefits in action.

Tim Chen turned the conversation towards AI for transport capacity management, referencing the use of AI in Taiwan for large events such as concerts, using AI insights to change schedules of long-distance transport and shuttle buses to manage demand. On safety, Tim called Taiwan a 'living hell' for pedestrians. He saw AI as a way to understand traffic performance, driver and pedestrian behaviours and risks at roadside or intersections.

Doug Priest focused on the underlying digital technology needed to properly implement AI tools, such as data analytics for transport modelling and planning. From his experience, the most successful implementations start with specific outcomes and clear metrics for measuring success before figuring out the digital infrastructure needed to achieve this.

The remaining panel discussions touched on some specific examples of AI impact in action, for example reducing the need for experienced snow-plough drivers in Connecticut, US and Robotaxis in Wuhan, China, as well as gathering insights from unstructured organisational data.

3.2.5 IF 5: Cooperative ITS – Automated Vehicles and large-scale real-world applications

Moderator:	**Dean Zabrieszach** Chief Executive Officer, HMI Technologies Pty Ltd/Ohmio Automotion Ltd, Australia
Keynote speaker:	**Xiaojing Wang**, Chairman, China ITS Industry Alliance; President, Intelligent Transport System Establishment Suzhou, China
Panellists:	**Sebastien Glaser**, Intelligent Transport Systems, CARRS-Q, Australia
	Kimihiko Nakano, University of Tokyo, Japan
	Richard Chuang, Turing Drive Inc., Chinese Taipei
	Russel McMurry, Commissioner, Georgia Department of Transportation, USA
	Joost Vantomme, CEO, ERTICO-ITS Europe, Belgium

Co-operative Intelligent Transport Systems (C-ITS) technology enables road users and infrastructure to communicate with each other, sharing information about road conditions, disruptions, traffic flow and safety incidents. C-ITS has been proven to have the potential to provide significant safety benefits by detecting and providing advanced warnings to drivers to prevent incidents and improve the efficiency of transport networks.

This forum discussed experiences of deploying large-scale CAV in urban environments, considering practical issues such as:

- What needs to be done prior to deployment?
- What are the opportunities for cost-saving for the broader network management and safety initiatives?
- How are government and industry collaborating to deliver on the safety and efficiency benefits C-ITS offers, and what works best?
- What needs to be done to enable effective data sharing for C-ITS, guaranteeing security and privacy governance that protects citizens and governments?

Keynote speaker **Xiaojing Wang** talked about how V2X is moving towards practical deployment across the world. He referenced the importance of regulations to enabling C-ITS and automated driving, as well as understanding the conditions of the road and its suitability for autonomy. He spoke on some of the cooperative ITS initiatives in China, including the 60km^2 Beijing test area, Wuhan's Robotaxi service and the pilot of an integrated system for intelligent connected vehicles. He closed by stating that there are still doubts about the safety of autonomous vehicles in the general public and that social equity and inclusion should be a focus topic for everyone; autonomy is not just for cars but also public transport, logistics and those with differing needs.

Sebastien Glaser talked about the application of C-ITS in the agricultural and mining sectors in rural and remote regions. He referred to the training centres developed in Australia to build workforce capacity challenges identified in the industry. He sees a need for innovation roadmaps to help businesses identify opportunities for C-ITS use cases that benefit end users.

Kimihiko Nakano presented a variety of Level 4 automated driving pilots deployed in Japan, including within Fukui prefecture and Haneda innovation city in Tokyo, as well as R&D deployments in Eiheji town, autonomous buses in Hitachi city, automated trucks on expressways and cooperative systems in mixed spaces in Kashiwa city.

Richard Chuang focused his presentation on autonomy in low-speed vehicles. His company (Turing Drive) are seeing demand for low-speed autonomy from manufacturers and manufacturing logistics, as well as tourism destinations such as national parks, which were to run self-guided autonomous shuttle tours. He talked about the importance of proactive risk management, with technology such as over-the-air updates for autonomous vehicle software being essential to gaining and maintaining trust.

Russel McMurry talked about the C-ITS deployments in his home state of Georgia, referring to this as the 'largest deployment of C-ITS tech in North America'. He explained how the state started small with a corridor approach in Atlanta using Federal DoT funding, then took a risk to scale up after the initial pilot. Today, they have 2,000 signals with C-ITS roadside units deployed and have built a grid network off the back of the initial corridor at a cost of just under USD 20m. His message was that 'Georgia is ready' for connected vehicles and will continue to deploy C-ITS across the state.

Joost Vantomme focused on three main topics: the European policy framework, deployment of connectivity and automation and physical and digital infrastructure needs for CCAM. He talked about safety, infrastructure, public acceptance and trust as key enablers, and that, once lost, trust is very hard to get back. He stated that there is no 'one size fits all' approach and that a lot depends on the appetite of vehicle manufacturers to invest, given their priorities around electrification and competitive advantage.

The panellists discussed the challenge of public acceptance in detail, speaking about the need for tangible use cases, clear communication and, ideally, public demonstrations.

3.2.6 IF 6: Urban Mobility Innovation: Will drones really change life in cities?

Moderator:	**Dónal Hodgins**, Head of Sustainable Transport & Traffic Management / ITS Nationals Vice Chair, Kildare County Council / ITS Ireland, Ireland
Keynote speaker:	**Daniel O'Neill & Addison Ferrell**, Skyports
Panellists:	**Laure Glatron**, Chief Business Development Officer, Crisalion Mobility, Spain
	Khaled Al Awadhi Director – Public Transport Agency, Roads & Transport Authority of Dubai, UAE
	Beth Kigel, Vice President, HNTB, USA
	Vassilis Agouridas, Project Manager, ERTICO
	Tongkarn Kaewchalermtong, President, ITS Thailand, Thailand

With two-thirds of the global population expected to live in cities by 2050, urban mobility challenges from greenhouse gas emissions and congestion are becoming increasingly important, with goods deliveries from e-businesses being a significant contributor. Innovations such as cooperative, connected and automated mobility, micro-mobility, shared mobility, active mobility and improved public transport aim to make urban mobility safer, more efficient and more sustainable. Additionally, drones and Urban Air Mobility, including delivery services and air taxis, are being trialled worldwide, including in Dubai, to address surface transport problems.

Sadly, foreseen speaker Daniel O'Neill was not able to make the session due to a road accident earlier in the day, so his colleague **Addison Ferrell** gave the keynote address. Addison spoke on the many use cases for advanced air mobility, from drones for passenger and cargo transport to air taxis in cities. He pointed to the air taxi deployment his company Skyports is working on with Dubai RTA and Joby as leading the way in this space. He also referenced the value of small cargo drones in transporting high-value goods to remote locations such as the North Sea, along with the challenges that still remain around the integration of urban air mobility with existing infrastructure, public perception and regulation.

The panel discussion focused on the themes of regulation, innovation, public/user acceptance and positive impacts.

Laure Glatron started by saying that regulation for urban air mobility was moving forward well in Spain but 'not there yet'; better harmonisation across Europe is still needed. She referenced the design of a new electric vertical take-off and landing (eVTOL) vehicle that her company Crisalion is developing as an example of innovation to improve safety and stability. Glatron sees the positive impacts as potentially 'unlimited' but customer acceptance is a key challenge as, ultimately, we are talking about flying cars!

Khaled Al Awadhi spoke about the desire of Dubai RTA to introduce more self-driving transport into the city and enable the '20-minute lifestyle' in communities through better transport. He saw regulation as a challenge they are working on; for example, gaining accreditations for air taxis to operate within the city. He pointed to

battery technology innovation as a necessary element to enable longer-range travel and referred to the autonomous Dubai metro as a successful case study in gaining public trust in autonomous transport.

Vassilis Agouridas highlighted ERTICO's role in urban air mobility across Europe and in launching an aerial services innovation platform to drive progress. He spoke about the challenge of regulating a totally new technology and the need to think about how to certify this alongside existing technologies. He pointed to the distributed population as a key innovation allowing new architectures for drones and air passenger vehicles. He touched on public acceptance as another challenge, with factors such as the impact on wildlife, equity and affordability being of high importance to surveyed users.

Beth Kigel spoke about the role of ITS America's air mobility working group (where she is vice-chair) in visioning, planning, policy and overseeing execution. She referred to the potential conflict between Federal, State and Local Government authorities on the use of drones in the United States, particularly in areas such as beyond visual line of sight operations. Innovation in airspace management is a big focus for ITS America, with intermodal connectivity and remote IDs for drones being key enablers. She pointed to the need for clear communication of use cases and benefits to encourage better public acceptance.

Tongkarn Kaewchalermtong spoke on the privacy and security concerns for air mobility in Thailand, along with the need for better cross-border collaboration. On innovation, he referenced the potential for artificial intelligence and machine learning to help drones avoid collisions and make independent decisions. He agreed with the point made by Beth Kigel on the need for better education on use cases and benefits.

Across the panel discussion, there was, unsurprisingly, agreement on the potential positive impact of urban air mobility and drones, as well as on the challenge and importance of regulation and public acceptance, if aspirations are to be made a reality.

3.2.7 IF 7: Fair Mobility as a Service (Fair MaaS) towards Digitalised Sustainable Transportation

Moderator:	**S.K. Jason Chang**, Professor, National Taiwan University, Chinese-Taipei
Keynote speaker:	**Young-Jun Moon**, Professor, KAIST, South Korea
Panellists:	**Mohammed Hikmet,** Executive Chairman, HMI Technology Ltd., New Zealand
	Sangho Choo, Professor, Hongik University, South Korea
	Vimal Rau Aparow, Assistant Professor, University of Nottingham Malaysia, Malaysia
	Roelof Hellemans, Secretary General, MaaS Alliance, The Netherlands
	Kurtis McBride, CEO, Miovision, Canada

The full value of enhanced mobility applications can only be unlocked if it is accessible to all in an equitable manner. The concept of fair mobility as a service (MaaS) leverages the mobility ecosystem for shared and equitable transportation by means of digitalisation and sustainability in order to balance fairness by age, gender, income level, urban and rural divide and mode of transport.

This forum discussed the question: how can MaaS be fair to the public by incorporating the real benefits of digitalised sustainable transportation technology as well as policies?

Keynote speaker **Young-Jun Moon** introduced the topic of 'fair MaaS' that he himself coined in a previous world congress as a way to conceptualise the next generation of mobility. He argued that current discussions on ITS focus almost exclusively on car transport. Fair MaaS is about enabling quality of life every day wherever you live and whatever you do, whether in rural or urban environments, for vehicles or pedestrians, independent of age, gender and wealth. He tied this back to the UN's sustainable development goals and challenged everyone to think about whether mobility as a service is currently fair to all.

Mohammed Hikmet focused his presentation on the inclusivity of transport solutions, from the perspective of a manufacturer of autonomous shuttles. He presented three pillars to enable inclusivity: digitalisation (including real-time information and on-demand mobility), sustainability (including shared transport and resource efficiency) and equity (accessibility for all).

Sangho Choo presented the elements of fairness, integrated services and social inclusiveness to enable 'Fair MaaS'. He referenced innovative applications of fair MaaS in Korea, such as the e-MaaS project, integrating energy and transport systems.

Vimal Rau Aparow steered the conversation towards safety and security as the main concerns for users of MaaS. He referenced Nottingham University (Malaysia)'s research as an assessment framework to analyse the safety and security of MaaS by integrating standards.

As a case study, they are turning the university campus itself into an 'integrated smart university'.

Roelof Hellemans' position was that the technical layers for fair MaaS exist in that we are technically capable of connecting systems and people. The challenge is to make these systems accessible to all, which requires integration between the government / public sector and the public. He referenced the MaaS Alliance's focus on understanding the tools that can be used or created to enable this integration.

Kurtis McBride offered a technology perspective on standards development. He sees open standards coming from the automotive world and telecoms world 'colliding' with ITS where many standards are proprietary. His view is that we owe it to citizens to open up some of the more proprietary systems to enable fairness in mobility.

The panel discussion began with the statement that emphasis should be on reducing unfairness, as we can never get to a place of 'complete fairness'. The discussion itself was high-level and broad on challenges faced in this space, peppered with a few specific examples, such as the unfair distribution of 5G connectivity in Malaysia and the impact of urban planning decisions in Korea on house prices, which price younger generations out of the housing market.

The main takeaway from the session was that we should aim to reduce unfairness in our mobility systems but the discussion highlighted the complexity of this issue. It is clear we are currently far away from achieving Dr Young-Jun Moon's vision of truly 'fair MaaS'. Part of that vision is that "There will be personal CO_2 allocation (which has the potential to cause there to be CO_2 trading among people). If we all have the same CO_2 allocated, if you have money but have expended your allotted CO_2, you cannot move somewhere without buying more CO_2 from someone who still has some or all of their allotted CO_2."

3.2.8 IF 8: A Green Revolution Against Climate Change?

Moderator:	**Jenny Simonsen**, Chief Operations Officer, ITS Norway, Norway
Keynote speaker:	**Muna Al Osaimi**, Acting CEO, Strategy and Corporate Governance, Roads & Transport Authority of Dubai, UAE
Panellists:	**Connor Allen,** Government & External Relations Manager, Mitsubishi Electric, Belgium
	Axel Volkery, Deputy Head of Unit Sustainable and Intelligent Transport, European Commission DG Move, Belgium
	Kome Ajise, Executive Director, Southern California Association of Governments, USA
	Douglas Wilson, Associate Professor in Civil and Environmental Engineering & Director, University of Auckland Transportation Research Centre, New Zealand
	Emrah Kinav, R&D and Innovation Management Expert, Ford Otosan, Turkey

Electrification is rapidly emerging as a key solution in the global fight against climate change, significantly reducing emissions and promoting sustainability. Essential to this progress is a robust charging infrastructure that alleviates range anxiety and ensures easy access to clean energy, thereby encouraging the adoption of electric vehicles (EVs). However, challenges such as the high financial costs of EVs and infrastructure, along with grid capacity limitations, hinder widespread adoption. Additionally, alternative energy sources like hydrogen are gaining attention for their potential in various applications, including fuel cells and heavy transport.

This forum assessed the role of charging infrastructure, financial incentives, and exploration of alternative fuels like hydrogen in the battle against climate change.

Keynote speaker **Muna Al Osaimi** presented statistics on the uptake of electric vehicles globally and locally within Dubai, where only 2.3% of new vehicle registrations are electric. She talked about public charging and interoperability as a key challenge, before highlighting the RTA strategic vision for Dubai to become a 'world leader in seamless and sustainable mobility'. The scale of this challenge is clear, with only 680 charging points in place across the city. Al Osaimi also presented on Dubai's net-zero aspirations to improve the sustainability of public transport alongside taxis and privately owned vehicles.

Forum moderator **Jenny Simonsen** set three questions for the panellists to consider within the discussion: what barriers are holding us back from electrification; what are the most promising solutions, and; how can we work together across industries and borders?

Connor Allen introduced Mitsubishi as a company with a long history of dealing with complex challenges. He referenced climate change as the 'next threat' they are dealing with across their business and the creation of the Mitsubishi Electric Mobility Corporation as a new venture to address this.

Axel Volkery talked about the almost ten million zero or low-emission vehicles across Europe as a good first step but that there is still a long way to go to have fully low-emission transport. The key barriers he presented included the complexity of the value chain for mass market vehicles and energy infrastructure for heavy-duty vehicles in particular, which require large grid capacity improvements across Europe.

Kome Ajise introduced the Southern California Association of Governments (SCAG), which covers six counties and 191 cities in the US. They are approaching electrification from an air quality perspective and targeting the electrification of shipping. The biggest challenge they face is also grid capacity, which needs to be doubled in the near future to meet their aspirations. Ajise also referenced permitting and development times as a blocker to achieving fast electrification.

Douglas Wilson brought a perspective from New Zealand, where the transport network is relatively low-density and financial resources for investment are limited. He focused on the potential for unintended consequences of electrification; for example, mass uptake of plug-in vehicles causing challenges to grid supplies into homes. He presented wireless charging as a potential solution but one which is part of a 'toolbox of technologies' available.

Emrah Kinav spoke about the view of automotive manufacturers, many of whom see themselves as 'mobility companies' rather than just manufacturers. He referenced the various priorities of manufacturers in electrification, automation and connectivity, and the importance of partnerships in the research and development and commercial deployment of these technologies.

The subsequent panel discussion touched on alternative fuels such as hydrogen, particularly for heavy goods vehicles, the importance of taxation and the need for public-private partnerships to achieve change. A lively debate took place on the practical potential of wireless charging, with Douglas Wilson as a strong advocate, based on the research from the University of Auckland.

A key takeaway point from the panel was the importance of expanding grid capacity at scale to enable further electrification of transport, the development of which is currently moving too slowly to meet the world's electrification aspirations.

