



LOS ANGELES

ITS WORLD CONGRESS 2022

THE 28TH ITS WORLD CONGRESS

POST-CONGRESS REPORT

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The 28th ITS World Congress | Post-Congress Report

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INTRODUCTION



The Congress's principal Theme "Transformation through Transportation" was chosen to illustrate the radical role Intelligent Transport Systems, digitalisation, and cooperative, connected and automated mobility can play in addressing the key technical and social challenges in the mobility and transport sectors. Deployment of ITS can take us further down the road to a mobility world that is accessible, equitable, affordable, has zero fatalities, has zero emissions, is resilient when stressed, is seamless across Continents and is sustainable. How to achieve these benefits was presented in policy discussions, technical and research paper sessions, discussion forums, demonstrations, technical tours and the Congress Exhibition.

The Congress was organised around seven key Topics:

TOPIC		Pages
1	Digital Infrastructure	16
2	Equitable and Seamless Mobility	21
3	Intelligent, connected and automated transportation	26
4	Organizing for successful policy & governance, Business Models, International cooperation	31
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The International Programme Committee, chaired by Laura Chace and Shailen Bhatt, appointed rapporteurs for each topic tasked with capturing the key messages and outcomes from the Congress, the exhibition and the demonstrations. The headline theme was addressed by a wide range of different types of sessions, over 150 in total – Plenary, Special Interest, Technical, Scientific – as well as specialised Workshops and Forums.

Part 1 of this Report summarises the Congress proceedings. The second part paints a picture of proceedings at the Plenary Sessions. The third part focuses on the Technical & Scientific papers and the Special Interest Sessions but also covers Workshops and the International and Regional Forums. The final part summarises the proceedings at the High Level Policy Round Table.

I give my profound thanks to the marvellous team of rapporteurs who contributed so much to the production of this report:

Topic 1	Nisar Ahmed, Gary Crockford;
Topic 2	Carol Schweiger, Ed Mason
Topic 3	Karla Jakeman, Sushma Srinivas, Frances Williamson
Topic 4	Louise Lawrence
Topic 5	Ed Mason
Topic 6	Pete Lauer
Topic 7	Pete Costello

My special thanks to Steve Dellenback and colleagues from SWRI who made this report possible; and also to Rachel Rettberg and Susan Nicoletti from ITS America; my colleagues from ERTICO; and Sharon Kindleysides and Tim Morris from the UK. The Reed Exhibitions organising team deserve thanks for their quick and cheerful handling of all my enquiries and questions.

Topic 1 was Digital Infrastructure, a key enabling technology overlapping with the other topics. The prominent themes were:

- using data and digital infrastructure to improve management of transport systems
- advanced wireless standards
- and improvements from digital infrastructure for travel safety, traffic flow and operations.

Many sessions looked at “How to do it” – especially managing and using data – and cybersecurity considerations. Continuing areas from previous congresses included application of digital twins and standardisation. New ideas included building cyber resilience into the digital network, exporting improvements from highway networks to road works zones, interaction of Automated Vehicles with level crossings, and safety benefits for connected vehicles through V2X technology.

An organisational barrier to the more efficient installation and use of digital infrastructure was regularly identified – a lack of coordination when planning data sharing and processing as departments were often not familiar with the data they held and its potential. We did not see much consideration on integrating transport’s digital infrastructure with that deployed more broadly in the built environment. Together they support the seamless, informed movement of people and goods and enable holistic “transformation by transportation.”

Topic 2, Equitable and Seamless Mobility, covered four major areas:

- integrated mobility and standardisation;
- equity, diversity, accessibility and inclusion with a focus on gender challenges and gaps;
- improving safety and security,
- reducing emissions and congestion.

Sessions reported improvements in all areas but there were some unexpected gaps: this Congress was perhaps the first since 2015 where MaaS was not a dominant topic. Electric mobility was less popular than expected particularly given media interest. And the impact of ITS on the environment featured in only two sessions.

In contrast we saw many new ideas:

- Using artificial intelligence to schedule e-vehicle charging.
- Predicting the numbers of empty seats on buses using 5G real-time payment data
- A “super app” supporting modal shift from trips by personal car to intermodal travel.
- A mobility wallet for travellers with credits that could be spent for paying road usage fees or to finance trips with alternative modes. For disadvantaged users, the wallet could be partially or wholly subsidised.

This and earlier Congresses have had sessions addressing equity, inclusion, accessibility and diversity in ITS. However there’s only a limited number of tools to measure these factors and test whether we are properly addressing them; and they are not well known.

Topic 3 was Intelligent, connected and automated transportation. As with earlier Congresses this was the most popular topic accounting for over 35% of all activities. Three areas featured prominently: improving safety especially at intersections; development of rural services; and collaborations. On this last point there were showcases of joint ventures between countries and regions, and collaborations between sectors such as industry and government especially in topics such as testing, and deploying Connected Vehicle technology. Collaboration between Government departments was presented and we also saw cases of commercial competitors in partnerships especially in areas such as V2X communications.

There were some slightly neglected topics: transport accounts for 29% of greenhouse gas emissions in the USA but we had very little on how deployment of connected or automated vehicles might enable reductions. We also had less than in previous years on regulatory and licensing issues.

By contrast new topics included truck automation where there had been major advances and more real-world testing. There were still challenges with regard to incorporating the first/last mile and yard/terminal movements but collaborations again seemed plentiful and these problems seemed to be on the way to resolution. Bus automation also attracted much attention and was wanted not just by cities but rural areas too.

Post Covid Automation was a new topic not considered a few years ago but the almost universal drop in public transport use after Covid had prompted the question – how would this trend impact automated travel, which was predominantly a shared travel experience?

Failure is an integral part of innovation, but it’s expensive and difficult to acknowledge publicly. Nevertheless live vs virtual testing was a common discussion point. Some studies were using live components in real-world situations either on test tracks or by deploying technology at public intersections. Others examined the technologies in virtual or constructed settings. A hot topic for the next Congress might well be how can we enable more cooperative testing and allow multiple participants to examine their technologies in environments that can include interactions between live and virtual components.

Topic 4 Organizing for policy & governance was an intriguing mix of exploring new approaches to familiar problems and devising ways to understand new problems. Many disruptive technologies had almost become mainstream thereby creating new challenges for the sector professionals. This emphasised how all stakeholders needed to understand how technologies critical to transformation of transportation could be enabled by effective policy setting at the earliest stages.

A number of sessions illustrated diversity in leadership not keeping pace with technological developments. In many areas we had global skills shortages, not least in diversifying and attracting women into ITS. However diversity has a broader span: age, education, disability, ethnicity. The challenge was that in many cases these groups were not available to participate as they were under-represented in the industry.

Sessions demonstrated fresh thinking in a number of areas. Papers and sessions reported application of data technologies particularly the management of congestion through deeper understanding of queuing and traffic optimisation. There were new studies on how to derive value from digital platforms. Many of the earlier studies focused on the technical challenges with very little work on understanding the business models and recognising revenue opportunities for data.

By contrast the delivery of new mobility services appeared constrained. MaaS technologies were very well established but sessions stressed the need for the broader environment to be effective. The challenges to overcome were both commercial and contractual. Was MaaS still a future-ready solution awaiting a future-ready culture?

Topic 5 The Path to Vision Zero focused on the question: *'How can we work towards eliminating traffic fatalities and severe injuries, while increasing safe, healthy and equitable mobility?'* Surprisingly it was the Congress's smallest Topic with a focus on urban mobility and little consideration of inter-urban networks. The technical papers presented addressed essentially the same issue – safe urban mobility in a shared-use, multi-modal environment. The SISs focused on data: crowd-sourced data, how to leverage and analyse the available data or get the right data, access to the data (and tools), and practical applications that allowed for improved decision-making.

The increased attention on safe urban mobility was perhaps a result of the rapid increase of active travel options (bicycle schemes, e-scooters, walking, mobility scooters, e-cargo bicycles etc.) This had led to a spike in mixed-use urban road traffic collisions which many urban networks were ill-equipped to handle. This was a significant blocker to achieving Vision Zero targets. There was no shortage of technologies to support Vision Zero – what seemed to be missing in many cases was clear top-down policy leadership.

Sustainability and Resiliency, **Topic 6**, covered 5 main areas:

- Transport operations
- Congestion mitigation
- Modelling impacts + emissions
- Electrification and related technologies
- Cybersecurity

Sessions looked at aspects of improving transport efficiency such as ITS for emissions reductions and decarbonisation; Safety improvements; and Signal timing for improved transit performance

However sustainability discussions had little mention of hydrogen fuel cell electric vehicles.

Many panels and papers discussed developments in cybersecurity to improve resilience with much sharing of best practice. Climate resilience featured prominently:

- Optimising energy resources to support EV charging
- New tools for measuring climate impacts from energy usage and emissions
- Supporting cities towards meeting goals and regulations for pollutant reduction

There was little discussion of external resources resilience and their potential constraints on climate strategies for example world lithium reserves

Sustainability and resiliency strategies differed across urban, suburban, and rural settings. For instance, rural areas were likely to have electrification capacity challenges very different from those in urban environments.

Topic 7, Bringing goods the last mile, covered a lot of ground with key building blocks of communications, data, integration, analytics and pilot projects. There had been massive investment globally in wireless and wired networks to improve ITS infrastructure and enable data movement from the transport network to the cloud and back to the edge. The future of ITS is integration of data, and innovative techniques for sharing, processing, integration and management. Travellers want solutions that are simple, flexible and give access to a multiple mobility offer. Mobility on Demand and Mobility as a Service were familiar; Demand-responsive transport had the potential to revolutionise public transit, replacing low-performing routes and providing new services where none existed previously.

Pilot projects reported work in a number of areas including:

- Software to collect multimodal travel behaviour data
- Broadening the scope of multimodal services for underserved populations to improve access to jobs, healthcare, education and other needs.

Freight solutions continued to develop. Long-haul freight networks were evolving to streamline the movement of goods and improve efficiency. To combat multiple deliveries on the same day and to one address but by multiple companies last mile delivery by modes such as cargo bikes, eScooters or delivery robots with reduced environmental impact had been trialled. Emerging topic areas presented included enforcement, kerbside management, electrification and quantum computing.

Los Angeles 2022 showed ITS was at a good place on the road to seamless mobility that works for everyone. We had achieved a lot in the last year but we had not finished and some difficult problems remained. Almost none were technology – they were about our behaviour and willingness to adapt. The technologies were ready to provide mobility that was

- Accessible
- Equitable
- Affordable
- Resilient
- Safe
- Clean

But hitting two or more of these targets at the same time was very hard. If we had the political drive; if we had the societal acceptance of the price – the social consequences of deciding to reach key goals quickly – then we would be able to achieve the key goals of Zero fatalities and Zero emissions.

The barriers weren't technological. The message to politicians was that we could deliver Transformation by Transportation but they needed to transform their thinking as well.

“If you do what you've always done, you'll get what you've always got”.

PLENARY 1 A SAFE SYSTEMS APPROACH TO ADVANCING EQUITABLE MOBILITY

Moderator	David Kim	WSP, USA
Keynote address	Jennifer Homendy	National Transportation Safety Board, USA
Speakers	Nat Beuse	Aurora, USA
	Minna Kivimäki	Ministry of Transport & Communications, Finland
	Yutaka Kobayashi	National Police Agency, Japan.
	Seleta Reynolds	LA Metro, USA

Jennifer Homendy began her keynote address with some stark statistics – roads were the most dangerous form of transport in the USA accounting for 95% of all transport deaths. Additionally the interim 2022 fatality rate on roads was up 10.5% from 2021 which in turn was the highest number since 2005. There had been a 5% increase in cyclist deaths, a 13% increase in pedestrian deaths, similar increases for motorcycling, and while walking was the oldest form of transport it was also one of the deadliest.

She asked what the audience considered a realistically achievable “safety” rate target; the answer was around 75%. She then rephrased the question as “What is the target you want for your family?” and stressed that the goal for all should surely be zero fatalities. To achieve this we needed to adopt a “Safe System” approach which looked at every aspect of transport from human to machine with emphasis on a human-centric approach.

Three principles underpinned the Safe System method: acknowledge that humans make mistakes that lead to traffic crashes, but no one should lose their life or be seriously injured as a result of a crash; that the human body has a limited physical ability to tolerate crash forces; and road safety was a shared responsibility; and all parts of the system must be strengthened so that if one part failed, road users were still protected. Implementing a Safe System approach required collaborative engagement among a diverse group of stakeholders to ensure all road users were safe. Our roads had been designed for vehicles not people with a focus on speed and throughput and not safety.

Ms Homendy explained that while drivers could be encouraged to do better through punishment and education, speed limits, infrastructure, vehicle design and regulations were also important as well as ensuring that first responders had all the right resources to save lives. Ultimately we could not “educate ourselves out of this”. It was necessary to look more broadly and embrace technology every step of the way. She stressed that technology should supplement humans, not supplant them. It was already clear that technologies such as V2X or collision warnings could improve safety for vulnerable road users. We should remember that 2 out of 5 people who died on the roads were alive when the first responders arrived. ITS could help by getting responders there faster – and with better post-crash care.