3.2.9 RF: Safety Potential of Connected Automated Vehicle Technologies for Passenger and Freight Operations

Moderator:	**John Barton**, Senior Vice President HNTB Corporation, USA
Keynote speaker:	**Dan Lukasik**, Vice President, Parsons, USA
Panellists:	**Roger Millar**, Secretary of Transportation, Washington State Department of Transportation, USA
	Brock Aun, VP of Communications & Public Policy, Haas Alert, USA
	Nicole Majeski, Cabinet Secretary, Delaware Department of Transportation, USA
	Tilly Chang, Executive Director, San Francisco County Transportation Authority, USA
	Tony Tavares, Director, California Department of Transportation, USA

Ensuring safety within the transportation network is a major priority for Infrastructure Owners and Operators (IOOs). In the United States, state Departments of Transportation are particularly focused on reducing the over 40,000 fatal vehicle crashes each year, which result in around $250 billion in direct costs and $800 billion in societal costs. The use of Connected Automated Vehicle (CAV) technologies in passenger and freight operations presents a promising opportunity for IOOs to achieve substantial safety improvements.

In this forum, IOO leaders from states and localities shared insights on:

- deployment use cases,
- how to align stakeholders to address legislative, privacy and equity challenges, and
- the role of information supporting automation.

Panel moderator **John Barton** set the context on safety by quoting recent statistics for annual road deaths in the USA (approx. 41,000) and internationally (approx. 1,200,000). He referenced road crashes as the leading cause of death for ages 5-29 across the world.

Keynote speaker **Dan Lukasik** gave some examples of using connected vehicle technologies to improve transport that his company Parsons has been involved in, including analytics to understand truck queues at port crossings, transit-only lanes in San Diego, and in-vehicle pedestrian and cyclist warnings in Chicago.

Roger Millar described how the Washington State Department of Transport are thinking about Connected, Cooperative and Automated Mobility (CCAM) from a multi-modal perspective. Their top priority is implementing a safe system approach to reduce deaths on the road, which currently stand at around 800 per year across the state.

Millar referenced a sixth 'leg' to this approach on safer land use, attempting to reduce dependence on car use by giving residents choices on how they travel and investing in active travel infrastructure.

Brock Aun introduced his company Haas Alert as a digital alerting specialist, addressing the issue that conventional sirens on emergency vehicles are becoming less effective, particularly for autonomous vehicles. He pointed out that 2.3m Stellantis vehicles are currently receiving alerts directly into vehicles and Mercedes has now launched a Beta trial in North America to do the same.

Nicole Majeski talked about the challenges Delaware State face around road flooding (as the lowest-lying state in the US) and managing a public transport and road network in a small state with large influxes of tourists. She presented safety as their top priority, and echoed Roger Millar's points about the importance of a safe system approach, recognising that people will make mistakes on the road and the aim is to stop these mistakes from turning into tragedies.

Tilly Chang referred to her authority in San Francisco as 'technology optimists' as they believe in the potential benefits it can bring. She recognised the need for partnerships with industry and referred to examples such as the Robotaxi service led by Waymo and the autonomous shuttle pilot on Treasure Island. Chang stated that the authority is maturing in their approach to safety management with emergency response services, and pointed to the importance of documentation, reporting and data to justify the risks, demonstrate learning and gain public acceptance of new technologies.

Tony Tavares brought the conversation back to safety statistics, talking about the unacceptable number of 12 deaths per day on average across roads in the state of California. He pointed to the rollout of vehicle-to-infrastructure technology on ramps as an example of technology helping to minimise crashes and near misses. His call to action was to continue investment and rollout of this technology as it helps to save lives.

The panel discussion went on to cover the differences in safety management for freight vs passenger transport, the importance of education on traffic safety from a young age (taking learning from successful implementation in Norway) and the importance of ground truth accuracy for vehicle-to-infrastructure solutions.

Within the wide-ranging discussion, the panellists gave some tangible examples of how connected and automated vehicle technologies are saving lives today, while recognising that there is much more to do using safe system approaches (not just focusing on technology) to reduce unnecessary road deaths.

3.3 Host sessions

The host sessions were organised by the Congress host and provided a stage to discuss the Congress theme 'Mobility Driven by ITS', focusing on regional and local issues and presenting recent progress made in the Middle East in the deployment of advanced mobility systems.

3.3.1 Innovations Across Horizons: Automated Transport in Water, Rail, Air and Beyond

The first host session focused on innovation and leadership, particularly in Dubai. The UAE relies on the rich and diverse contributions of its people to guarantee its prosperity and sets ambitious goals to motivate innovation. Dubai's RTA has a goal of converting 25% of all journeys to autonomous travel by 2070. The Dubai 10 X Innovation Challenge garnered more than 160 entries from 36 entities, and more than two dozen are now being pursued.

Private companies are also fostering innovation. Joby, the company developing electric four-person air taxis, is partnering with Dubai RTA. Joby has made battery improvements and material carbon frame improvements resulting in aircraft that are five per cent lighter than the Tesla Model 3 and recognises their technology must be affordable, accessible and scalable.

Transurban is advancing infrastructure such as smart roads and toll roads, as well as bike paths, community facilities and autonomous trucks. They are one of the earliest organisations in Australia working on autonomous trucking. Dubai RTA is very motivated to get into autonomous trucking. Part of RTA's strategy is to address logistics and labour shortages through autonomous trucking. RTA is also focusing on outreach to stakeholders to increase support for autonomous taxis.

Other transformative transportation developments on the horizon are data integration and quantum computing, hydrogen-electric propulsion and 3D printing.

Going forward, companies and governments will need adaptive regulation to overcome challenges related to insurance and cybersecurity. Government and private sector companies should work with academia to tackle all of these challenges. Moving forward, we need courage and to communicate a positive vision for new modes of transport. Dubai is an ideal city for advanced transportation technologies.

3.3.2 Connected Horizons: National Connectivity, Cybersecurity and the 5G Frontier

The main message of this session was that progress in transportation is part of all national agendas and includes plans to take advantage of technological developments. New technologies bring new associated risks but concerns can and should be managed. Countries share similar challenges and can share lessons learned but solutions also need to be developed to address specific local needs and concerns. For example, Europe developed the General Data Protection Regulation (GDPR) standard, which has expanded to places like China, California and Washington but has not been – and probably should not be – applied globally.

Some countries have created national mobility roadmaps for connectivity and 5G. When Dubai created a national roadmap for mobility, a major consideration was given to building successful industries and making sure approaches were sustainable.

The ideal in the vehicle-to-everything industry is that countries and companies develop connections between vehicles, infrastructure and road users but there are numerous hurdles. The important part is the applications developed to provide value to travellers' daily lives. Strong bandwidth is a fundamental requirement, and technology is improving with 5G as a foundation.

Challenges related to connectivity and 5G implementation include cybersecurity protections and securing personally identifiable information (PII). Ensuring safety is always top of mind for companies and governments.

3.3.3 Driving Change: Government Policies, Sustainable Planning and Future Fuels

This session focused on public and private sector roles in deploying sustainable transportation solutions. Joby representatives provided a case study of working to deploy electric vertical take-off and landing vehicles (EVTOLs) and government representatives discussed the challenges of harnessing private sector initiatives to meet policy objectives.

Dubai has a growing population and is looking to EVTOLs as a potential form of sustainable transport. They find that air taxis can cut commutes by 60-80%. However, many new entrants to the market lack familiarity with existing aviation regulations, making compliance and safety adherence more complex.

Several steps are required to accommodate air taxi transport, including infrastructure development, addressing technology challenges, ensuring safety and developing consistent national plans related to aircraft certification and use of airspace.

The ultimate goal is for air transport to complement existing transportation and become another viable option for commuters.

The United Kingdom has long had goals of reducing and ultimately eliminating gas/diesel vehicles, but this cannot be done in a vacuum. Broader policy goals related to equity are also important. Mobility programmes need to meet the needs of people with less access to transport, low-income groups, women and girls and people with mobility challenges.

In the UK, cycling and walking are promoted because of their benefits. There is a focus on long-range planning to ensure people have access to resources and more adaptable and flexible transport services. Transportation must also meet the needs of people in rural areas, where providing transit service is particularly challenging. The UK seeks to align transportation policy with housing policy.

Although the UK government wants to take advantage of technological advances, the government is not interested in technology for its own sake but rather in useful technology applications. For example, Oyster Cards and City Mapper are both widely used and provide confidence for people making transit trips. City Mapper uses Transport for London data, which is a good example of the public sector setting the private sector up for success and then stepping back.

A perennial question is how the public sector can encourage the private sector to develop the solutions required to meet public sector goals. The government's role in setting standards and defining what is needed should shape private sector investment. Lessons learned from planning for EVTOL travel include: working across silos, reaching out to stakeholders, developing a common language, gaining perspective from outside our geographies (at events such as ITS World Congress) and paying attention to tax incentives.

3.3.4 Energising the Future: Innovations in Clean Mobility and Intelligent Systems

The host session 'Energising the Future: Innovations in Clean Mobility and Intelligent Systems' highlighted ground-breaking advancements at the intersection of clean energy and intelligent transportation systems. Discussions focused on how emerging technologies and sustainable practices can drive the transition toward cleaner, smarter and more efficient mobility solutions.

Key themes included the integration of renewable energy sources like solar and wind into transportation infrastructure, supporting electric vehicle (EV) ecosystems and developing energy-efficient public transit systems. Speakers explored innovations in EV charging networks, such as ultra-fast and wireless charging, and emphasised the importance of grid integration to support growing energy demands.

The role of intelligent systems in optimising energy use across mobility networks was also a focal point.

Examples included AI-driven energy management platforms, predictive analytics for reducing congestion and connected vehicle technologies that enhance energy efficiency. Panellists underscored the potential of these solutions to reduce emissions, improve system reliability and promote sustainability.

Equity and accessibility in clean mobility were highlighted as critical considerations, with participants advocating for inclusive strategies to ensure underserved communities benefit from these innovations. Public-private partnerships, regulatory frameworks and investments in green infrastructure were identified as key enablers for scaling these solutions globally.

The session concluded with an optimistic outlook on clean mobility's future, emphasising the need for collaboration, innovation and policy alignment to accelerate the shift toward a more sustainable, energy-efficient transportation ecosystem.

3.3.5 Revolutionising Mobility: Customer-centric Tech and Cybersecurity Standards

This session provided an example of an agency (Cincinnati Metro) that used customer-centric thinking and analytics to optimise service and gain ridership. It also provided overarching insights about maximising the benefits of new technologies for transit and customer reactions to automated vehicle technology.

Cincinnati Metro has 309 paratransit and microtransit buses. The agency used advanced planning tools, made service changes based on analytics and increased the reach of its transit service, benefiting customers. The agency also optimised operations and safety using AI-driven predictive maintenance and analysing absenteeism with AI.

Further innovation is needed. Cincinnati Metro identified the following needs: connected vehicle safety applications; customer-centric mobility hubs; services for disabled users or tourists, including walking directions and creating a call centre for one-seat paratransit trips; offering customised rides based on user preferences; and protecting investments by ensuring proper cybersecurity measures.

Other speakers echoed that customers' mobility needs are changing. The e-commerce boom has created new mobility patterns affecting transit. Customers expect multimodal travel experiences and consider climate change a priority.

How will AI benefit riders and improve mobility? Connected consumers are not defined by age but by behaviour. Some customers are digital-first, multi-channel, have high expectations for personalisation, are influenced by peers and social media, consider convenience key and prefer subscription services over long-term commitments. To cater to these preferences, the goal is to create a seamless Mobility Ecosystem, providing information and services anywhere and anytime, as well as new subscription mobility services.

This requires new thinking and the creation of a technology ecosystem based on connected data on a digital infrastructure platform. This also requires strict cyber-security standards: protection, resilience, physical security and consistent standards from state to state.

Regarding the transition to automated vehicles, research shows that riders are most concerned about safety. Younger travellers are motivated to use AVs as they are not as interested in driving. Interestingly, women in particular were more concerned after riding in AV than before trying out AVs.

3.3.6 Securing Tomorrow's Rides: Navigating Cyber Challenges in Mobility

Cybersecurity presents challenges at every step of operations. New technologies require new levels of vigilance. There is no room for error when lives are at stake. Ensuring safety in cybersecurity requires considering everything from supply chains to wireless providers and more. Attacks can be uni- or bi-directional. Systems must be built from the ground up with security in mind and those systems must be guarded with robust infrastructure, including physical protection. Systems require regular security updates. Finally, personnel must be educated to be part of the cybersecurity system.

3.3.7 Navigating Tomorrow: The Confluence of Big Data, Digital Transformation and Smart Technologies in Urban Mobility

Open standards help deliver connected vehicles. Some companies (including Leidos) have V2X standards coordinators. There are resources and tools to support development and testing. Global architectures and standards are needed.

Digital twinning is an exciting new development. Digital twins offer a virtual model of an asset or system for simulation and testing and can be the foundation for integrated transport networks. Imagine a replica of the entire transport network predicting delays and optimising routes. Digital twins can also create a fully integrated passenger experience.

The UK has established a vision to enable an ecosystem of connected digital twins for multimodal UK transport networks to facilitate decision-making to deliver efficient, safe and environmentally conscious mobility for people and goods. Significant economic benefits of nearly USD 2b are anticipated. These benefits will come from multimodal journey optimisation, multimodal incident management, increased traffic capacity and freight management at ports and planned works and maintenance management.

Mobility disruptions include automation, connectivity and electrification. Enablers include sensors, data, the Internet of Things, AI and new business models. AV offers safety and brings challenges. The following trends are evident: urban mobility needs differ vastly; useful data is what matters, whether big or small; there is an imbalance between the global North and the rest of the world; it is time to think about real or true intelligence rather than artificial intelligence.

All speakers advocated for collecting, standardising and sharing data. All discussed precautions are required so that this approach does not negatively impact safety or equity. Standards are needed but often have to be customised for specific environments. Some say there are too many existing standards. The question of who should own and maintain standards is still open. Not every country has a national ITS architecture but many regions do, and even using parts and pieces is helpful. Perhaps an international committee should champion standards with representatives from ERTICO, ITSA and others. There is a need to consider whether it is possible to build equity into data standards from the beginning. All use of data and data standards need to consider human factors design.

3.3.8 Urban Mobility Innovation: Digitalisation and Smart Infrastructure

This host session delved into how digitalisation and advanced infrastructure are reshaping urban mobility. Experts emphasised the pivotal role of emerging technologies like artificial intelligence, IoT, and big data in transforming transportation systems to be smarter, more sustainable and user-centric.

Key discussions revolved around integrating digital tools to optimise traffic management, enhance public transit systems and reduce congestion. Panellists highlighted examples of smart infrastructure, including intelligent traffic lights, sensor-based parking systems and autonomous vehicle corridors, demonstrating their ability to improve efficiency and safety. The session underscored the importance of fostering data sharing between public and private sectors to unlock the full potential of mobility solutions.

Equity and accessibility were also central themes, with speakers stressing the need to design urban mobility systems that serve diverse populations, particularly underserved communities. Innovative financing models and public-private partnerships were identified as critical enablers for scaling smart infrastructure projects.

Looking forward, participants identified trends like mobility-as-a-service (MaaS), connected vehicle ecosystems and the integration of green energy into transport systems as transformative opportunities. The session concluded with a call to action for collaboration among governments, tech providers and stakeholders to create resilient and future-ready urban mobility ecosystems.

TECHNICAL PROGRAMME

TECHNICAL PROGRAMME

The Technical Programme was organised alongside the four Congress subthemes of **Automated Mobility**, **Clean Mobility**, **Urban Mobility** and **Innovations in Mobility and Logistics**. This chapter reports and reflects upon the different presentations and discussions in sessions and exhibitions for each theme.

4.1 Pillar 1: Automated Mobility

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Contributing authors: **Darren Capes, Carol Kuester and Tim Morris**

The overall situation

The topic was once again a very prominent one, with about 50 research / technical papers and 30 strategic future / special interest sessions. The sessions featured plenty of discussion on the crucial role of regulatory frameworks and international collaboration in facilitating the seamless global integration of interoperable technologies, paving the way for a harmonised and interconnected future of transportation. For the automated driving system developers and the vehicle industry, the domain is definitely global but the emphasis on use cases has regional and even national differences. In Dubai, about 40 % of papers on the automated mobility topic originated from the Asia/Pacific region.

In general, the basic technology solutions work and things are going forward. The evolution has, however, been slower than anticipated as the practical issues have proven to be very complicated. The discussions at the Congress sessions clearly demonstrated the progress focusing on deployment and policy aspects.

What is popular and what is not?

The value of sharing experiences, learnings and challenges featured prominently in sessions, including the concept of sharing globally to benefit locally and zoom in on the developments and innovations from world-leading metropoles.

Automation

Operational Design Domains (ODD) were discussed in several sessions, looking at the development of taxonomies to support common understanding between actors in the automated vehicle ecosystem. Challenges for design guidance caused

by over or under-specifying ODDs were also considered. The physical and digital infrastructure support to extend ODDs, as well as to enable automated mobility services, was highlighted by many experts. Despite the primary focus being on digital infrastructure standards, physical infrastructure standards for automated driving were also discussed.

The emphasis on automated mobility services was often on shared and on-demand automated mobility services, such as automated ride-pooling and public transport corridor service in big cities. In addition to urban areas, the presentations also dealt with rural areas, as well as highway corridors and networks. Remote management was shown to be an integral part of many services and is under serious development.

The shared automated mobility services need to be affordable enough to attract users in sufficient numbers. At the same time, the service must be safe and reliable to earn the trust and willingness of the customers, which can only be realised with a high-quality Automated Driving System. In the discussions, the experts highlighted the importance of this balance of economic feasibility and technological capabilities, and some stated that a feasible balance cannot likely be reached in the near future. According to the experts‘ statements, only Waymo has gained the experience and data basis required to provide a safe automated mobility service, but this has required an investment of billions of US dollars.

The role of shared autonomous vehicles in driving sustainable transformation and safety for passengers and goods was discussed, with a view that sustainability is only part of the mobility equation and solid integration is also key to success. There was also discussion around whether we should be looking beyond autonomy itself, in terms of technology, to ask whether society is actually ready for automated mobility.

Infrastructure issues also need to be considered; e. g. in a city like Dubai, infrastructure is geared toward cars, so the opportunity for alternative, more sustainable modes of travel may be difficult to implement. However, it was recognised that we should not wait for the regulations and act to develop the systems and solutions that are needed. We cannot wait decades for the regulation to catch up with the technology. There was a parallel view that we need to make sure we are offering something people want – no one will adopt shared automated cars if taking one’s own car is far easier and more comfortable and convenient, and the infrastructure is there to support private vehicles, e. g. in the form of car parks.

PAVE Europe (Partners for Automated Vehicle Education) explored the nuanced interplay between society, economics and cutting-edge technology. Strategies of public authorities for the deployment and integration of automated mobility services were discussed in various instances.

The safety of automated driving remains a crucial issue. Solutions discussed included scenario testing and how an automated driving system should react in atypical situations, with Standard Development Organisations competing to publish relevant Automated Driving System (ADS) standards. Concepts like emergency fallback, human occupant takeover time, minimal risk manoeuvre and failure mitigation were under active discussion. The often-asked question ‘what is safe enough?’ also came up. The response was that the Courts of Justice would decide.

Social acceptance and societal impact were identified as key deployment prerequisites. From the end-user perspective, results concerning the willingness to pay for both private and shared rides were debated during the Congress.

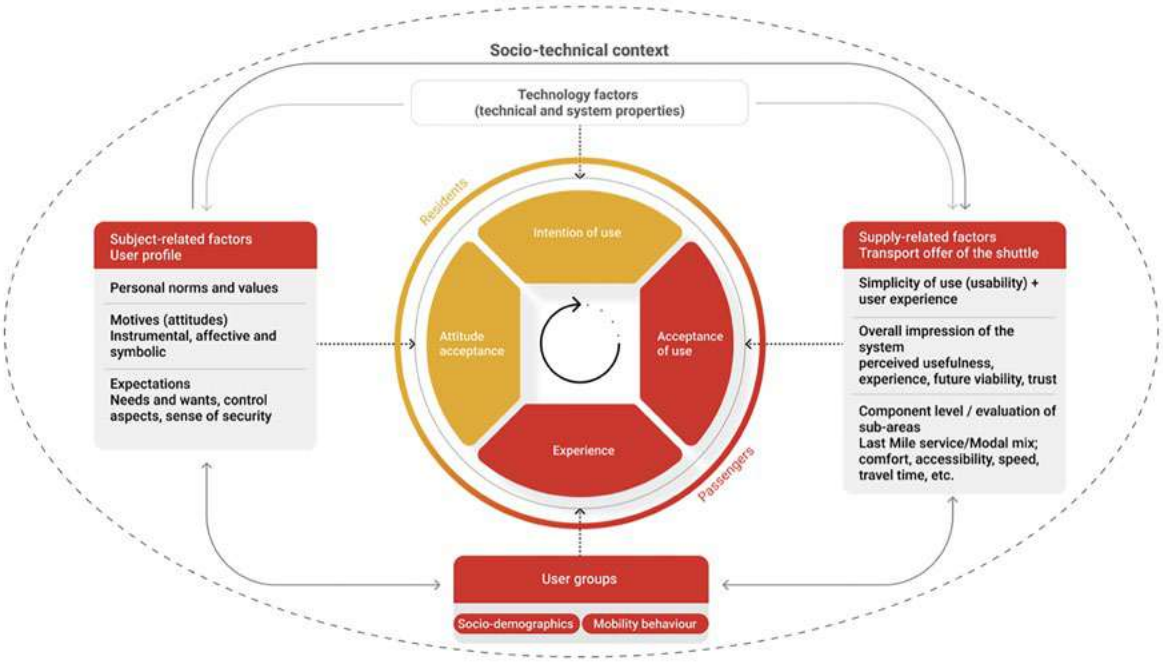

Fig. X: Acceptance model used for automated shuttles in Berlin
(Source: Arndt et al. in session RP3)

There was considerable interest in the topic of what roadside infrastructure is needed to support AV rollout across various use cases, including smart highways but also freight and ferry operations, with a general consensus that cooperation, enabling legislation and regulations are needed to drive progress and consistency.

The question of who should lead automated vehicle deployment was discussed, using examples from China, North America and Europe. The pace of deployment for automated cars and trucks has been much slower than originally foreseen and no standard business model exists for the most effective way to speed up deployment and generate the promised economic and social benefits. Though the economic and political situation of each country varies widely, much could be learned by comparing successful business and political deployment models.

Connectivity

In this Congress, connectivity papers and sessions were distributed under more than one pillar. Under the automated mobility pillar, the connectivity discussions dealt with topics such as private 5G networks to facilitate automated bus depot operations, C-V2X for self-driving buses, cooperative/collective perception services sharing information detected by sensors via V2X services and 5G-6G for remote vehicle control.

5G technology discussions included a look at the latest developments and deployments, along with risks and opportunities, in the evolution of connected ITS services, and the status of the existing networks to fulfil C-ITS requirements. A look at 5G/B5G for connectivity, safety, cybersecurity and profitability in the context of trucks and private vehicles on motorways was also featured.

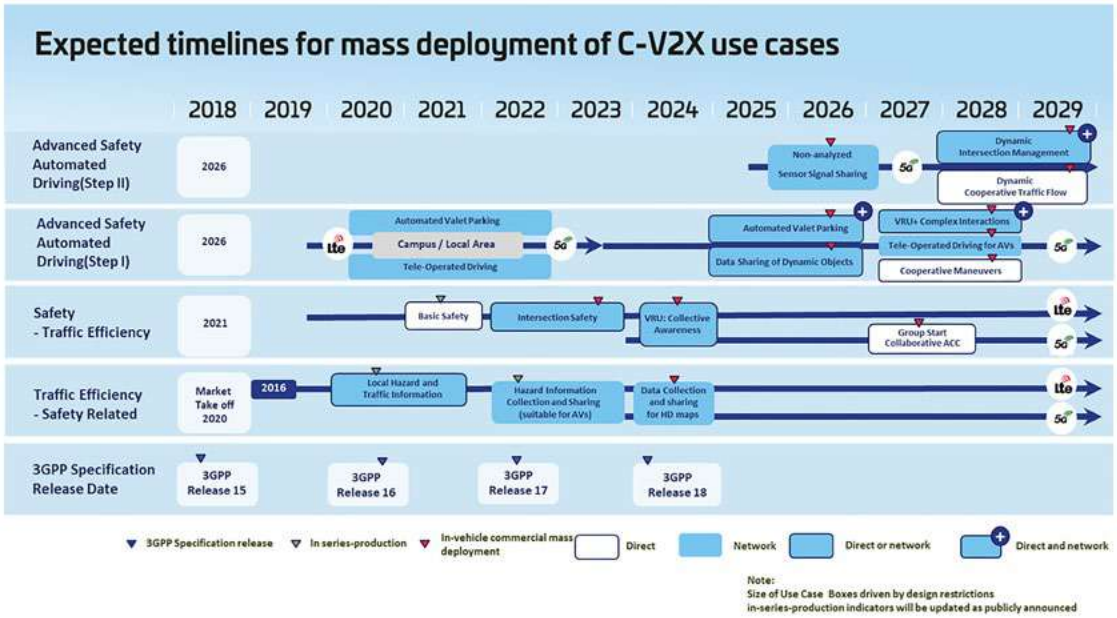

Fig. Y: Roadmap for C-V2X deployment

(Source: Maxime Flament in session SIS 59)

The value of roadside assistance for connected automated vehicles was discussed, with a look at challenging situations like edge cases and vehicles operating at the limit of their ODD. The recently developed DOVA concept, which stands for Distributed ODD Attribute Value Awareness, was explored through practical examples and use cases.

In the United States, V2X deployment is reaching an inflection point with the just published National V2X Deployment Plan and a clear move towards C-V2X. The strategy ten years ago was focused on getting vehicles equipped; now, the focus is on providing infrastructure that will give the vehicle manufacturers something to work with.

In Europe and Japan, an additional focus is on protecting vulnerable road users and furthering research. Discussions are underway on licensing and how to allocate spectrum. A new 'Mobility Roadmap' being developed by the Japanese Government is expected to be finalised soon. The factors that may have implications for the implementation of Connected and Automated Driving were highlighted during the Congress.

The complexities of certifying V2X messages and establishing the legal validity of digital traffic signs were also explored at the Congress.

Space satellite technology for driver support systems was discussed, with key messages conveyed on thinking about collaboration to expedite the progress of smart cities: embracing the bold and ambitious! Standardisation is seen as key to bringing in users and stakeholders, and the intelligent fusion and sustainable provision of Position Navigation and Timing technologies, with GNSS as the backbone, is regarded as essential. A view from the automotive supply sector was that we need to ensure needs are heard by different sectors – are industries expecting too much from the automotive industry vertically? Automotive is just a small fraction of the chain.

New ideas

Typically, new ideas were brought up in the research and technical papers sessions, rather than other types of sessions.

Concerning vehicle technologies, the new ideas discussed contained the use of external human-machine interfaces (eHMIs) to improve interaction with pedestrians, the use of LIDAR to complement video in automated traffic safety assessment with traffic conflict-solving techniques, defining sensor performance requirements by driving behaviour analysis of the merging scene and object tracking in LIDAR point clouds by application of the Spatio-Temporal Gradient method.

Concerning interaction with other road users, including other automated vehicles, the use of fuzzy logic in adaptive multi-robot formation tracking in a low-quality communication environment, digital visibility of broken-down or otherwise stopped vehicles via an IoT light signal and the analysis of interactions between an automated vehicle with surrounding road users were examples of new innovations.

An interesting study dealt with the impact of the external impression of automated buses on the behaviour of other road users. The different outlooks of buses and shuttles, as shown in Fig. Z below, had an impact on the reported behaviour of the study subjects. For instance, people behaved more cooperatively when dealing with “cute”, rather than “strong”, vehicles and were more irritated when stuck behind a “futuristic”, rather than a “weak”, vehicle. Other research concluded that riders in automated vehicles had the highest levels of concern around safety and that women in particular had increased levels of concern after riding in an automated vehicle.

Many of the new ideas were related to simulation, such as how to evaluate the ability of autonomous vehicles to comply with road traffic laws from the perspective of road traffic safety in Software in the Loop Simulation (SILS), the development of intelligent driver models for manual vehicles following autonomous vehicles for simulation and the identification of high-risk road spots for manual vehicles following autonomous vehicles via driving simulators.

Promising road safety-related ideas were the identification of near accident conditions utilising risk estimation models to generate test scenarios, monitoring each road user’s location on the basis of communication means such as smartphones and infrastructure cameras, sharing information in the cloud, assessing the risk and then notifying road users of the danger.

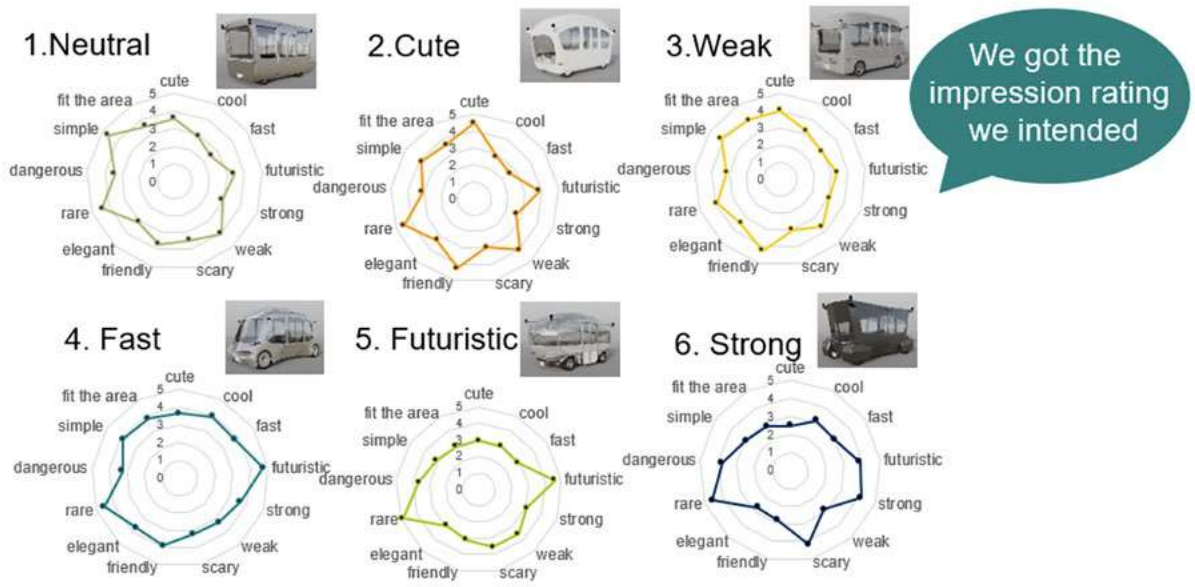

Fig. Z: External impressions of shuttles

(Source: Ayako Taniguchi in session SIS 56).

The development of an infrastructure platform service for high definition (HD) maps to collect production and management information of infrastructure providers was presented as an important innovation based on the sharing of public and private data stemming from road operators, detection information of autonomous vehicles and other private data.

The cooperative traffic management system innovations included coordinated cooperative behaviour planning for so-called 'Managed Automated Vehicles' (MAV) within the area monitored by roadside sensors, a cooperative vehicle-infrastructure system of assisted and autonomous driving, detailed monitoring of driving behaviour and high-precision positioning-assisted electronic toll collection

Other new ideas included the integration of generative AI into automotive cybersecurity threat modelling, providing proactive means to identify and address potential vulnerabilities in connected cars, the use of Large Language Models to instruct automated driving systems and Automated Valet Parking, using an autonomous car transportation robot.

With regard to connectivity and data exchange, new ideas included determining the Collective Perception Message (CPM) significance index level for redundancy mitigation in congested communication situations and Gaia-X-compliant data exchange for ADS, using the Eclipse Dataspace Connector.

The Congress also brought up the emerging concept of maritime ITS and the opportunities it presents for autonomous ships, exploring the future of intelligent transport systems and focusing on barriers, opportunities and the transformative path towards autonomous ship transport of cargo and passengers. It became obvious

that enormous benefits could be gained from the automation of marine transport and its integration into the wider ITS ecosystem. However, it was recognised that there are huge barriers to streamlined cooperation in the movement of freight and goods by intermodal means – maybe maritime ITS is the answer.

Trials and experiences of services

Trials and first deployments are extremely important for automated mobility services. The demonstration of benefits from the forerunners of automated mobility will encourage others to try out and deploy these services. It was stated that 'it is easy to do trials and pilots, it is difficult to do commercial deployments.'

Many speakers provided trial-based evidence of the service performance, acceptance and impacts from all over the world, such as the acceptance of automated shuttles in Berlin, the self-driving bus service with platooning in Taiwan and a large connected and automated driving pilot in Australia.

Speakers discussed the question of who should lead AV deployment and reviewed experiences at the national, state and local levels (Oslo, Hamburg and San Francisco).

Results were also shown concerning the automated large-scale HD map production for self-driving vehicles using LIDAR and artificial intelligence, integration of smart building technologies and automated vehicles and the implementation of the continuous operation of L4 automated driving Living Labs.