There was abundant evidence from over 20 years’ experience that technologies were readily available that would save lives and take us along a path to zero fatalities – but they were not being deployed by legislators and regulators. What were we waiting for? We could not get to zero without ITS solutions, it was not “either/or” but “yes/and”. We needed to implement life-saving technologies and act outside our comfort zone.

David Kim moderated the panel discussion that followed and endorsed the keynote speaker’s remarks – the USA was an outlier regarding road safety as the figures were going in the wrong direction. He introduced the panel and asked each to give a short summary of their approach towards zero fatalities

Minna Kivimäki agreed that zero was the only acceptable goal and applauded the Safe System approach, a holistic approach. Finland had adopted a similar holistic method for road safety which looked at all modes of transport. There were 7 aspects to the strategy:-

- Safety concerns all people
- Transport skills must be improved
- Safety must be based on knowledge and evidence
- Attitudes need to be changed
- Transport systems must be safe
- Tech advances must increase safety
- Legislation must increase safety

The important point was taking decisive action. She cited Lithuania as an example of a European country making great progress for example the number of road fatalities had decreased by 17 %. This meant that 2021 fatalities were less than half the number a decade back. These good results had not happened by accident but were the result of a strong push behind the scenes.

Nat Beuse argued that regulations were the foundations of safety but the safety benefits often happened before the regulations emerged – the technology happens first, the market adapts, and only then are the regulations written. Electronic stability programs, emergency braking, air bags were all introduced by suppliers well before regulations caught up. He emphasised that we needed to regulate safely, quickly and broadly. It was not necessary to wait for perfection. And regulation processes that had worked in the past were not automatically the right solution for next year. We should bear in mind that when the roads were safer, the whole transport system became safer.

Yutaka Kobayashi presented impressive figures on Japan’s movement to the lowest road fatality rate since 1948 with figures dropping from 3848 deaths in 1948 to 2636 in 2021. There was a series of rolling 5-year programmes to drive down road accidents generally and fatalities in particular. He identified some of the methods which had led to this result including road engineering, revisions and penalties to driving legislation, vehicle technology such as ADS, use of delivery robots, enforcement, education and improved emergency care capabilities. A key factor was a changed social attitude that supported steps to improve safety.



Seleta Reynolds reflected that we now had a far better understanding of the complex mix of people behaviour and traffic behaviour that surrounded accidents and noted that safety must be a shared responsibility. It was interesting to look at the safety culture in a different mode: when recently an airplane design fault had been identified as an accident cause the airline had grounded all the models immediately, US airlines had checked all models within 48 hours and the global industry had also acted within 48 hours. She highlighted that airlines didn’t “sell safety” as a feature – but we did so on road transport. The airline industry shared all safety-related data but for ground based transport the data was still in silos. We had to come together and see road safety as a shared activity and address it with a systems approach.

The moderator asked the panellists, “What do we need to do to ensure ITS solutions equity, innovation and ITS solutions are all addressed to improve safety?”. Seleta argued that we needed to take a safe systems approach as well as a cultural approach and doing both should be a requirement before receiving any public sector funding. There must be a shared agreement that purpose-driven innovation was not just about developments inside the vehicle to save lives but also developments outside the vehicle to save lives. There must be a base line for ITS and innovation.”

Nat agreed that we needed to be transparent and clear on what was the problem we were trying to solve. There were things we could do with policy and a transparent approach but to achieve a truly equitable approach all shades of opinion had to be represented at planning discussions and a consensus agreement was vital.

The panel were asked to consider what could be done to improve safety in rural areas where the incidents were very different to those in cities. Yutaka explained that in Japan, 60% of fatalities were in urban environments and the rate of V2V accidents was 44% higher in urban areas. There was no single solution – the way forward was a mix of enforcing speed limits, redesigning infrastructure for safety, checking vehicle condition and be seen to be enforcing regulations.

The moderator switched the panel discussion to zero emission and automated vehicles. These had the potential to reduce greenhouse gas emissions and improve safety but they prompted the question whether they encouraged continuity of a personal car culture. There were increasing arguments for addressing the reliance on owning a vehicle and allocating increased road space to non-car users such as pedestrians, cyclists in car free zones? How did the panel see this ? How could it be done ? Seleta said that when Los Angeles hosted an annual Cyclovia Open Streets event the air quality received a matching boost in a larger area and there were also reductions in crime rates. It was far from straightforward to achieve a one-day event and would be controversial if proposed as a permanent state. The way forward might be a regular Open Streets event akin to a regular Farmers' Market to assist a transition . However there were other ITS techniques available such as congestion pricing which brought benefits for safety; LA Metro was researching its introduction.

Yutaka explained that remote-control delivery robots and scooters had emerged in Japan as new classes of road user and the Japanese Government had responded with new rules to support road space management. He felt that it would be difficult in most Japanese cities to have significant car free zones due to limited physical space so changes would take time. However there were a number of non-driving initiatives designed to improve facilities for the active modes and Ministers were keen to develop "walkable city" projects especially to try to reduce accidents. Nat commented that policy makers frequently did not take into consideration the big differences between urban and rural areas, for example absence of sidewalks which made difficulties for children cycling to school. One size definitely did not fit all. This final sentiment was agreed with by Minna who said that the management of urban space was complex and was a major driver of the need for holistic and integrated solutions. The key was being able to offer all classes of traveller a choice of attractive solutions.

Finally, David Kim asked the panel if they had a magic wand which one tool would they want the Government or Private sector to deliver today in order to reduce road crashes and fatalities. Seleta opted for congestion pricing, Yutaka voted for highly automated vehicles to improve the quality of life for older or/and mobility limited travellers. Nat wanted to see alignment of all stakeholders behind the development of mobility strategies; Minna wanted social acceptance that reducing fatalities is everyone's responsibility. The moderator closed the session with the comment that the speakers' contributions had very clearly shown the pathway to greater safety: the only barrier was the social will to take it. He thanked the speakers for an engaging, realistic and positive discussion on road safety.