Forward versus constrained issues

Key 'forward' issues

Hybrid technologies within large-scale Connected, Cooperative and Automated Mobility (CCAM) deployments were viewed as essential to ensure seamless and efficient operations.

A look at standards as enablers explores how value is created, delivered and captured by actors in a 5G/B5G ecosystem, emphasising the crucial role of standards in creating new business opportunities. Some of the key themes highlighted were:

- Interoperability: ensuring different systems and devices work together seamlessly;
- Global Consistency: maintaining uniformity across global markets;
- Innovation Acceleration: facilitating rapid development and deployment of new technologies;
- Economic Benefits: reducing costs and driving economic growth;
- Security and Reliability: enhancing the safety and dependability of networks;

- Regulatory Compliance: meeting legal and regulatory requirements; and
- Facilitating Investment: providing a stable environment that attracts investments.

Digital infrastructure was much more in the foreground in this Congress than in some earlier ones. The topics highlighted contained cooperative and competitive multi-agent interactions of automated vehicles and big data classification to optimise traffic management of both automated and manual vehicles.

Developments and challenges with 5G for connectivity, safety, cyber security and profitability were discussed, with a view that 5G will be essential for the future of automotive transport and that the future will feature more centralised and integrated applications, leveraging the Software Defined Vehicle technology. One of the key challenges shared was that vehicles are often connected via different telecom network providers, making cross-border compatibility and effective cooperation difficult for data sharing. Trust and truthfulness could be the redeeming factor here.

The vehicle and infrastructure sensors provide large amounts of data but many discussions during sessions and outside them dealt with how to manage the data in an efficient manner and how to distinguish, identify and prioritise the essential information for the ADS. A good example was the discussion of how to assess the significance of safety-critical collective perception messages among a multitude of messages exchanged by a high number of vehicles in a challenging urban environment involving also several vulnerable road users and obstacles.

Transitions of control between the automated driving system and the human occupant fallback were very prominent in Congress. The optimal take-over request lead time (TORlt) was specified based on human factors for safe switching between driving modes when exiting the operational design domain (ODD) to reduce the take-over time (TOT), maximise the success rate of take-over, and minimise the potential of rear-end collisions due to vehicle interactions.

More attention was given to the atypical situation or edge cases, which are too rare and various to be addressed via the scenario approach. The responsibility of the vehicle occupant in such situations should be elaborated upon, along with the acceptable behaviour of the ADS in different circumstances. The conclusion was to ‘keep going forward and share best practices, involve all stakeholders, bring the public along and manage public expectations, despite some bad actors of the industry.’

The legal aspects were brought forward in the special interest sessions. The regulations are increasingly dealing with the use of highly automated vehicles and the provision of highly automated mobility services, while earlier congresses discussed regulations dealing with the testing of self-driving and driverless vehicles.

Key ‘constrained’ issues

The sensing technologies of automated vehicles were less prominent in the papers and sessions than in earlier congresses. With regard to connectivity, the performance comparisons of WIFI-based and cellular solutions attracted less attention than in the past.

However, the sensing systems and solutions were very prominent in the exhibition, giving further proof that the area is progressing.

The participation of the vehicle manufacturers in the Congress sessions was very limited, although several manufacturers presented their vehicles in the exhibition and demonstrations. However, the products presented in the exhibition were more focused on electrification than automation and connectivity.

Regarding connectivity, the motor vehicle aspects dominated the V2X communication presentations and sessions. Only a few speakers brought up the need to integrate pedestrians, bicyclists and other vulnerable road users with their nomadic devices in the cooperative and connected transport system.

Changes in the topic area

Connected and automated mobility services are progressing towards large-scale deployment, which is a major change in this topic area. Progress remains slow but obstacles and issues were shared and means to address them were discussed.

In automation, digital infrastructure and especially data have become more prominent than in past years. Digital twins, shadows and models of road infrastructure and traffic conditions were largely seen as fundamental building blocks in the implementation of automated mobility services. For reasons of trust, it is necessary for the data providers to ensure proper management of data and quality. Digital infrastructure is increasingly viewed as a necessity for enhancing the connected automated vehicle performance, as well as for optimising the road network operation and traffic flow.

The term ‘cooperative driving automation’, commonly used in the USA, highlighted the need to embrace the four SAE cooperation levels: A – sharing, B – intent sharing, C – agreement seeking, and D – prescriptive, in addition to the well-known SAE automation levels.

In connectivity, the necessity of the hybrid approach combining the use of several radio technologies has been widely adopted. The 5G and multi-access edge computing (MEC) solutions were much more prominent than in earlier congresses. With regard to C-ITS and V2X, the number of equipped vehicles is increasing, and various deployment-oriented services are appearing on the market, such as the automated message certification service promoted at the exhibition.

4.2 Pillar 2: Clean Mobility

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The Congress presented a comprehensive vision for Clean Mobility in sessions that highlighted several key themes critical to advancing sustainable transportation.

Reducing urban speed limits to 30 km/h emerged as an effective and straightforward policy to cut emissions and enhance safety, offering cities an actionable step toward cleaner mobility. Taiwan's success in implementing Mobility-as-a-Service (MaaS) demonstrates the potential of integrated transport solutions to reduce emissions and energy use by encouraging collective over individual car travel. MaaS makes sustainable choices more convenient and appealing to consumers.

Hamburg's ambitious 2030 goals illustrate the transformative impact of urban mobility changes. The city aims to reduce car usage to 20% and promote public transport, biking and walking, targeting a 70% emissions reduction from 1990 levels. However, the challenge of consumer resistance to policies such as low-emission zones, often perceived as punitive, underscores the importance of effective communication and incentives to foster acceptance.

Technological innovations, including digital twins and signal optimisation, are gaining traction as tools to enhance efficiency and cut emissions by up to 17%, according to models. Similarly, electrifying buses globally could equate to removing 1% of cars from roads while boosting ridership due to their eco-friendly reputation. Yet, while battery-electric buses are well-suited for urban settings, challenges remain for longer intercity routes, necessitating further advancements.

The transition to clean fuels also featured prominently, with electricity emerging as the most viable option over hydrogen and biomethane, which are not yet reliable enough for widespread use. Smart charging strategies, such as leveraging solar power or off-peak energy, will be crucial to avoiding strain on the energy grid. Additionally, demand-responsive transit and shared mobility services are pivotal in shifting from individual to collective transport, with one bus potentially replacing up to 30 cars and significantly reducing emissions.

Data-driven solutions were a recurring theme, emphasising the role of real-time information in optimising mobility and energy use. Platforms like OpenRouteService.org already enable users to track energy consumption and CO2 emissions, supporting informed decision-making. Robust policy frameworks and standards are also essential for the clean mobility transition. Initiatives like the ISO TC204 Working Group's green ITS standards aim to integrate vehicle data, traffic energy management, and energy-based routing, fostering coordination between transport and energy systems.

The integration of transport systems with energy grid management emerged as a critical area, highlighting the need for smart energy use during periods of renewable energy availability. Countries like Norway and Austria are leading in electric vehicle (EV) adoption, yet the rapid transition poses challenges, including lagging charging infrastructure and ensuring equitable access across social groups.

Public transport, responsible for only 2% of global emissions, holds enormous potential in reducing the carbon footprint of mobility. Increasing ridership tenfold, supported by strategies such as MaaS, greater EV adoption and improved integration with other modes of transport, is vital to achieving green goals. These insights underscore the multi-faceted approach required to advance clean mobility and meet global sustainability targets.

The Old versus the New

The evolution from traditional car-centric mobility to modern sustainable transportation systems marks a significant shift in urban planning and mobility management. Historically, urban infrastructure was designed around private cars, resulting in congested roads, high emissions and underutilised public transport. Policies prioritised road expansion over strategies to reduce car dependency. Emission regulations were sparse, with little emphasis on clean alternatives like electric buses or shared mobility, while transportation remained heavily reliant on fossil fuels such as gasoline and diesel. Public transport faced low ridership, often perceived as outdated and inefficient, providing minimal incentive for users to switch from private vehicles. Early charging systems for electric vehicles (EVs) were rudimentary, lacking integration with energy grids, renewable energy sources or pricing strategies. Moreover, limited data integration across transport modes left cities without real-time analytics to optimise energy use, traffic flow or emissions.

In contrast, the new approach embraces ‘people-first mobility’, prioritising safety, sustainability and efficiency. Measures like citywide 30 km/h speed limits significantly reduce emissions, enhance air quality and improve safety by decreasing traffic accidents and noise levels. MaaS systems, such as Taiwan’s model, promote collective transport, encouraging shifts to public transit, biking and walking, leading to fewer cars on the road and cleaner air. Hamburg’s vision to reduce car usage to 20% and achieve a 70% reduction in emissions by 2030 exemplifies this transformative departure from car-centric planning.

Technological advancements are key to this transition. Tools like digital twins enable cities to test and optimise traffic signals, cutting vehicle stops and reducing emissions by 17%. Electrification is also reshaping public transport, with electric buses not only reducing emissions but also boosting ridership through their eco-friendly image. While battery-electric buses dominate urban transport, innovations are still needed to address their limitations for long-distance routes. Smart charging systems now optimise energy use by aligning with renewable energy availability or off-peak energy pricing, reducing strain on power grids.

The shift to sustainable mobility includes adopting fuel-agnostic solutions, particularly for urban buses operating in central business districts. While hydrogen

and biomethane face challenges due to limited reliability and infrastructure, electricity has emerged as the most viable clean energy source. The broader goal of zero-emission transport involves a structured plan: transitioning to zero-emission vehicles, increasing sustainable energy supply and reducing energy demand through digital solutions.

Real-time data integration is revolutionising transport and energy networks. Mobile devices and apps like LCMM (Low Carbon Mobility Management) track trip emissions and energy consumption, enabling users and cities to make more eco-friendly choices. Connected Intelligent Transport Systems (C-ITS) and Autonomous Vehicles (AVs) further enhance fuel efficiency by integrating traffic signals with vehicle powertrains, improving fuel economy by up to 30%. However, hydrogen's role remains limited due to the high cost of refuelling infrastructure and low availability of green hydrogen, which accounts for only 4% of global production.

The focus on collective transport is a cornerstone of modern mobility. Buses, capable of replacing up to 30 private cars in emissions savings, are central to this approach, complemented by shared and demand-responsive transit systems tailored to consumer needs. This marks a departure from the older model, where public transport was secondary to private vehicles. The development of green ITS standards by ISO TC204 underscores the importance of standardised platforms to manage energy, traffic and emissions across multiple transport modes.

Finally, clean mobility now integrates with energy grids, emphasising the use of green energy sources for charging vehicles and creating synergies between transportation and energy networks. Public transport revitalisation, with a goal of increasing global ridership tenfold, demonstrates the shift from underutilisation to a prioritised role in reducing emissions and congestion. These advancements highlight the comprehensive and interconnected strategies driving the transition to sustainable urban mobility.

Forwards versus Constrained

Efforts to achieve sustainable transport reveal a dynamic landscape where progress in some areas is offset by challenges in others. On the path forward, cities adopting 30 km/h speed limits exemplify how small policy changes can yield significant benefits. These limits not only enhance road safety but also reduce emissions, offering a low-cost, scalable solution. Similarly, Taiwan's Mobility-as-a-Service (MaaS) model demonstrates how seamless integration of collective transport can shift trips from individual vehicles, reducing energy consumption and carbon emissions while making public transit more accessible and attractive.

Electrification is another key area of progress. Cities worldwide are adopting electric buses, which not only reduce emissions but also attract more riders due to their eco-friendly perception. Smart charging solutions now optimise charging times based on energy pricing and renewable energy availability, helping to reduce grid strain and improve sustainability. Meanwhile, real-time data management tools, such as those guided by standards like ISO 23795-1, allow users and policymakers to make informed decisions about energy consumption and emissions, further driving

clean mobility. Countries like Norway showcase the potential of strong policies, with 95% of new vehicle sales being battery electric vehicles (BEVs). However, Norway's experience also underscores the importance of complementing EV adoption with robust public transport infrastructure to prevent congestion.

Despite these advancements, significant constraints remain. Hydrogen, although promising, struggles with viability due to infrastructure limitations, high costs and low green hydrogen production – only 4% of global supply. Electric buses, while ideal for cities, face range limitations that make them unsuitable for intercity travel, requiring further innovation or hybrid solutions. Electric grids in many regions, including Norway, are struggling to meet the rising demand for EVs, with insufficient charging infrastructure, particularly for heavy-duty vehicles, posing a barrier to widespread electrification.

The sourcing of clean fuels remains a challenge, with hydrogen and biomethane still lacking reliability for large-scale adoption. Meanwhile, the high costs of infrastructure such as hydrogen refuelling stations (costing around USD 6m each) limit scalability. Fleet decarbonisation is another hurdle, as hybrid solutions needed to bridge the gap between current technology and zero emissions complicate management and tracking.

Social equity is also a critical concern. The transition to battery electric vehicles (BEVs) and clean mobility risks excluding marginalised groups who may not have access to these technologies. Similarly, low-emission zones, while effective in reducing pollution, are often perceived as punitive measures, creating public resistance. In Norway, the rapid adoption of EVs has led to increased congestion, highlighting the need to prioritise public transport and shared mobility to maximise environmental and social benefits.

Energy grid challenges further constrain progress, as the transition to green electricity has been slow. Sustainable and interconnected energy networks are vital to supporting the electrification of transport systems. As the world strives for clean mobility, it must address these constraints alongside its successes to achieve a truly sustainable and inclusive transport future.

Any Generally Recognised Barriers for Deployment

The deployment of clean mobility solutions faces several barriers across public acceptance, infrastructure, technology, policy and economic domains, as well as operational and cultural challenges. Public perception and acceptance often hinder progress. For instance, low emission zones, while effective in reducing pollution, are frequently perceived as punitive 'taxes' by consumers, creating resistance. Similarly, efforts to shift individual transport habits toward collective modes like buses and shared mobility face cultural inertia, with many users reluctant to forgo the convenience of private car ownership. Equity concerns also arise during the transition to BEVs, as lower-income groups may lack the financial resources or access to charging infrastructure, exacerbating inequalities in clean mobility adoption.

Infrastructure limitations further constrain deployment. Despite rising EV adoption, charging infrastructure remains insufficient, particularly for medium and heavy-duty vehicles in densely populated areas. Even in advanced EV markets like Norway, where 95% of new vehicle sales are BEVs, the infrastructure struggles to meet demand, leading to congestion and diminished benefits. Hydrogen refuelling stations are similarly problematic, with fewer than 50 stations in the U.S., each costing USD 6m to build. Additionally, the logistical challenge of transporting hydrogen to these stations adds complexity. The reliability of hydrogen fuel cells is another issue, as they degrade quickly and underperform over time, reducing their practicality.

Energy and grid constraints also pose significant challenges. Existing grids are often ill-equipped to handle the increased demand from EVs and electrified transport systems, particularly in regions with low renewable energy penetration. While smart charging solutions can optimise energy use and reduce grid strain, many systems still rely on inefficient 'stupid' (as opposed to 'smart') charging methods, exacerbating the problem.

Technological maturity and integration represent additional barriers. Electric buses are suitable for urban environments but are limited by their range for intercity travel, curtailing their broader application. Meanwhile, fuel-agnostic buses that could use hydrogen or biomethane remain impractical due to unreliable sourcing – only 4% of global hydrogen production is currently 'green'. Advanced systems like digital twins for traffic optimisation and connected intelligent transport systems (C-ITS) for fuel economy improvements show promise but are not yet widely adopted due to high costs and integration challenges.

Policy and regulatory issues also hinder deployment. The lack of a coordinated regulatory framework complicates efforts to support clean mobility, with fragmented or inconsistent policies across regions. Uncertainty in emissions tracking standards further complicates regulation, particularly when personal device data does not align with official vehicle-generated data, undermining the accuracy of emissions measurements.

Economic challenges are a persistent barrier. High costs associated with new technologies, such as hydrogen refuelling stations, fuel cell vehicles and advanced charging systems, strain financial feasibility, particularly in smaller economies. The transition to EVs also reduces gas tax revenues, creating a funding gap for infrastructure development and maintenance. This issue is particularly pronounced in countries like Norway, where widespread EV adoption has significantly decreased traditional revenue streams.

Operational and logistical barriers further complicate deployment. Decarbonising large public and private fleets requires complex management of charging, route planning and energy consumption. Hybrid fleets, while necessary in the short term, introduce additional management challenges. Real-time energy demand management is underdeveloped, and the integration of transport systems with energy, water and communications networks remains insufficient, as many systems operate in silos rather than collaboratively.

Cultural and behavioural factors also play a critical role. Consumer habits are slow to change, with many individuals reluctant to embrace shared or collective transport solutions like MaaS. Public transport ridership must increase tenfold to meet clean mobility goals but this requires substantial investments in infrastructure and a shift in public perception to view public transport as convenient, safe and reliable. Achieving widespread cultural change remains one of the most formidable challenges to deploying clean mobility solutions.

4.3 Pillar 3: Urban Mobility

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The Urban Mobility (UM) topic at the Congress was expected to cover the following areas:

- Regulatory challenges for transport authorities
- A seamless travel experience from a user perspective
- Safe, clean and efficient transport
- Multimodal deployment
- Data and digital transformation
- Connected Vehicles
- Smart infrastructure.

Not all of these subtopics were covered. Most notably, regulatory challenges and seamless travel experience had minimal exposure.

Urban Mobility surpassed Automated Mobility in terms of the number of research and technical papers, as well as strategic future / special interest sessions. Urban Mobility had 86 papers and 29 strategic future / special interest sessions. There was some overlap with Automated Mobility and Innovation in Mobility and Logistics.

Urban Mobility covered five major areas:

- The increased use of artificial intelligence (AI) in traffic management and control, image recognition, processing and prediction;
- The migration from analogue systems to Vehicle-to-Everything (V2X) technology;
- Continued discussions about equity, diversity, accessibility, inclusion and mitigating bias in ITS and technology-enabled mobility services;
- The use of new techniques and tools to improve safety; and
- A continued emphasis on data sharing and exchange to improve ITS tools.

The use of digital twins was another topic covered more than in past Congresses.

Several topics that have been prominent in prior ITS World Congresses were **not** prominent this year:

- Traveller and traveller-centric design of specific ITS technologies;
- Mobility as a Service (MaaS), mobility on demand (MOD) and Shared mobility; and
- Development and implementation of data standards.

The use of 'mobility flow' rather than 'traffic congestion' (the term used in previous Congresses) seems to have disappeared. Other items that appeared minimally were technologies for active travel, micro-mobility, e-micro mobility and public transport.

Overall observations include the following:

- Key trends point towards the integration of systems, increasing automation and the critical need for equity and inclusivity in future transportation and technology solutions. The integration of multiple systems was extolled to help manage, review and gain insights into urban mobility status on networks, including 'live' information and data that could be used to review congestion status. This is not a new trend but perhaps highlights how challenging combining big volumes of data can be.
- While many of the papers highlighted the importance of inclusivity, several of them acknowledged that their results could be skewed due to gender imbalance and other biases. It was highlighted that these results must be considered carefully due to such an imbalance. Also, this type of bias was discussed in detail in SIS 'Artificial intelligence and data bias in ITS: How do we address this?'.
- The transformative role of advanced technologies like AI, the Internet of Things (IoT), V2X, Cooperative Intelligent Transport Systems (C-ITS) and connected vehicle data in enhancing urban mobility, focusing on safety, efficiency and sustainability was highlighted. Advanced technologies versus aged infrastructure were seen as an opportunity to reduce (relatively speaking) the need to replace roadside ITS.
- A mix of new C-ITS initiatives that utilise newer V2X, as opposed to other studies that focus on applying closed-circuit television (CCTV) and camera footage to solve similar problems, was highlighted in paper sessions. However, it is questionable whether the 'ground' work to adoption, implementation and connectivity has been considered on a practical level (e.g. 5G/6G or other advanced connectivity technologies).
- While significant emphasis is on digital transformation, smart infrastructure and sustainable mobility, several discussions featured underrepresented topics like active travel and micro-mobility options and public transport innovations. One paper on micro-mobility across five European cities noted that cost seemed to deter wider adoption and discussed the impact of micro-mobility on public transport. Another interesting observation is that, in some cities, micro-mobility was thought of as more of a leisure pursuit, while in others, using it to commute was more popular.

- Surprisingly, and in contrast to previous Congresses, there was little overlap between the Urban and Clean Mobility (CM) topics. It was expected that the UM topic would overlap with CM in discussions about decarbonisation, electrification and charging infrastructure. The overlap only existed in one session ('Decarbonisation in Mobility Services: Public Transport Experience').

- Urban mobility is trending towards being highly automated, data-driven and digitally integrated, with an emphasis on equity for all travellers. The equity aspect was covered in several sessions, including two that focused on equity in technology-enabled mobility and traffic management and how we should measure it.

- There were some papers that acknowledged the importance of digitalisation, assessing 'readiness levels' for moving to advanced technologies and ageing asset management as a factor in looking at newer technologies without the burden of past infrastructure.

- There were a number of papers that considered the use of ITS and advanced technologies to monitor the deterioration and condition of road infrastructure, such as road condition, or using technologies to assess faint road markings and impact on lane-keeping assistance or, in other cases, traffic on ageing infrastructure (such as structures).

Eight themes gained particular interest in the Urban Mobility part of the Congress programme:

Artificial Intelligence (AI)

- Increased use of AI in traffic management and control, particularly in road safety, dynamic network system management and addressing congestion includes several noteworthy applications:

    - Advanced pedestrian detection using a new fusion sensor combining radar and AI-enhanced overhead camera, which eliminates blind spots and enables accurate identification of detection targets – a task that is challenging for radar alone.

    - Integrating AI into traffic signal control using reinforcement learning in Taiwan: using the Q-Pensieve algorithm, this approach adapts to varying traffic volumes over time by exploring different objectives for adaptive learning.

    - Integrating AI to CV2X data in adaptive traffic control in Melbourne, Australia to provide situational awareness to road authorities to better identify certain events, such as cars queuing across an intersection, prolonged presence of vulnerable road users and other scenarios.

    - Improving adaptive signal control to quickly detect anomalous traffic congestion, identify the extent of the impact of anomalous traffic congestion using traffic flow simulator functions and modify signal control parameters.

- Using AI to enhance decision support for integrated corridor management (e.g. in Virginia, USA).

Network Efficiency and Management

Solutions for intelligent traffic management systems and network operations, adaptive traffic controls, smart corridors and the impact of C-ITS on traffic flow were presented and discussed under this headline.

Connectivity

Presentations on V2X, particularly about intelligent traffic management, network operations and the migration from analogue systems to V2X technology, were featured under this topic. Also, V2X being used to intermodally network all vehicles, including public transport vehicles, was addressed.

Cameras and Hardware

Using CCTV and camera footage to reconstruct crashes, particularly with new scalable data sources, was mentioned. Many of these studies were conducted in areas with less C-ITS infrastructure and older fleets (India, Pakistan, Philippines) where connected and automated vehicles may be limited. One focus area is on cameras for object recognition in conflict areas and near-misses between cars and active travel modes (e.g. bikes).

Equity, accessibility and inclusion

The importance of these topics and the need to mitigate bias in ITS and technology-enabled mobility services was highlighted. The challenges of data bias in AI were discussed, emphasising the need to understand correlation versus causation to make meaningful use of data. The European Union's AI Act was mentioned as a step forward but not a complete solution to data bias. Effective communication and demonstration of AI's impact are crucial for gaining support from policymakers and investors. Additionally, there is a critical skills gap in data analytics and AI that needs to be addressed.

Road Safety at Intersections

Mika from REMOTED said: "We all laugh about how Incas sacrificed children to the gods... but we are also sacrificing our children to the new god: Road vehicles."

Predictive safety with a focus on near-misses or near-crashes will improve safety at intersections. In a complete juxtaposition, there are a lot of proposals to use cameras and CCTV to identify crash hotspots (e.g. using AI on images to assess changes to the road network to reduce accidents) but this requires crashes to happen first, rather than implementing a proactively preventative approach.

However, proactive road safety implementations were very popular, along with road safety interventions at intersections. Most examples focused on conflict points within intersections and major corridors. Part of this may be due to new technology that allows for data collection within intersections, not just at the midblock.

Furthermore, another proactive approach incorporates integrated risk assessment and safety strategies for highway truck accidents using cluster analysis in South Korea. This approach will lead to real-time risk assessment and advanced traffic safety systems in the future.

Driver Behaviour

Driver behaviour was covered from multiple perspectives, including the reaction of drivers to C-ITS information displayed in the vehicle, the effects of different driving behaviours on fuel consumption, driving behaviour analysis using AI image processing technology, estimating driver drowsiness by using technology and improving driver vigilance by using plasma cluster ions.

Autonomy and ADAS

Discussions included conversations about liability and car accidents. Furthermore, it appears that, in terms of road safety concerning autonomous vehicles, people are less concerned with actual death or serious injury caused by self-driving cars. They are more concerned about the fact there is no identifiable person at fault when a death or accident happens under these circumstances.

Finally, the possible missing link in sessions around data bias and the 'trolley problem' is similar to Large Language Models (LLMs): how does the data – and the embedded biases – we feed into an autonomous vehicle impact the decisions it makes in road safety scenarios?

Other topics – prominent in previous Congresses – were less popular or even missing:

Ridesharing & Shared Mobility

The little coverage there was of this item mostly focused on trust and integration into other multi-modal planning apps and the sustainability of these options.

Technology for Public Transport

The limited coverage of this subject included mostly existing technology such as account-based ticketing, analysing bus safety, surveying the need for new local mobility services enabled by technology platforms (e.g. in rural areas in Taiwan) and predicting passenger flow in urban rail environments.

Parking

Parking continues to be unrecognised as a significant part of the technology-enabled mobility ecosystem. Only one paper directly addressed the digitisation of parking as a real opportunity to rethink urban mobility. Only one special interest session dealt with parking as a factor in urban access.

Digital Twins

There is limited knowledge of how to apply this technology to ITS at this time. In one paper, a digital twin was described but there were no major insights into its

necessity, outcomes, or uses.

Three others mentioned were:

- a cloud-based Digital Twin for public transport operational decision support;
- building predictive Digital Twins of cities with a focus on sustainable urban mobility; and
- a digital twin that is supposed to revolutionise urban planning as an asset for policymakers and a tool to visualise the outcomes of potential changes to cities.

eCall

Despite a large number of sessions focusing on using V2X, CAVs and new forms of data, there were very few sessions on eCall. Only one special interest session focused specifically on eCall for proactive safety.

eCall has been mandated in parts of the UK and the European Union as part of in-car safety. eCall data was seemingly absent from more broad proactive road safety discussions.

Targeted Applications of AI

While there were a lot of conversations about AI, they seemed to centre around what we 'can' use AI for rather than what we 'should' use AI for.

The discourse did not touch on where AI is best used and how to apply it in a targeted way so that we are not adding extra complexity while not generating any additional value.

Road Usage Charging

Only a limited number of papers addressed road usage charging. Many presentations used the approach to reduce carbon impact and deal with congestion. The most extensive discussion of road usage charging was in the session 'Road User Charging – Why aren't we there yet?'.

Practical Next Steps for Live Projects

Some fantastic projects presented would have benefited from more clearly articulating the next steps – we have come this far, so what is next? How do we get there? What is the 'North Star' or ideal end goal of the project and the practical steps to achieve it?

Measuring versus Modelling

Several data-centric sessions talked about how all of this new data can be used for better modelling. However, there was a less obvious discourse about when we should be using this data for measuring, not modelling, and contexts where it is appropriate for each approach.

For example, some datasets above certain penetration rates can be used to directly measure change and do not necessarily require modelling to extract value (e.g. Connected Vehicle data).

Mobility as a Service (MaaS)

While this topic was the subject of an international forum session and a global forum, it was not covered much during the Congress. However, the few discussions that did take place included the following:

- Fair MaaS: defined as ensuring equitable access for all travellers, integrating multiple transport modes and catering to vulnerable communities. It is synonymous with 'freedom of movement'.
- New concepts include E-MaaS, which integrates energy and mobility, and S-MaaS, which encourages sustainable mobility through incentives.
- Measures of Effectiveness (MOEs):
    - conventional: time, cost, safety, efficiency
    - sustainability: ecological or green measures
    - both qualitative and quantitative KPIs are important for comprehensive evaluation.
- Data sharing and standards: critical for MaaS value, requiring integration into land use planning and co-creation through partnerships. Trust and transparent funding are essential.
- Challenges: practical and political challenges outweigh technical ones. Collaboration among municipalities and mobility agencies is crucial but currently lacking. It will be challenging to align with the 17 UN Sustainable Development Goals.
- Future concept: personal CO_2 allocation could lead to CO_2 trading among individuals.
- Mobility4Users Community: an MaaS Alliance initiative aiming for neutral cooperation, improved mobility services and better service for all travellers through partnerships, alignment and knowledge sharing.

Major Event Planning

There was only one paper about the Tokyo 2020 Olympics. It was surprising not to hear more about major events analysis given the emphasis on congestion and connected vehicle data as a source of traffic insights, particularly during big events such as the World Cup and the US Super Bowl.

Cross-border ITS

Typically, this topic gets a fair amount of coverage in an ITS World Congress. This year, there was only one paper discussing innovative approaches to measuring border wait times at the United States Land Ports of Entry.

Pedestrian Safety

Given Vision Zero's efforts around the world, it was surprising that there was limited coverage in this area. The pedestrian-related safety discussions included radar for counting pedestrians on crosswalks, simulations of pedestrians and personal mobility vehicles (PMVs) to determine the risk to pedestrians, analysing three approaches for enhancing vulnerable road user (VRU) protection at intersections and leveraging crowdsourced probe-vehicle data for safer mobility of VRUs.

New ideas to improve urban mobility gained particular interest during the sessions:

bCall

While eCall is automatically activated in an emergency, bCall is used to alert for less-serious breakdowns that do not require the presence of emergency services. However, it is not clear how it is or will be implemented.

Advanced Driver Assistance Systems (ADAS)

This is not new as a technology but new applications of the technology in the ITS space are becoming more well-known, including how to re-create the effects of Light Detection and Ranging (LiDAR) with on-board car sensors (e.g. cameras, radar) or external hardware.

Furthermore, the use of ADAS on buses is being used for the automated collection of road information. This approach uses image recognition technology in conjunction with ADAS systems to identify traffic signs and road conditions using cameras on buses and locates the positions of these objects based on global positioning (GPS) data. This method enables the digitisation of road assets and automation of facility inspections while providing real-time traffic information to other road users.

Flexible Integration and Fleet Management of On-Demand Shuttles in a Gaia-X Ecosystem

Seamless integration of small and individual on-demand shuttle fleets in existing public transport systems using a Gaia-X ecosystem is addressed in a European initiative that aims to create a secure and open data infrastructure for sharing data while maintaining data owners' digital sovereignty.

An Adaptive Speed Advisory Algorithm based on Switching Time Predictions

The integration and evaluation of a speed advisory system is used in a traffic simulation environment, with a particular emphasis on buses at intersections and the prediction of traffic signal switching times.

Through simulation, the system demonstrated the potential to not only reduce the number of stops and total stop time but also to reduce fuel consumption with relatively accurate forecasts of switching times, thereby improving overall traffic flow.

Increased Green Time for Cyclists with the Bicycle Platoon Prioritisation (BPP)

This application prioritises groups of cyclists without requiring them to adjust their speed. This system predicts cyclist groups' formations by determining the estimated time of arrival for each cyclist. If three or more cyclists are estimated to arrive within six seconds of each other, the BPP prioritises the cycling signal phase, therefore having a minimal impact on the waiting times of conflicting traffic.

Trials and systems in service were reported in several sessions:

- Tolls have been adjusted in the Chukyo Region in Central Japan for users who detour to other roads with different toll systems to avoid traffic congestion caused by construction.
- Deploying adaptive traffic control systems that adjust signal timings dynamically in response to varying traffic conditions to minimise congestion, reduce journey times and lessen the environmental impact of road travel is being demonstrated in three busy test regions in Hampshire. The FUSION system reduces journey time considerably across the day in all three regions.
- In Taiwan, an application uses a multi-agent deep reinforcement learning approach in which AI agents are trained to dynamically control traffic signal phases based on real-time traffic conditions.
- Insights from delivery drivers' perspectives in the Attica Region of Greece are used to enhance road safety.
- In the US, the Transportation Research Board produced the 'Transformational Technologies and Mobility Inclusion Playbook,' which "is a playbook of resources for public and private entities to assess, plan, and measure their progress toward achieving transportation equity and inclusive mobility in an era of transformational technology."
- Various aspects of this playbook were presented to provide an example of how to consider the impacts of new technologies on travel behaviour and to include underserved users in transportation technology design and deployment.
- Another equity-related project is CulturalRoad. It is an EU-funded project developing new methodologies for the fair deployment of Connected, Cooperative and Automated Mobility (CCAM) services with 18 partners and has five demo sites.
- In terms of the state of the art in mobility data exchange, the US Department of Transportation (USDOT) is looking at creating a department-wide initiative in digital infrastructure, even though there is a wide array of data needed.
- However, on the public transport side, USDOT has four projects in the ITS4US programme that have, as one of their focus areas, data exchange (see the following image Fig. A presented in Special Interest Session 48 by Brian Cronin, Director, Intelligent Transportation Systems Joint Program Office at Federal Highway Administration, USDOT).