PLENARY 2 TRANSPORTATION DECARBONISATION, EQUITY, AND TECHNOLOGY, – HOW ITS ADVANCES A SUSTAINABLE AND SOCIALLY JUST FUTURE

Moderator	Shailen Bhatt,	AECOM, USA
Keynote address	Toks Omishakin	California State Transportation Agency; USA
Speakers	Margaret Anderson Kelliher	City of Minneapolis, USA
	Everett Lott	Washington D C, USA
	Gzim Ocakoglu	European Union delegation to the USA
	Sue Wiblin	Transport for NSW, Australia

Climate Action



In his keynote address Toks Omishakin explained how California was deploying ITS to deliver the Governor’s four top-level action areas: Safety, Climate, Equity, Economic Prosperity. The efficiency and safety gains from ITS were well known but the impacts on climate and equity were perhaps less familiar. To give perspective he noted that California had 10% of all transport fatalities in the USA. Fatalities/serious injuries were at a 16-year high and increasingly the most vulnerable users were affected. 50% of Greenhouse gas emissions in California were from transport; the national equivalent was closer to 29% and internationally it was around 15%. He remarked that these figures were often challenged but for those who did not believe the science they should believe their eyes – floods, severe temperatures, extreme storms etc. The Equity and Prosperity targets were closely linked: every person must have an equal opportunity to succeed regardless of race, gender, economic status.

The key policies to address all goals were zero fatalities and serious injuries from road accidents by 2050; carbon neutrality by 2045; institutionalisation of equity; and improving from the current position of the world’s fifth largest economy. Regarding safety the State Highway Safety Plan majored on adopting a safe system approach; doubling down on solutions that worked; accelerating the deployment of advanced technology; and ensuring that an equitable mechanism was integrated into all policy setting.

The primary tool for addressing climate change was zero emission vehicles (ZEVs) where annual exports from California were already \$5 Bn with a predicted 1.5M sold by 2025. The target was 100% electrification of passenger and also medium- and heavy-duty vehicles. There were many challenges, not least developing the charger network, but California was already 40% of the ZEV market in America.

ZEVs would be very helpful but were not the sole solution for climate challenge. It was essential to create a multi-modal system For example the ports of Long Beach and LA handled 40% of container traffic entering the USA and so the connecting corridors were heavily loaded. Living in California was expensive so about 1.8M people lived in Mexico and commuted across but sitting at that border meant extensive emissions and significant waste of time. Investment in the port cut the waiting for travellers on both sides of the border and improved goods movement. Plans were emerging for the deployment of ITS to enable truck priority and generally streamline the operation of the road.

A key element of the use of technology to improve equity was the CAL ITP app for opening up transit. There were over 400 transit systems across California and CalSTA was working with the Netherlands company Rebel to build a card usable everywhere across the state. It would include payment, fare capping, automated customer discounts etc. A very different equity initiative was the opening of the Otay Mesa East port in 2024 where extensive use of ITS would cut the 6-8 hour waiting time for the Mexico / USA border crossing US to an hour or less with massive consequences for air quality and economic impacts.

Key economic actions also supported climate goals: over 60 companies in California were trialling highly automated vehicles on the roads system – in 2021 over 4M miles of testing was achieved. Of those 60 companies 7 were testing fully autonomous, passenger-less driver-less vehicles.

Shailen Bhatt as moderator introduced the international panel of speakers and asked for a brief statement about how they were approaching the integration of technologies with actions to improve equity and address climate change. Sue Wiblin said that numerous severe bush fires had raised public support for actions to counter climate change. Electrification was seen as one key technology but its application was not always straightforward – for example freight vehicles in Australia had to travel very long distances so hydrogen was a more probable option. For passenger travel there was a change of emphasis: strategies were being changed to refer to “place” instead of “community”. More focused on creating places for people. New South Wales now aimed to create “30 minute cities” and “15 minute neighbourhoods” to close the gap between work and living and push for more effective uptake in active modes.

Everett Lott had a range of integration problems as the local, county, and state governments were all wrapped up in one in DC. A major policy was trying to get people out of single occupancy vehicles. They had invested in car-free lanes to enable buses to travel freely and efficiently and encourage mode shift to buses, and were generally persuading individuals to find other ways to travel for all types of trips (school, shopping, leisure, work, etc). Unlike many US cities there was a lot of infrastructure for bicycles or shared mobility. Capital Bikeshare was a regional programme so bikes were also usable and available in Maryland and Virginia regions Safety was improved by over 100 miles of bike lanes with plans for expansion. These initiatives helped make transport in the city more pleasant and more efficient.

Margaret Kelliher described the family of plans governing Minneapolis’s activities which covered transport generally, climate action, vision zero and a 20-year streets funding plan with a strong equity focus. Integrated planning was essential; for example there was a light rail service with many bus lanes crossing it so signal prioritisation was needed. There was considerable investment in signal processor capacity at intersections to simplify inclusion of new technology or new products. A key aim was moving buses through the city centre more efficiently.

The Evie Car Share Scheme was addressing both emissions reduction and equity improvement. There were 120 shared EVs so users could be a biker most of the time but have access to a car when it was needed. There was a high level goal to move 3 out of 5 trips in a single occupancy vehicle to a bus or to an active mode. A key factor was being able to give people the confidence to get out of their vehicle and be safe as a cyclist, a walker, or a bus rider. To support this the road space was being redesigned with protected bike lanes and separate lanes for bus rapid transit.

Gzim Ocakoglu said that most European cities were geographically different from US ones and multi-modality was built in historically. The trend today was towards active mobility which had the obvious benefits but was also a contribution to building resiliency into the network. Resilience was needed to counter climate change. In Europe 25% of greenhouse gases were from transport, the highest of all sectors and unlike other sectors transport emissions had continued to increase every year with the exception of a Covid year. Citizens pushed the European Parliament to do something about this resulting in the European Green Deal. It was a law committing to becoming the first carbon-neutral continent by 2050 and a reduction of 55% by 2030. The drive for decarbonisation through reduction in use of fossil fuels had been reinforced by the war in Ukraine/Russia which had validated the goal of more use of renewables. It was not enough to set policies and just hope and wish. Europe had a number of new regulations including limiting GHG emissions from vehicles to zero by 2035

On the role of ITS, digitalisation and technology generally supporting the equity and climate change agendas the European thinking was the adoption of Smart Mobility as one of the enablers supporting all goals. Smart mobility in Europe meant putting digital infrastructure in place, and bringing together the data from cars, public transport, other fields such as urban air mobility to build a holistic dynamic picture. Within Europe the key legislation for deployment of ITS (the ITS Directive) was being revised to become a Cooperative ITS Directive as a key step towards connected, automated mobility across all modes.

The moderator asked the panel what steps they were taking to encourage people to make more healthful choices. Sue Wiblin described moves to create more pleasant places for people. The “30 minute cities” and “15 minute neighbourhoods” policies encouraged people to work closer to where they live but they also lead to a more effective uptake of active modes. This had developed during Covid and seemed to be sustained so there had been heavy investment in new cycleways. A key change was aiming to think about a general improvement to community mobility rather than improving specific modes.