Another key data exchange project in the US is Managing Disruptions to Operations Data Exchange (MDODE). In this project, the Work Zone Data Exchange (WZDx) has active feeds in 22 states and the National Park Service has feeds in development in six states and has a near-term focus on integrated corridor coverage.

Fig. A: ITS4US Deployment Program
(Source: Brian Cronin in session SIS 48).

Urban mobility is evolving, with a focus on technology, sustainability and equity. Key issues in equity for ITS include:

- defining and measuring equity accurately and considering underserved communities' values;
- transitioning resources to underserved communities;
- listening to underserved communities to understand their needs;
- avoiding the exclusion of underserved communities due to funding constraints;
- addressing negative perceptions of equity, inclusion and access terms;
- evaluating the effectiveness of tools like the UK's Equality Impact Assessment (EIA);
- including health, income levels, target demographics and safety needs in equity assessments;
- educating and changing beliefs about equity; and
- considering the role and impact of regulations on equity.

These points emphasise the need for inclusive and equitable ITS solutions that genuinely address the needs of all communities.

The integration of AI, IoT, ITS and connected vehicle data is enabling smarter, safer and more efficient transportation systems. However, it is not clear if the emphasis on IoT/AI/ITS refers to their integration or just being 'bolted together'.

There is more of a focus on low-cost and easy-to-implement solutions, but this is also contrasted with a number of projects that almost seem to increase the complexity by adding new layers on top of existing applications without a clear benefit of including these add-ons (e.g. indiscriminately applying AI, more hardware and more touch points without a clear explanation of how they add tangible or targeted value beyond the original idea).

Innovations such as micro subsidies and micro incentives will be utilised more in the future to nudge travellers' behaviour toward more sustainable mobility services (e.g. away from the single-occupant automobile).

V2X communication is increasingly used to secure efficient public transport. V2X technology claims to interconnect vehicles across modes, including public transport vehicles such as buses and trams on the road, as well as trams on dedicated tracks, enabling new V2X-based public transport use cases.

An activity-based simulation framework to evaluate travel behaviour changes will be able to reproduce individual activities in real-time, based on observed data such as transient population in the target area and traffic volume (pedestrians, vehicles, etc.). A 'Macro Nowcast' is proposed to support understanding people's behavioural changes to optimise the transport and environment in urban areas. Furthermore, this framework aims to forecast the impact of changes in travel demand.

Digital transformation in road management for Korean local governments is promoted by developing a standards model for road operation and management that can diagnose the level of digitalisation differences among local governments. Korea is promoting the digitalisation of social overhead capital (SOC) to respond to the worldwide trend. However, local governments have low digitalisation rates due to staffing shortages and limited budgets.

A New Mobility Data and Solutions Toolkit (nuMIDAS) project provided insights into what methodological tools, databases, and models are required for the new mobility ecosystem (with new mobility services, stakeholders, etc.) and how existing ones need to be adapted with new data. nuMIDAS, which was piloted in four cities in Europe, created a tangible and readily available toolkit that can be deployed elsewhere, including a set of transferability guidelines, thereby contributing to the further adoption and exploitation of the project's results.

New forms of mobility data are increasingly being accepted by transport professionals, shifting their focus from questioning the data's validity to exploring how it can solve complex transport issues. This acceptance contrasts with the general public's scepticism, influenced by media fearmongering. Globally, mobility data exchange is advancing, with major regions like the European Union and Australia establishing legislative frameworks to support the provision and use of mobility-related data.

Road safety conversations are finally trending towards proactive measures and monitoring leading indicators – mostly enabled by new data – rather than reactive approaches. Predictive safety with a focus on near-misses or near-crashes is one of those approaches.

The future of Transportation Management Centres (TMCs) was described as utilising an integrated suite of technologies (e.g. a mix of communications technologies for C-ITS, data-driven traffic management, AI and integrated corridor management) to introduce dynamic measures to make it possible for drivers to react only when and where they need to (e.g. minimise the negative effects of regulations, regardless of whether street-side equipment is available at a specific location).

Traffic management has become completely data-driven (see the following graphic Fig. B) so improvements in data analytics are critical in the future.

Data Driven Traffic Management

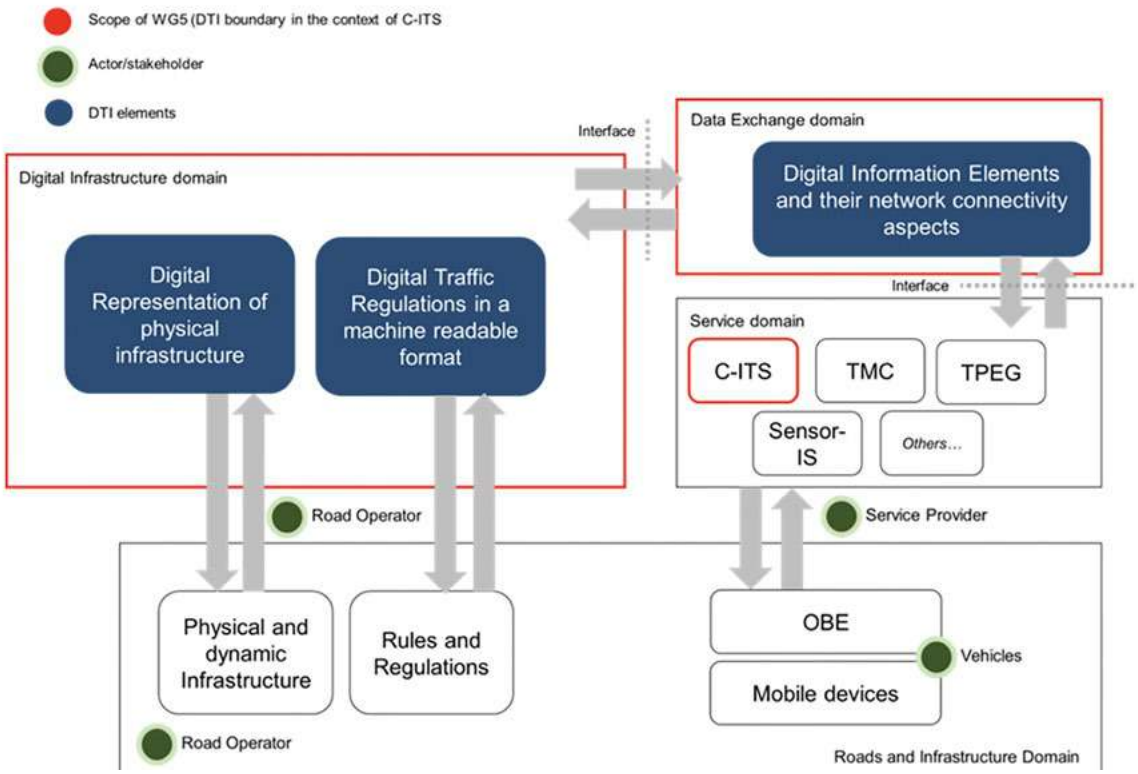

Fig. B: Data Driven Traffic Management

(Source: Martin Böhm in session SIS 6).

Finally, climate change must be factored into TMC operations and applications. The next graphic Fig. C explains the use of AI in TMCs and why it is critical to the future of TMC operations.

Why AI?

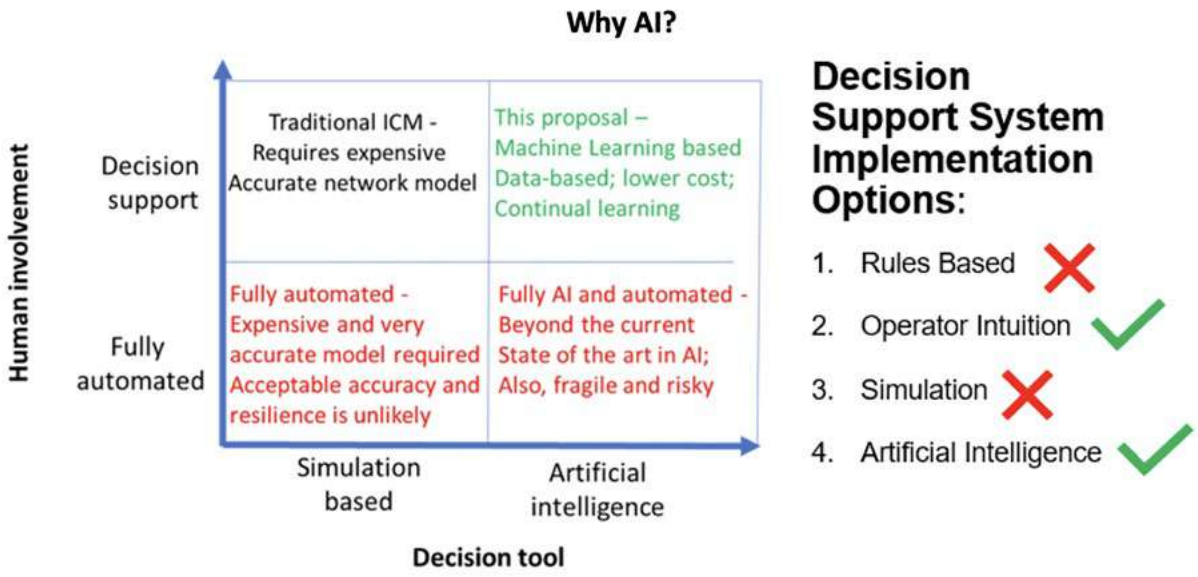

Fig. C: Why AI?

(Source: Josh Johnson in session SIS 6).

In a discussion about the data education gap in government, Chris Lane from Transport for West Midlands made this point: many data vendors will simply throw data at an organisation and expect them to be equipped to extract value. Data is not valuable unless it can be applied to a use case and used to solve a problem with tangible results.

Lane said: "Unless we've got our data right unless you can trust it, unless you understand the provenance of where that data comes from, you can't start to use it for clever things".

In terms of training data quality using AI, there was not enough discussion about how the inputs we include in AI data models affect the outputs we receive

Balazs Barnucz from Kapsch said: "While the algorithms of AI are critical, the quality of the training data is what truly defines the effectiveness of these models".

Several sessions focused on using cameras for object detection but few adequately discussed the practicalities of storing and analysing terabytes of video footage. This technology and its application at intersections is not new, but what should be included in the discussion is the longevity of such solutions that seem difficult to scale and complex to use and analyse without large cloud storage and data computation facilities. Simply changing the data type (i.e. video instead of raw data outputs) will probably not alleviate these challenges.

Public perception, trust and regulation particularly centred around autonomous and connected vehicle data. The industry has an image problem because of a few bad actors.

There appears to be a lack of education for the general public and those who do not work directly with ITS about the technologies being used, protective security and privacy measures in place and how these new technologies can benefit end-users.

Knowledge gaps, existing litigation cases and the need for significant infrastructure investment could constrain the pace of this transformation.

There is still work to be done to have autonomous-ready systems operating network-wide. This is a challenge because not all road networks are standardised.

The underrepresentation of critical areas like micro-mobility, electric vehicle infrastructure and charging and broader public transportation innovations suggests that while urban mobility is advancing, it may be hindered by gaps in focus and implementation.

Achieving 2050 Net Zero goals requires deep decarbonisation in the transport sector. Furthermore, increasing ridership is crucial to meeting decarbonisation goals.

Electrification will not solve traffic congestion and will increase the demand for electricity production. Furthermore, effective electrification of public transport requires comprehensive planning for charging infrastructure, including depot charging, requiring substantial spatial and power infrastructure, which is costly and challenging to implement. Finally, strong public-private sector cooperation is essential for successful electrification.

Battery electric buses are suitable for short-haul services but generate significant battery waste and operational uncertainties due to frequent battery replacements.

Hydrogen buses are significantly more expensive than electric buses. Gender-based perspectives on environmentally friendly travel include reducing travel, improving vehicle efficiency, using alternate fuels, and changing transportation modes but these methods face various barriers. C-ITS technologies can improve fuel efficiency in hybrid vehicles by 20-30%.

Insurance for electric buses and depots is difficult to obtain due to a lack of industry knowledge.

The dynamic element in road pricing is not covered well. Many systems are pricing based on time of use (basically, digitally recreating toll booths and/or distance-based charging for electric vehicles [EVs]). They are not utilising other forms of dynamic pricing based on factors such as vehicle type, road class and time of day.

The only session that addressed dynamic road user charging (RUC) provided multiple cases from around the world, some of which have been successful (Singapore) and some of which failed (Cambridge, UK, South Africa). Key points included:

- User Pay Principle based on congestion;
- charges known in advance;
- equitable charges based on vehicle type, location, and time of day; and
- operational and technical reliability with high compliance.

These strategies would be supported by:

- travel alternatives (route, time, public transport);
- car ownership strategies;
- parking policies and charges;
- fuel tax and fiscal measures; and
- decentralisation of land use.

A broad, future-focused discussion about predictive road safety cannot take place without incorporating eCall sensor data. There is already a knowledge gap in the industry, particularly in Oceania where technology is not mandated and lacks the formal infrastructure to be implemented properly.

Models and results tend to show major gender imbalances and therefore it feels improper to determine models or findings on user behaviour if only one demographic is prevalent.

For example, Transport Infrastructure Ireland identified the drivers of car dependency for women, including transport infrastructure, significant caregiving responsibilities, safety concerns and equality of access to quality services. In addition, there are still issues associated with the design and implementation of ITS that recognise mobility for all populations, including underserved individuals and communities.

While the discussions about equity in ITS included forward-thinking concepts, one of the many aspects of equity, measuring equity, is somewhat constrained:

- Many equity measurement frameworks exist but one size does not fit all. Each of the existing frameworks measures specific equity characteristics and is not interchangeable. Furthermore, there are significant gaps in measuring equity, including air quality measuring health impacts, racial profiling in which technology does not tell the whole story, transit ridership (increases in ridership do not necessarily show that transit is improving lives) and pedestrian safety.

Two quotes help in understanding the challenge:

    - Richard Easley, President of E-Squared Engineering, said: “You can’t address a problem that the data doesn’t show”; and
    - Susanna Zammataro, Director General of the International Road Federation (IRF) stated: “It is imperative that we understand the unwanted consequences of well-meaning ITS policies and initiatives”.

- While there is an increased role of data in mobility, mobility data exchange can be constrained as shown in the following image Fig. D presented in Special Interest session 48 by Tomotaka Kageyama, Director, ITS Japan).

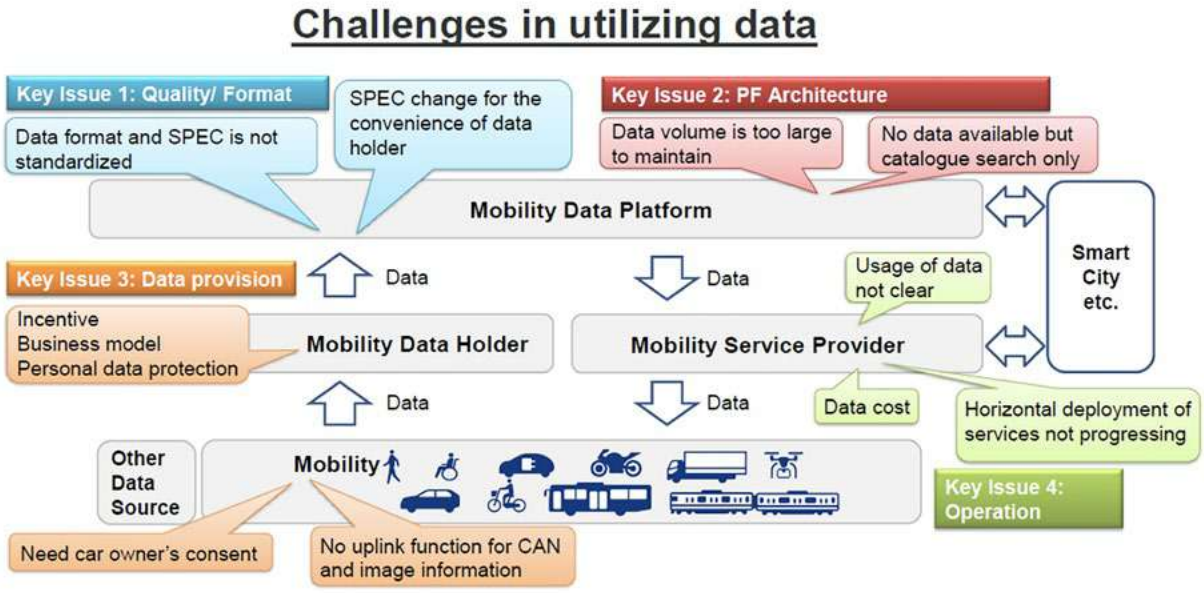

Fig. D: Challenges in utilizing data

(Source: Tomotaka Kageyama in session SIS 48).