Everett Lott explained that Washington DC was reinforcing healthier and more equitable travel by putting in more infrastructure for protected bike lanes, bus lanes, better designs of crossings. A key action was making sure that people understood the choices available with a specific target of additional transit services in under-served areas that were safe, reliable and affordable.

The moderator asked Margaret Kelliher to develop her earlier points on a generational challenge. She argued that the key issue was managing change. People were used to certain ways of doing things and addressing that was probably harder than the collision of different generations’ attitudes. A good example was the redesign of Hennepin Avenue in Minnesota where many arguments were reconciling all view points regarding kerb space. Every proposed change had people arguing that it was not sufficient and others arguing for its abolition. It had been necessary to stress that the object was the shift of three out of five SOV trips. That required creating a space for the next 60 years and so compromise was essential to navigate the next 10 years to share the available space. Two key techniques were funding ambassadors to go to communities to explain; and funding small scale trials. For example the carshare scheme allowed people to try it out, have a good experience, then decide what was best for them.

The moderator asked Gzim Ocakoglu to develop his earlier remarks about using technology to promote health goals. He explained that active mobility was central. The European Commission had a Sustainable Smart Mobility Plan that addressed GHG emission reduction through smart mobility. The central element was the urban mobility framework – possibly a Europe-specific point because of the historic evolution of cities – and this plan had specific actions to continue promoting active mobility. It was interesting to look back on experiences from COVID. Because there was far less traffic some city Mayors had permitted pop up bike lanes to contribute to mobility during the pandemic and in some cities they had stayed.

This Covid experience prompted a key question: can we also address demand? Can we curb mobility? The usual response is that we can’t because demand for mobility will continue to grow. But some cities had introduced restrictions for cars, changing the usual road lanes to bike lanes or even abandoning lanes. He noted that Brussels had reduced a lane on a main artery going from the suburbs into the main city. This was expected to increase congestion but it had not. Commuting times were the same because people adapt. To have real effects on people’s health it was necessary to bring in new options and alternatives. It was a simple public health issue – we cannot afford collisions, fatalities.

The moderator commented that the great cities around the world were the ones reclaiming space for people and creating a sense of “place”. This usually required a mix of public and private sector actions but objectives and financial attitudes differed. How were panel members addressing this issue ?

Sue Wiblin said that COVID was a good example of lessons learned when it was possible to do things at a record pace . The pandemic prompted a shared vision between the commercial and government sectors to get things done; the NSW State was on record saying “we can’t do this on our own”. The collaborative approach had led to an open data portal which the corporate sector could use and commercialise it for community products. In Australia generally there was a realisation that public and private needed to work together.

Everett Lott reported that Washington had its first Public Private Partnership which had taken about 8 years to get off the ground. It involved replacement of over 75K street and alley lights with LEDs giving a capability to control remotely, monitor outages and respond more quickly. There was a health benefit from improved lighting in neighbourhoods where people gathered.

Margaret Kelliher said that technology was a natural place for Government and private sector to be working together. A key area for progress was procurement reform to allow quicker deployment to users

Gzim Ocakoglu said that joint working was the new normal for the European Commission. It was familiar from research projects and was being developed for early deployment phases. The challenge was large scale deployment, especially for road safety, and there was work on a regulatory framework to support this.

The moderator thanked the Panel for their energetic and stimulating contributions.

PLENARY 3 A SMARTER, DIGITAL FUTURE – HOW ITS TECHNOLOGY SERVES AS THE DIGITAL BACKBONE TO DELIVERING OPPORTUNITY TO COMMUNITIES

Fireside chat Moderator	Shailen Bhatt,	AECOM, USA
Speakers	Tom Demaria	Dell Technologies, USA
	Brad Haczynski	Intel Corporation, USA
Moderator	Beth Kigel	HNTB Corporation, USA
Speaker	Tilly Chang	San Francisco County Transportation Authority, USA
	Danielle Kochman	San Diego Association of Governments, USA
	Young-Jun Moon	Korea Transportation Institute, S Korea
	Joost Vantomme	ERTICO-ITS Europe

Laura Chace (ITS America) welcomed everyone and explained that the plenary would focus on the digital eco-system of the future, where data could be used to better serve our communities. It would launch with a panel of representatives from private companies to discuss this issue informally in a 'fireside chat'.

Sameer Sharma introduced his panel and noted that there had been a lot of discussion at the conference about digital twins, system of systems and digital infrastructure etc. The facts about physical infrastructure were that it was ageing, and this would impact on the economy and on the progress on reduction of road deaths. He asked "what does new digital infrastructure mean?" Brad argued that it was the fusion of physical and digital architectures made possible by the technology 'superpowers' of 'Ubiquitous Computing'; 'Pervasive Connectivity'; and 'Cloud to Edge infrastructure'. Together they provided the basis of moving from single use devices requiring physical maintenance to software defined devices that could be reconfigured for different uses.

Sameer raised the topic of the amount of public investment in transport infrastructure, using the US, India and Europe as references and invited the panel's thoughts. Tom stated that there was an opportunity for a once in a generation change to the way we provide transport infrastructure. The incredibly large number of journeys globally carried out by both vehicles and walkers every year demonstrated that transport was much bigger than just infrastructure, it was a critical asset. Using software defined technologies to improve the efficiency of that infrastructure by only 1% would be an incredible impact. He used Air Traffic Control (ATC) as an example of utilising data to manage mobility citing that, even though aircraft were

incredibly complex and mainly autonomous, if the ATC was down then planes didn't fly. Applying this thinking to ground transport at scale (Ground Traffic Control) could provide a mobility platform for the future.deprivation.

Sameer closed the session with a question about how people at the conference could collaborate with the private sector? Tom stated that the real innovation in ITS was collaboration; Brad agreed with this and discussed the work Intel have done in creating alliances and learning resources to help 'matchmaking'. Parties needed to work together in the fusion of physical and digital infrastructure as the subject was too big for many companies to tackle and we needed to make it real for users.

Beth Kigel introduced the panel of speakers for the second



part of the plenary, a discussion on discuss how public/private collaboration could be leveraged in digital infrastructure from a policy point of view. Beth discussed the definitions of 'digitisation' and 'digitalisation', pointing out that both were about transferring something into a digital form, but the latter, in ITS, was really about improving operations and adding value. She asked the panel how we could make the most of this opportunity?