Urban mobility was prominently represented in all parts of the programme and presentations featured interesting details of recent advancements and changes in the area.

Artificial Intelligence is becoming more and more widespread. However, it remains questionable if it is being used as a blunt instrument and becoming more indiscriminately applied to problems that do not require an AI solution to be effective.

A lot of AI applications for analysing video footage use video cameras or other forms of CCTV for safety and crash reconstruction and analysis or asset management. These AI applications are at a low level with nothing advanced enough to conduct much analysis.

The Congress explored the question 'what is needed to change travel behaviour?' much more extensively than before. One key quote by Josep Laborda from Factual Consulting, explaining the challenges associated with this is: "We are creatures of habit, so changing travel behaviour is a complex topic. Every person is different and requires that micro incentives are personalised to have an impact on travel behaviour."

The complexities of changing travel behaviour were discussed, emphasising personalised micro incentives as crucial, due to individual differences in travel behaviour. The key points include:

- mobility service design should consider household travel decisions and appropriate business models (subscription vs. pay-as-you-go);
- incentive programmes must account for travel time, comfort/service quality, cost and environmental impact;

- incentives alone are insufficient – they must be paired with supportive policies. Another key quote was: “Incentives alone won’t get people out of their cars” said Terry Smith from WSP.;

- public transport needs to offer better services to encourage behavioural change, as demonstrated by Cincinnati, Ohio’s post-COVID ridership increase to 110% of pre-COVID levels due to improved services.

In-vehicle sensors that monitor the driver include eye tracking, heart rate and other visual cues. This has always been on the periphery, coupled with a lack of discussion on regulation and legislative frameworks around accessing this kind of data and consent. It is an odd juxtaposition: we seem to be very careful about the perception of data use in the public domain but openly talk about tracking driver facial cues inside the vehicle.

Exploring the impact of information channels on sustainable mobility behaviour is a recent change. An Austrian project is aiming to improve the use of existing shared mobility options by providing quality real-time information. Over the long term, it is hoped that the impact of information channels will prompt a transformation in users’ attitudes – choosing sustainable travel options, whether for leisure or commuting purposes.

4.4 Pillar 4: Innovations in Mobility and Logistics

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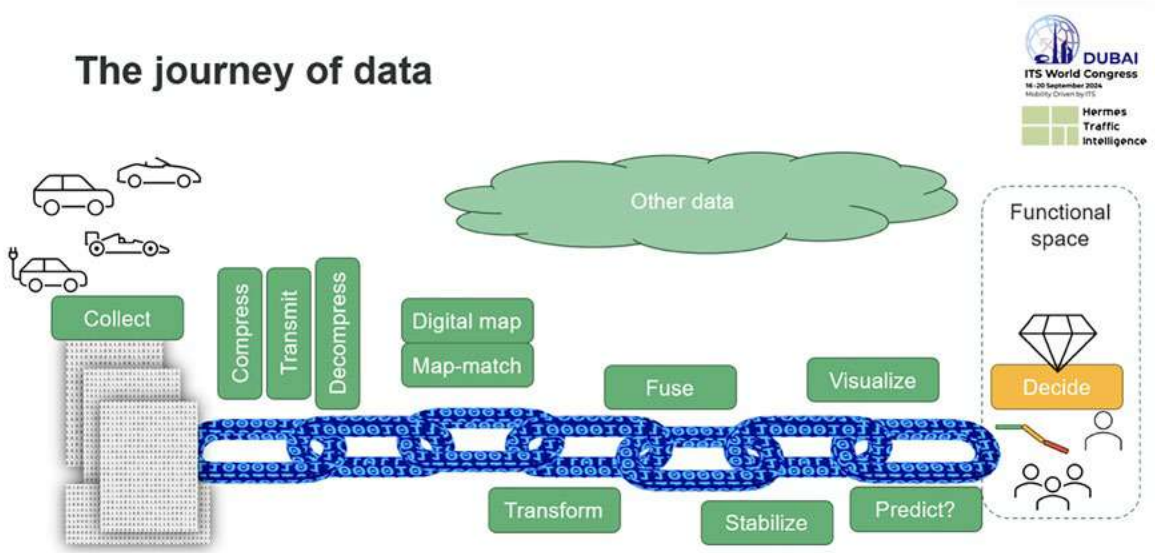
The overall situation

Mobility is trending towards highly automated, data-driven, digitally integrated and proactive systems. Emphasis was placed on data sharing, AI and improving blackspots in location-based data across both mobility and logistics.

Data-driven solutions were certainly front and centre of the technical sessions. A session on traffic flow optimisation underlined the importance of applying recognised traffic management theory to gain full value from the data being utilised. The amount of data and related stakeholders is rapidly increasing. This creates huge opportunities but also pinpoints the need for analytics platforms that can process raw data and create an accurate situational awareness picture and short-term predictions for different use cases.

Digital twins are a hot topic and can create great opportunities but are still a work in progress in many cases. Equally, AI applications have been developed and tested worldwide and the results are promising; for example, the detection of vulnerable road users and transit fare evaders, as well as potentially fatal road user behaviour.

The use of data and digitalisation for the efficient management of cross-border solutions featured across a number of sessions and garnered some enthusiastic audience engagement. There appears to be scope for this to continue to evolve as a topic relevant to all land-based transport modes. However, notes of caution were sounded, with stories that pilots have presented multiple challenges in stakeholder coordination. Trials can be a challenge as operators do not want to disrupt the daily flow of goods movement. Related to this, there was a sentiment that we are a long way from fully automated border crossings (in the US and Canada in particular) as border authorities are currently not open to removing human checks. This echoes the need for greater truth and confidence in the data and the systems used to share it.



(Source: The Journey of Data in AI/ML applications, SIS 43, Jorgen B Wanscher)

What is popular and what is not

Mobility

AI is common across both mobility and logistics, particularly in relation to ITS and how it integrates with SaaS systems. Viewed in the context of traffic management applications, there was strong insistence that, in order to get usable outputs, there needs to be a focus on ensuring quality in the data being used to drive AI-based solutions.

Building on this thinking, there was discussion around the need to acknowledge bias in AI systems and how this evolves from human biases used to build the AI in the first instance. Linked to this was a discussion of data and data pipelines, particularly with the addition of AI – how do we ensure that the data we use to get our results are good sources of information? AI could compound existing dirt inside datasets and amplify any biases or issues: "If you are putting poor data in your data supply chain, expect to get poor results out" stated Jorgen B Wancher.

Evacuation modelling for natural emergencies was an important theme for **resilient mobility solutions** (for events like bushfires and floods), looking at how to ensure safe evacuation paths using AI, historical, predictive and real-time data. Reference was made to network 'black swans' (rare events with significant impacts), with the example of the pandemic given.

Collaboration and data sharing are seen in both mobility and logistics contexts but with similar aims of creating better information-sharing processes to increase efficiency and communication, resulting in better C-ITS applications.

An interesting project looked at the use of space data to track the uptake of shared e-mobility services, with a clear trend of people transitioning away from public transport to use e-scooters, where this was feasible.

Equity was mentioned a number of times in reference to different topics. Namely, accessibility and safety for active travel or roadside users. Often, this is combined with AI, V2X or other vehicle-related data.

Urban mobility and last-mile solutions were scrutinised, focusing on their role in enhancing the overall vitality and sustainability of suburban areas. Multiple benefits were identified, linked to traffic, environmental and societal impacts and an approach to increasing the sustainability of last-mile solutions, building on innovation and collaborative planning, is proposed.

Cybersecurity was certainly one of the hot topics in the Congress, as the automotive industry – among others – needs solutions to ensure the security of connected and automated vehicles now and in the near future. There are two regulatory frameworks in place, namely the more general Cyber Resilience Act (CRA) of the European Union and the United Nations Regulation 155, targeted to regulate the requirements of the vehicle manufacturer. The comparison study implemented by IDIADA Automotive Technology Spain concluded that the R155 seeks to ensure that manufacturers implement robust processes throughout the vehicle life-cycle, whereas the CRA adopts a broader scope but introduces challenges by being less prescriptive in essential requirements.

The development of the digital twin, capable of accurately representing the current traffic situation based on the infrastructure and data from the surrounding moving entities, is another popular topic.

A paper highlighted the potential of C-ITS and automated vehicles in improving the accuracy of data and situational awareness, which can be utilised in traffic management even before automated vehicles become more widespread.

Urban air mobility constraints were examined, with a look at how to create safely shared airspace for the anticipated increase in aerial passenger-carrying drones. The conclusion that AI algorithms for drone deconfliction could represent an interesting approach to pave the way to the development of the digital sky, and thus ensure a drone's safe operation in urban areas, cautions that regulatory and ethical frameworks are needed alongside technological ones to bring forward future air mobility.

An interesting study developed a traffic flow prediction model that performs clustering analysis, demonstrating the high accuracy of this model in predicting traffic flow changes during special events. The results underscored the importance of cluster characteristics for accurately identifying traffic patterns from traffic data.

The need to ensure the safe utilisation of AI in transport and other sectors is certainly a hot topic, and the EU has issued an AI Act to address this need in Europe. The Act regulates AI systems based on their potential risk levels to health, safety and fundamental rights, the idea being that the higher the risks, the more actions required from both the provider and the user of an AI-powered solution.

The Traffic Management 2.0 platform took the initiative and provided guidelines on how to assess systems' risk levels for traffic management applications. This framework considers the purpose for which AI is used (strategic, tactical or operational) as well as what is the automation level of the system.

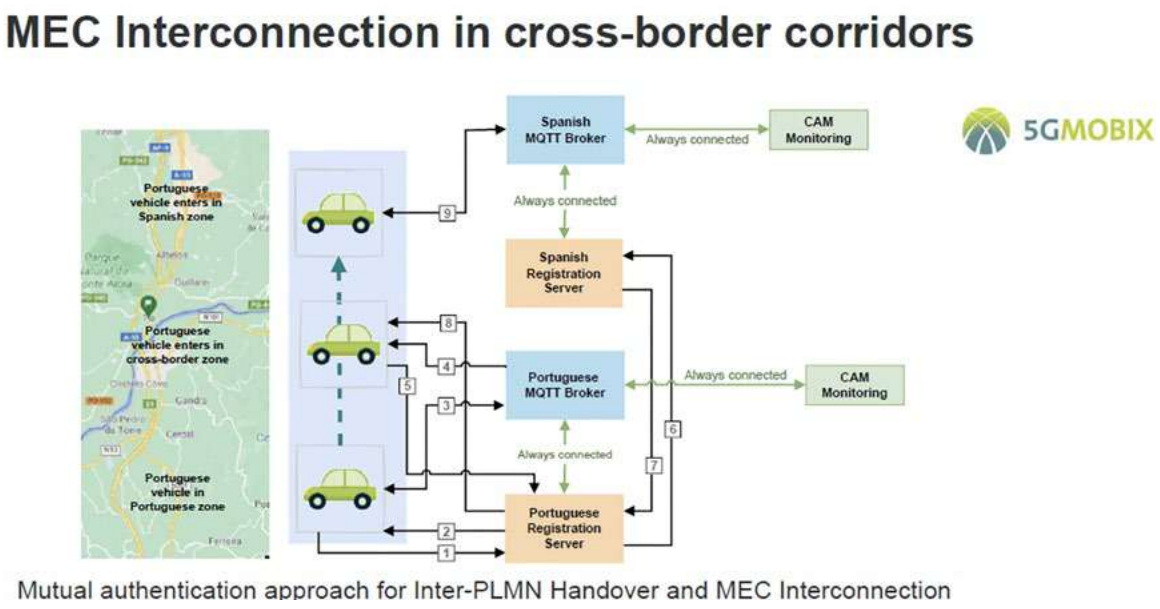
According to a recent study, many current applications seem to fall into low- or medium-level risk categories.

According to the framework, as long as there is a representative human-in-the-loop, the risk level may stay at those levels. More discussion is clearly needed to address situations where AI makes wrong conclusions or proposes false actions to human operators based on false, biased or limited data fed into the system. The results of AI applications are only as good as the data that is put into it.

It was also brought up that when the world becomes more dependent on the use of AI, the imbalances in the data regarding travel modes, road user types, gender, race and the global North and South might result in even bigger imbalances in the benefits of development if these imbalances are not considered in the early phases.

Logistics

Cross-border mobility in logistics was examined with the aim of achieving more efficient and safer trade, as well as how an advanced tech solution (i.e. AI and automation) could enhance this. Emphasis was placed on resilient systems.



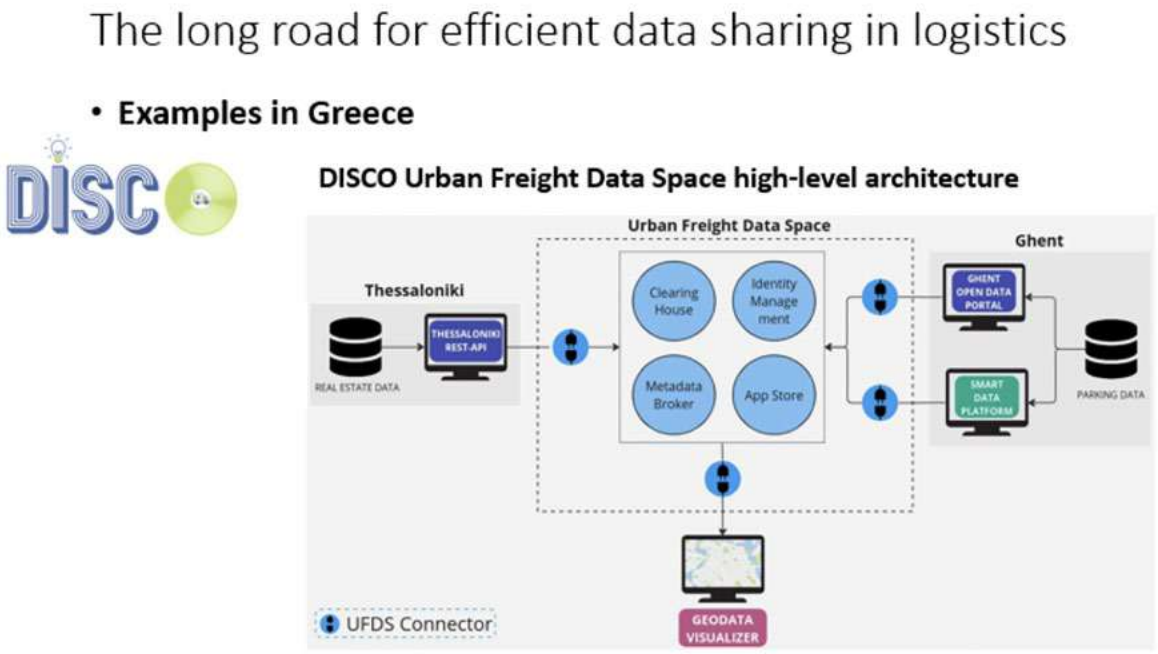
(Source: MEC Interconnection in cross-border corridors, SIS 19, Joaquim Ferreira)

A session on the MODI project talked through some of the current issues in relation to cross-border freight. Because of the borders between Sweden and Norway, these countries lose anywhere between a few seconds to a few minutes of location data for heavy commercial vehicles. This issue prevents higher levels of automation in trucking. The project aims to drive a Level 4 automated truck between Sweden and Norway and seeks to address regulatory challenges too – requiring legislative changes between the two regions. MODI outcomes also identified the need to shape data exchange alongside mutual agreements to overcome challenges in what is a highly competitive and low-margin sector.

Network connectivity was discussed – leveraging upgrades and new technology to address gaps in environments that may have previously negatively impacted mobility and logistics in areas with high latency or poor reception or infrastructure, e.g. the impact of 5G and 6G networks, GNSS and GPS systems and how these can be leveraged.

Decarbonisation of freight was popular across other parts of mobility and transport, particularly with the rise in EV ownership and the need for public infrastructure.

Service strategies using Unmanned Aircraft Solutions (UAS) for cargo transportation to remote areas and islands in Taiwan were explored, with the recommendation that a hub-to-facility model should be adopted for the early stages of UAS-based cargo delivery introduction in Taiwan. The paper sets out a useful roadmap approach for industry and authorities seeking to overcome challenges in UAS service models.



(Source: The long road for efficient data sharing in logistics, SIS 26, Evangelos Mitsakis)

There was interest in space data challenges and how space data can be used to improve the visualisation and digitalisation of freight movement and logistics. At a basic level, the finding from focus groups in one pilot was that the main question consumers and customers are asking is 'where's my stuff, and when will it get here?'.

Fenix 2.0 has enabled various trials and demonstration datasets but there was a suggestion that knowing what is not there, or has not happened, can be just as crucial as knowing what is or has. This is where gaps in visibility are still a challenge.