Danielle Kochman talked about the importance of achieving climate goals now, by tackling existing congestion. She also stressed the importance of achieving equity within the constraints of the existing infrastructure as enlarging the network was not feasible. Digital technologies offered the ability to operate the existing infrastructure more efficiently in the near term, whilst paving the way to the future. Tilly Chang spoke about the importance of infrastructure resilience. In her view there had been a lot of experimentation focusing on performance and technology. She mentioned two major issues that could be helped by digital technology: the need to know what is happening in real time and coping with new sources of traffic on the network, referencing the new 'Treasure Island' community development on the bay bridge in San Francisco.

Young-Jun Moon spoke about the idea of 'Smart Cities' where there was a strong basis in digitalisation of the physical transport networks to enable movement to a reduction in road deaths (Vision Zero) and roadside emissions (Net Zero) by connecting users together. Joost Vantomme explained that ERTICO was an extensive public/private collaboration of over 125 partners so it had easy access to the collaboration and understanding that were essential to deliver what users actually wanted. He argued that data was the glue facilitating collaborative thinking and delivery and commented on the European Union's targets to make transport data more available and interoperable. He left the question for all – did better data availability need to be mandatory or voluntary?

Beth then asked the panel whether data governance should be a priority to develop data sharing and collaboration between the public and private sectors. Joost responded by citing the EU ITS Directive, which was in the process of being amended to update the candidates for mandated data sharing (eg electric vehicle charging). The intention was to share this data through the existing National Access Points (NAPs). Data was being used to create information at a national level and a new project called NAPCORE was about synchronising NAPs to ensure that they were interoperable and could share static and dynamic data (safety related traffic information) and real time traffic information free at the point of use. He also spoke briefly about another EU initiative called Data for Road Safety where both public and private sector would share data from multiple sources to create 'event' information.

Tilly spoke about the need for seamless mobility and what data sharing meant in that context. In her view data was key for decision makers and in maintaining public trust. Data sharing requirements should be used as a way of incentivising sharing, but definitions of terms and standards needed to be created for all of this to work. She also stressed that taking the users with us on the journey was key and that tying innovation to investments could help speed up progress in this area. Danielle noted that data had always been used for planning, for example traditional surveys, but these quickly became out of date as things were changing so quickly. Live real time data would be so much more useful and had a new value level that was different for each partner. So data sharing was certainly key here but might have to be a negotiation between parties.

Young-Jun stated that although in S Korea the government had invested heavily in ITS on the national roads local governments had problems doing this. So Mobile Network Operators (MNOs) and Satnav providers were using mobile phones to collect data. The government approach was to enable the sharing of their data and also the MNOs' data to improve services for the users. Joost added that access to vehicle data was key – but would the OEMs (Original Equipment Manufacturers) do this and what about the cyber security issues? In the EU if you held data that was needed for the delivery of defined use cases then you were legally obliged to share it. 'Ecall' (an emergency system in vehicles utilising the cellular network to provide emergency messages) was an example of this type of safety related traffic information and real time traffic information free at the point of use.

Beth thanked the panel for their views and moved to ask about public trust. Tilly started by referencing recent incidents involving Tesla where data was essential for analysis and diagnostics. It was essential that the public could see that incidents were being properly investigated and the sharing of data could not be voluntary as real time accountability and transparency were vital. Danielle added that the experience of sharing your data was important as it demonstrated the protection of privacy and security. She suggested that allowing those sharing data to have a choice to 'opt in' to different levels of data sharing would be valuable. Joost picked up the point about personal vs non personal data. He pointed out that in the European Union vehicle data was considered personal data and therefore the 'user' had to grant permission for access to the data, the power to delete it or 'port' it to another platform. Data must be dealt with in a secure way.

Beth asked how the problems and solutions translated to freight. How did data benefit the movement of goods from port to doorstep or kerbside? Danielle responded first and talked about some of the problems that San Diego had to deal with including one of the busiest border crossings in the world where long delays were routine. She suggested that as freight traffic has more regularity than private vehicles, they make a good use case for new data led interventions. She continued to say that they were going to trial digital border crossing techniques to hopefully reduce the current waiting times dramatically. Tilly then spoke about the importance of kerbside management, where digital techniques could create the ability to dynamically assign the kerbside for different purposes and users (eg autonomous delivery bots). This was expected to bring flexibility and reduce costs as opposed to the current physical and expensive to change methods.

Young-Jun talked about actions in South Korea where real time data was making commercial vehicle operations more efficient utilising the capabilities of modern cellular networks (4G, LTE & 5G). Joost finished by talking about ERTICO's FENIX project where the EU was seeking to making the logistics chain work more efficiently by digitising documentation. This could be complex and varied so creating a common dataset would ease the current issues. Beth finished the session by talking about the amount of sensors on vehicles, including autonomous vehicles and trucks and wondered if there was data that public authorities could share that would help the sectors work together?

Beth moved to finish the session by asking each panellist to give a key point to take away. Danielle made the point that perception changes after experience, so piloting was important to enable users to see what it was all about!

Tilly said that she would have a central knowledge base of all the pilots and evaluations both nationally and internationally so that we could learn from each other more effectively.

Young-Jun made a strong point not to focus on just vehicles, but to consider data from all roads users when designing the systems of the future.

Joost said that digital infrastructure and data represented a paradigm shift in transport and mobility, but it was all driven by who has the data. We needed to work out how to tackle inequalities in data ownership.

Beth thanked the panel and closed the session.





TOPIC 1 DIGITAL INFRASTRUCTURE

THE OVERALL SITUATION

There was a fair amount of overlap between this busy topic and the others, particularly Intelligent, Connected, and Automated Transportation and Technology from Entry to the Last Mile. The topic also had impact and influence on equity and safety aspects of transportation and mobility. The key themes in the sessions featuring Technical Papers were: the use of data and digital infrastructure to improve the management of traffic and transportation, application of advanced wireless standards for connectivity, and understanding the safety improvements digital infrastructure can bring for travel. A frequent message was “How to do it,” in the sense of “how to manage so much data and use it in a beneficial way, bearing in mind traffic operations and management, and cyber security considerations”.

One important subject was the challenge of overcoming organisational barriers to effective data manipulation and visualisation that often stem from departments being unfamiliar with the data they have available to them or not fully understanding the roles and responsibilities that different systems and departments have. The key message being “while data may be plentiful, matching an area of need with the right data resources within an organisation is vital.”

Some recurring areas from previous congresses included application of digital twins and standardisation. Surprisingly perhaps, the physical infrastructure requirements to provide digital services were not discussed in detail, but the challenge of merging existing operational technology with new digital infrastructure featured in several sessions, particularly in relation to cyber security.