Related to CCAM, a suggestion that the freight sector and transport authorities speak different languages, in terms of cross purposes, was raised, with commercial entities fixed on the operational side and authorities more concerned with policy

and regulation. There needs to be a will to 'meet in the middle' to get the most out of innovation in CCAM for freight and logistics.

The topic of how we can achieve smart and decarbonised freight transport was discussed, with a focus on the development of the physical internet and how, at its core, the physical internet is about logistics, so it can be used to frame actual logistics operations and efficiency.

There was a view that less emphasis should be put on the cost of achieving smart and decarbonised freight transport and more placed on implementing standards that work to deliver the ultimate goal: networks in different geographical regions that can be seamlessly connected (with data across the physical internet).

New ideas

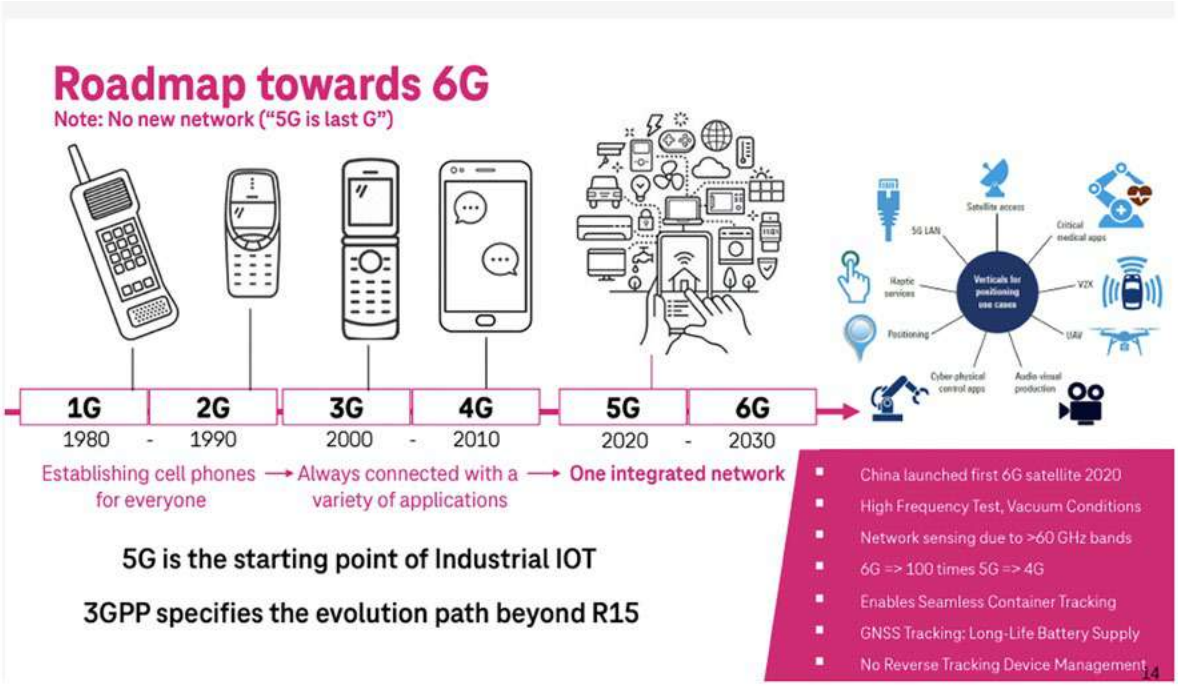
Perhaps more applicable to logistics, though not exclusively so, was an exploration of how advances in standardised sharing of digital data in the maritime sector can help the broader ITS ecosystem to leverage gains in efficiency and integrated transport networks.

With estimates suggesting 96% of global trade is via sea-based transport, there was a view that **maritime ITS** should be brought further into the fold of the ITS world as a key part of the data exchange puzzle that needs to be unlocked if we are to achieve truly interconnected mobility services.

The use of connected vehicle data and other new data sources and technology to model **emergency planning** was shared. The Chief Scientist Office in Australia has recently created grant programmes around this exact use case.

ADAS, whilst not new as a concept, is being talked about more openly as an application for safety in mobility. It was a surprise to see little discussion of eCall safety features given its widespread adoption into connected vehicles in the EU and since it forms part of the ADAS/CAV ecosystem.

6G networks, for addressing areas with poor data signals (rural or high-density urban areas) were also discussed. Again, it is not an entirely new concept, but it offers a new-generation tech application to an existing problem.



(Source: Roadmap towards 6G, SIS 51, Ralf Willenbrock)

Goals for public and private collaboration in traffic management for CCAM logistics were described in relation to developing collaborative technical and functional architectures. The integration of more traditional, statistical traffic models with machine learning models was looked at, with the benefits of improving accuracy in identifying and predicting traffic jams and travel delays, both in terms of time and location, championed.

The concept of the **connected construction site**, leveraging advanced technologies to redefine onsite assembly, was presented. Building on ITS for logistics and underscoring the strategic imperative of aligning technological capabilities with industry needs – thus positioning the construction sector at the forefront of digital transformation – the integration of industry 4.0 and ITS technologies to improve safety, planning and productivity was explored through the lens of a systems-based approach.

In Madrid, a solution to detect vulnerable road users with AI cameras has been tested, and a warning has been sent to CAVs when the collision risk was estimated to be high.

Another promising application of AI-based solutions has taken place in Australia, where an AI-based multi-function enforcement solution has been tested to detect the 'fatal five' road user behaviours: drunk/drug driving, distraction, speeding, fatigue and failure to wear a seatbelt. Currently, the system has proved capable of reliably detecting three out of five risky behaviour types, but work is undergoing to expand the capabilities to the other types based on following vehicle's movement patterns on camera.

A look at machine learning (ML) in the context of improving the resilience and sustainability of transport infrastructure advocated that we need to move towards

having enough integrated sensor information to detect pain in transport networks rather than having to visually inspect everything in transportation systems as we do today. ML helps to group assets, networks and network features together, providing seamless integration and representing a single view – a Digital Twin – of a system of systems.

In Dubai, the RTA prepared a Proof of Concept (PoC) to test an AI-based solution to improve the detection and inspection of fare evasion. The results were promising, as the camera/ machine learning-based detection system, after an extensive training phase, managed to correctly detect over 90% of the typical fare evasion actions, even the 'fake tapping' of travel cards to the reader. Based on real-time data, the inspectors can target their work on selected buses with the highest number of fare evaders on board.

In Taiwan, a synergistic application of smart glasses, empowered by high-speed 5G connectivity and enriched by XR technologies, has demonstrated substantial improvements in efficiency, precision and overall quality of maintenance tasks of rolling stock.

An innovative study explored the integration of urban air mobility (UAM) services with railway stations, proposing repurposing railway roof facilities as UAM vertiports and revealing distinct groups suitable for various UAM service roles by utilising evaluation indicators in terms of safety, connectivity and usability that affect the connection between railway stations and UAM.

There was an interesting idea featuring a method of bicycle localisation using vibration information generated by road surface roughness to identify the position of a bicycle and correct its positioning by matching a vibration map created in advance with real-time data acquired during the bicycle ride. Findings indicated that, whilst there are still some issues to be solved, the localisation method developed for conventional automobiles can be expected to be applicable to bicycles.

Trials and experiences of services

There was not a great deal shared in terms of interesting outcomes or experiences from trials for this topic; however, points of note included a project trying to increase seatbelt compliance in New Jersey and a project in Shandong Province, China looking at multi-modal transportation connectivity between cities.

Other trials included MORGEN – a virtual data generator to address edge cases in data scarcity for autonomous driving, which simulates driving scenarios that are rare or that we lack data for, and Q-free automated truck trials.

Forwards versus Constrained

Key 'forward' issues

Smart energy and decarbonisation

Upgrading hardware to support better performance of new C-ITS initiatives was a featured topic. For example, upgrading automotive semiconductors to ensure that ADAS and other vehicle-generated datasets can be collected. 6G, Star Link and upgrades to telecommunications in order to improve cross-border communication or blackspots, and advanced network slicing techniques for 5G communications technologies to support connected mobility and ITS services in the cloud and at the edge, was a novel solution to achieve a smoother and more reliable mobility experience within the ITS ecosystem.

Software-enabled telecommunications innovations are likely to be a key factor in the evolution of ever more connected and autonomous transport and mobility solutions. There was an interesting look at how the costs of evaluating LEO satellites for connected vehicle applications can be managed by using an integrated simulation approach. Examination of several simulation scenarios revealed that the integrated simulation approach can achieve performance comparable to existing ones.

Staying with satellite communications, there was a look at the position, navigation and timing (PNT) needs of future ITS initiatives, with a view that the evolution of 5G services, including provider interoperability via RAN and other software-defined techniques, will provide the connected ground-based communications infrastructure needed to effectively leverage and harness satellite and space communications in a safe and secure way. This could have huge benefits for connected and automated mobility services across all transport modes, including freight and maritime.

The European regulation regarding safety-related traffic information (SRTI) sharing came into force in 2013 and large-scale adoption has advanced slowly but steadily. The development will likely take on new speed as the ability to integrate SRTI information into vehicles' ADAS and information systems will become part of the EuroNCAP rating, which is known to be of high priority among OEMs.

In addition to the regulated SRTI data types, service providers have introduced commercial road safety alert services, digesting input data from various sources (authorities, vehicle systems, etc.) and using state-of-the-art analytics to provide timely and spatially accurate warnings to both OEMs (who want to improve their NCAP rating) and consumer applications.

Key 'constrained' issues

Commercialised services, offering valuable insights for the advancement and incorporation of LEO satellite communication technologies in connected vehicle networks, are still hindered. The challenges of regulatory adaptation, public acceptance, ethical considerations and the need for significant investment in infrastructure could constrain the pace of this transformation.

The economic viability and scalability of some of the projects and approaches for long-term and widespread implementation, along with collaboration between

private and public entities and the general public buy-in/opt-in and trust, is an issue. Higher levels of autonomy are constrained by physical network infrastructure, policy and public trust.

The 'love affair' with AI was explored, with the question asked: "are we using it as a blunt instrument?"

In the field of C-ITS, harmonisation still needs a lot of work to make large-scale implementations a reality. It is clear that the industry will not adapt to different national specifications. Rather surprisingly, there still seems to be confusion among stakeholders as to what communication method(s) to choose and how they will develop in the near future.

This may be one of the factors that hinders C-ITS uptake among OEMs. There are also clear cultural differences as, in Europe, governments are asked to solve the remaining open issues whereas, in the US, it is expected that the industry will select the winning concept.

Cooperative ITS for safe and sustainable transport featured a discussion on achieving a balance between top-down legislation and bottom-up evolution, driven by equitable collaboration in technology development.

The view that the automotive industry cannot sell safety or a detailed understanding of the technology but can understand the user and their needs was countered by the example of seat belts and ABS, which were both introduced without public consultation.

So, introducing C-ITS in phases that help drivers in a real way (e.g. for speed limits) can potentially induce enough drivers to change their behaviour that a tipping point is reached across the road user base and resulting network efficiency and safety improvements are seen across the board.

Interestingly, not much about road user charging/congestion charging was discussed, which is surprising considering it seems this would go hand-in-hand with conversations about decarbonisation and electrification of fleets (either across freight or other modes).

Safety constraints were brought to the forefront, with a look at 'dilemma zone' strategies for a Vision Zero future, leveraging the latest sensor technology to develop advanced detection zones for dynamic signal extension. Though not touched on in the paper, the ongoing challenge of financing and resource availability in transport authorities continues to be a barrier to adopting nascent solutions such as these.

Road and traffic data are available from several sources as Traffic Management Centres, Road Operators, Service Providers, OEMs and the automotive sector and data encoding provided by several interfaces varies based on the applications and standards used in the different inter-related fields adapted to the best suitable communication channels.

The paper by Autostrada per l'Italia highlights the importance of semantic consistency in the adaptation rules that transform information from one encoding and model into the other, ensuring consistent information services.

At the moment, only a few harmonised specifications are available to address this issue across different services.

For cross-border mobility, there was a feeling that passengers are easier to handle than freight due to the complexities of coordinating multiple players in the value chain. The lack of coordination between telecommunications providers was seen as an additional blocker to effective cross-border cooperation, particularly where a competitive edge is apparent.

Changes in the topic area

Regarding preparation for large-scale emergencies and evacuation, progress has been made as the **Common Alert Protocol (CAP)** has been adopted in most countries in the world and people in general are more and more connected in real-time. TISA has developed a solution where a TPEG2 message is produced based on CAP data and can be sent directly to vehicles and other media in a standard format, enabling this life-saving information to be given to drivers clearly, in their own language and with minimal distraction.

Transparency in end-to-end supply chain logistics was not overly visible in Congress sessions. However, based on discussions around the Congress, there appears to be greater transparency offered to end-consumers; for example, scanning barcodes on products to understand the suppliers you buy from and the ethical implications of choices.

An increase in automated processing by AI, robots and automation becoming widespread in more areas of mobility and logistics, was evident. It seems that AI has really taken a step forward.

In many applications, AI has been successfully used in the detection of various phenomena from camera feeds. Machine learning, provided with a sufficient amount of quality training data, seems to offer viable solutions to problems that have been impossible to solve with traditional computing technologies.

Whilst there were no 'off-the-shelf' applications published, applications are currently in the pilot phase. AI was visible again in an 'Integrated AI-based Traffic Incident Management Workflow' to automate and improve the operation and efficiency of traffic incident management, finding that integrated AI has clear benefits in a multi-disciplinary process like traffic management.

Smart energy, as it relates to mobility, was discussed and a view was shared that, to overcome resistance to a willingness to tackle objectives linked to decarbonised transport, the public-private relationship is key: it requires the public to accept private intervention, and for the public sector to create market conditions to facilitate the private sector.

Public authorities almost need to be influencers in this scenario, to present an attractive proposal to the private sector – being as much about marketing the service outcomes as the project that enables it.

ITS SUMMIT “FUTURE OF MOBILITY”

ITS Summit 'Future of Mobility'

Global leaders and decision-makers at the Future of Mobility Summit discussed the urgent need for mobility stakeholders to attain sustainability goals. The event brought together government and ministerial representatives from 20 countries, along with 25 representatives from local and regional governments and 10 international organisations, to reflect on ways to assess the impact of mobility initiatives in alignment with global sustainability goals.

Key topics included social equity, data-driven policy, technological standards and the integration of transport with economic indicators. The Summit emphasised the need to turn ambition into action and move from discussion to measurable progress in advancing global sustainability goals.

The importance of establishing a unified framework to guide the global transition towards safe, resilient and environmentally responsible transport systems was highlighted. The focus was on two of the sustainability pillars: the social and economic aspects. The role of technology and policy as key facilitators of this transition was emphasised.

The broad governmental representation at the Summit, featuring different ministries, reflected the multi-faceted approach needed to achieve sustainability in mobility, with participants underscoring the interconnected nature of these sectors.

Participants elaborated on the way forward in developing global indicators that could serve as benchmarks for sustainable mobility. The interplay of innovation and regulation was a central theme. Summit participants were divided into six focus groups, each focused on one aspect of the transition process.

They concluded with an agreement among participants that any universal set of sustainable mobility indicators must consider some key issues because sustainable transport touches on a wide range of social and economic factors. 'Intersectionality' was a crucial concept in the call to mobility, as well as the need for leaders to look beyond traditional transport systems.

Along with social considerations such as equity and workforce development, there was also a call for integrating land use and transport for economic impact in smart cities.

The emphasis on value-driven policies was a common theme. There are lessons to be learnt from the European Commission's Sustainable Urban Mobility Indicators, but only if the framework is well understood by those for whom it is designed. Technology was seen as a tool to support data-driven policy but not a deciding factor. Whilst calling for more global standards and interoperability, there was consensus that any study of sustainable mobility must be user-centric

ITS must be recognised as a prominent contributor to sustainable mobility. The statement 'global indicators must be globally fair' also highlighted the need for many regions in the world to secure proper financing to deliver on its promise.

OUTLOOK

Outlook

The **31st ITS World Congress,** taking place from 24-28 August 2025 in Atlanta, Georgia, USA, will continue to explore the Future of Mobility under the theme 'Deploying Today, Empowering Tomorrow', featuring vehicle automation, connected transportation, transportation systems, managing and utilising data, sustainability and resiliency, multimodal integrated mobility and incorporating emerging technologies.

The **16th European ITS Congress,** scheduled for 19-21 May 2025 in Seville, Spain, will focus on clean, resilient and connected mobility topics such as CCAM deployment, emergent technologies, data and services for mobility, societal aspects of mobility, as well as resilient and safe mobility today and tomorrow.

Both Congresses are excellent opportunities to continue discussions with peers from the ITS community. We look forward to learning of the progress made since ITS Dubai 2024, as well as the challenges ahead.

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