WHAT WAS POPULAR

Digital Infrastructure was seen as mainstream and ‘business as usual’ so many of the challenges described in sessions and papers were like those faced by physical ITS infrastructure in the past. Considerable work was taking place on many aspects of digital infrastructure with most happening in silos by companies involved in smart devices, data and AI, sensor and image processing, CAVs, and EVs. Smart devices, camera technology, and communication infrastructure were being used to monitor traffic, real-time traffic management decision support, and worker and pedestrian safety. There was no shortage of data being generated, but most of it was not being utilised properly due to lack of interoperability and data processing and analysis not based on use cases.

It was argued that despite many siloed advancements in digital infrastructure the industry hasn’t made much progress in affecting travel behaviour – dependency on car-centric travel has not reduced. With battery technology maturing and EV production growing the focus was shifting towards the availability and dependability of green electricity. There were frequent references to the increased need for public/private partnerships and the ‘opening up’ and exchanging of data.

Information Technology



Operations Technology



Convergence of the two is critical



From SIS 68: Nexus of Transportation and Technology: Planning for excellence in the digital world to enhance physical transportation

USE OF ITS DATA FOR SOCIAL IMPACT:

The Plenary 3 discussions addressed using transport data in wider decision making including social policy, health and economic opportunities. Physical network data can be digitised to make it available and adjusting the requirements for sharing could be used as a way of incentivising sharing. This real time data has a new and different value for each partner, making data trading and arbitration key. Standards, communities of interest and managing the complexities of working together can enable the fusion of physical and digital infrastructure, moving existing ITS operational technology from single purpose devices to multi-purpose devices.

DATA BASED TRAFFIC DETECTION AND OPTIMISATION:

Long established ITS challenges were addressed, with novel approaches to accurate traffic detection and flow optimisation, and discussion of how Smart City and V2X technologies could help improve predictive models for better optimised real-time coordination. The use of predictive modelling to provide greater resilience, by mitigating against failure of traffic detection sensors, was explored. It was noted that distributed fibre-optic sensing systems had shown tremendous potential as a cost-effective technique for wide-area traffic observation, with applications such as congestion monitoring and travel-time calculation.

Advanced communications featured strongly with a focus on how adoption of advanced ITS digital infrastructure was dependent on efficient communications networks and wireless technologies, such as microwave and LTE/5G, which reduce costs whilst providing similar performance parameters to fixed infrastructure. Papers also highlighted how approaches to active traffic management were changing in a connected world, and how traffic managers should look to exploit existing infrastructure, such as fibre networks for communications, to provide cost-effective ITS services and monitoring applications.

On the theme of safety there was a presentation on the benefits of deploying IoT sensors on highway barricades for more accurate roadworks information. CCTV along with detection technology was being used successfully on a Tokyo expressway to detect pedestrians, bicycles, and motorbikes travelling in the wrong direction and alerting them through roadside speakers.

APPLICATIONS IN RELATION TO CONNECTED VEHICLES:

There was much discussion on the issues around data generated by connected vehicles such as accessibility, ownership, value, and privacy as well as methods for using data generated by CVs to deliver for the public good. Related to this, IoT sensors could be used to provide operational redundancy for connected vehicles, by providing information on safety facilities and infrastructure when on- or in-vehicle sensors fail.

Another timely debate was on real-time communication and decision-making between unconnected, connected, and autonomous vehicles, and how this would be a critical prerequisite for the next generation of road safety and accident prevention technologies. Papers suggested intelligent edge computing services, with the capability to cater to varying deployment scenarios and conditions, would be critical to service the rapidly evolving smart city and transport sector.

A number of sessions looked into Smart Corridors with examples from the FHWA's CARMA programme; a case study from Melbourne, Australia; a project from Europe on smart management of road traffic following large scale catastrophes or emergencies (wide-spread fires, toxic clouds, large-area flooding, severe weather etc); and another European session on knowledge transfer from corridor pilots. A session on digital infrastructure for roadway transportation explored models to evolve and sustain the information and communication technologies that create, transmit, and manage data about the roadway environment to enable vehicle automation and electrification.



Enhancing Mobility and Safety through Digital Infrastructure and Analytics Ecosystem at a Port Authority. (Jennifer Bates in TS12: Digital Infrastructure's Impact on Transportation)

The use of data analytics and visualisation to improve mobility and safety for metropolitan areas, using a data hub ecosystem, was presented as an approach to creating unified digital data infrastructure to help streamline data management and building of digital assets from siloed data repositories. Also related to visualisation techniques was the application of VR simulation to safely validate spatial movements in pedestrian-related scenarios.

STANDARDISATION – TREATING DIGITAL INFRASTRUCTURE IN THE SAME WAY AS PHYSICAL INFRASTRUCTURE:

Transport Authorities had a rich history of experience and design standards for roadway construction and operations (physical) and must embed the same level of lifecycle management and planning (cybersecurity, communications, technology operations) in their digital assets as they have placed on their physical assets. There was a base level of cyber security 'insurance' that was required, but there was a lack of knowledge in agencies that impacted on their ability to get the correct help. Within the industry there was often the illusion that 'we are secure', this invariably was not true. There needed to be a change in mindset; there was no 'silver bullet' or 'final solution' just a need to keep working on security and to address the key question, who owns risk?

WHAT WAS LESS POPULAR

The physical aspects of digital infrastructure such as sensors and 5G were not prominent; perhaps because this was now considered to be the state of the art. Similarly there was little consideration of the benefits of integrating transport oriented digital infrastructure with that deployed more broadly within public spaces and the built environment, to facilitate the seamless, informed movement of people and goods and enable holistic "transformation by transportation."

Integration between digitally equipped and traditional vehicles was not covered in this Topic. Another area slightly lacking in attention was the development of business and use cases to demonstrate the value of V2X and other digital, connected infrastructure technologies for efficient public highway transport – buses and trams for example – but also application for environments such as airports, train stations and ports. Although the industry itself was awash with AI solutions only one session covered it explicitly; the area was also missing in technical papers. It was surprising not to see more research into the implementation and application of digital infrastructure to drive forward decarbonisation and sustainability in the transport sector.

Though the digital infrastructure deployment continued to move forward not much attention was being paid to equity and safety aspects. Would transportation be efficient and affordable for communities of concern? Would the infrastructure be safe and secure? Would new technologies make a dent in traffic congestion without making it economically burdensome for the people with less affordability? These questions need to be addressed in the digital infrastructure of the future.

OLD VS. NEW

OLD

Recurring themes from previous congresses included digital twins where a session explored applications for them where the use cases were already well known such as active transport management, transport planning simulation and modelling as they were already used by a variety of cities and authorities.

There was an interesting exploration of established concepts in a review of the crucial role of data in the design of a congestion prediction speed control algorithm system, and the data dashboards developed for system monitoring and evaluation in a pilot by Virginia Department of Transportation. Also on familiar ground was an examination of the robustness of Origin Destination data derived from floating vehicle data. Similarly, the use of smartcard data to establish journey patterns was another topic that has appeared in many previous congresses.

NEW:

The need to properly build cyber resilience into the digital network was repeatedly stressed. A lively workshop assessed the steps that needed to be in place to prepare, prevent and quickly restore operations after a cyber attack against critical ITS transportation assets and systems. It was not always recognised that as we automate and adapt to a world of sensors, big data, improved connectivity, digital cities, connected vehicles, and greater mobility, there is a much increased risk from those who wish to play havoc with or totally disrupt our transportation systems.

Extending the use of data into neighbouring applications such as work zones by linking them to connected vehicles, digital infrastructure and data sharing was a timely reminder that around 750 people died in work zone crashes on America's roads each year. Work Zones remained the most dangerous places on the traffic network prompting the questions why was their digitisation falling behind the rest of the infrastructure, and what could be done to reverse that trend?

Novel approaches to improving ITS operations were presented such as an Ethereum-based Blockchain platform for transport in a Taiwan Rural ITS Project, which demonstrated applying secure ledger technology to integrate data for provision of a secure rural car sharing service.

There was a report of an investigation of global relevance: how might automated vehicles interact with level crossings? The presentation focused on how smart level crossings could offer safety benefits for connected vehicles through the deployment of V2X technology.



Preparing level crossings for the arrival of automated vehicles (Virginie Taillandier et al. in TS8: Traffic Management Safety)

Use of micromobility data to inform and monitor regulatory frameworks, for the safely managed operation of e-scooters, demonstrated how the Mobility Data Specification can be used to share data effectively between cities and private mobility providers.

A novel presentation on the use of bus open data in the UK explained how to make passenger information easy to access, ready to use and of high quality, thereby reducing the friction for data consumers to support MaaS and encourage modal shift. The platform was also being leveraged to digitally transform the industry and encourage positive development.

FORWARD VS. CONSTRAINED

FORWARD:

The SIS sessions within this topic concentrated very much on how to incorporate digital ITS into business as usual and to treat it in the same way as traditional and physical ITS assets. Including the best way to use, manage and standardise data and ways to extend the benefits into new areas such as roadwork safety.

From the papers presented the forward-looking themes mainly focused on development of advanced communications to enable connected transport services and applications. Equally, the value Digital Infrastructure could have for improvement of understanding and improving traffic flow and operations stood out, and it was pleasing to see consideration of the impact Digital Infrastructure could have for the improvement of transport and mobility, through both on-street deployment and through its use in the optimisation of advanced simulation techniques.

CONSTRAINED:

Whilst not strictly a constraint it was essential to remember the need to standardise approaches and procedures to ensure that working in a digital world was managed as safely as working in the physical world and in particular, that cyber security and resilience were always kept at the forefront of developments.

One of the barriers to more efficient installation and use of digital infrastructure, evident from the papers, was the common theme of a lack of coordination when planning for effective data sharing and processing whether it be due to technical, financial, or organisational factors,. Hopefully this theme would be less visible at future congresses as recommendations from the research on show started to be implemented more widely across the transport ecosystem.

WHERE MIGHT WE BE HEADING

No one can be certain about where we are heading, but the work presented at LA 2022 painted an interesting picture on several digital infrastructure fronts that have significant potential.

- AI based decision support systems in transport would continue to emerge. In this arena private sector companies with advanced big data technologies would play a key role in supporting large scale government decision-making.
- On the other hand, local government agencies would continue to experiment and innovate with pilot advanced digital infrastructure deployments for collecting and analysing data for efficient mobility management. This trend would likely continue for a long while before a truly connected digital infrastructure would be ready.

- Concern about the quantity of data was no longer an issue. Every vehicle and mobility device, every roadway safety device, every roadside infrastructure element is connected and can collect and disseminate data. Plenty of data was being generated but we were not yet able to put them to good use. There was an urgent need to identify practical use cases and develop relevant tools to analyse data to help with those use cases.
- USDOT's work zone data exchange (WZDx) specification had gained significant momentum. Government agencies had started producing data feeds and major data consumers in navigation and CAV companies were investing in consuming WZDx data. Significant growth in WZDx adoption was expected soon.
- While digital infrastructure development and deployment in transportation industry were moving forward and moving quickly the industry was likely to need to pay more attention to the safety and equity aspects of technology deployments. For example a need for more policy level conversation was identified to provide clear definitions and to help understand the equity and safety impacts as well as potentials of digital infrastructure in order to provide safe and equitable mobility for all.



TOPIC 2 EQUITABLE AND SEAMLESS MOBILITY

THE OVERALL SITUATION

The Equitable and Seamless Mobility topic at the Congress recognised that everyone should have affordable, safe and equal access to transport. It included discussions about innovations that expand equitable mobility and overcome existing challenges, with a particular focus on accessible and barrier-free mobility, mobility trends, and emerging technologies supporting transportation access. There were 14 Special Interest Sessions, one Strategic Technology Session, four technical paper sessions, two International Forums, three workshops, two Regional Forums and two Plenaries. There was frequent overlap between this topic and others. The most prominent sub-topic was equity, diversity, accessibility and inclusion with emphasis on gender challenges and gaps. Other sub-topics included improving travellers' experiences, enhancing existing mobility tools with new technology, the need for and power of open data sharing and exchange, and the use of ITS to create "greener" mobility.

WHAT WAS POPULAR

Several Congress sessions addressed the question "is mobility a fundamental human right?" (general conclusion: "Yes"). Mobility was defined as the ability for a person to move or be moved freely, and so was at the centre of all life activities: healthcare, employment, education, housing, local/regional government services and entertainment. Furthermore, a person's ability to move must be without barriers to, for example, accessing transport as this can increase the need for healthcare services. Equality and equity were not synonymous – equality was giving the same mobility to everyone and equity was providing different mobility options depending on a travellers' needs. Two sessions specifically addressed using automation to enhance mobility and equity with the comment "If the technology can address the needs of people with limited mobility, it can address everyone's needs".

Other popular subjects were:

- Strategies and best practices to overcome barriers to advance gender equity and equality, and empower more women and girls to choose a profession in mobility; and
- Measuring equity using impact assessments and equity frameworks
- Real-time traffic monitoring and management systems
- Technology to perform multimodal optimisation of traffic flow along corridors
- The role of open platforms in delivering seamless mobility;
- Automated feeder transport to facilitate integrated mobility services
- A "super app," to support the shift of trips by personal car to intermodal travel involving the integration of public transport with micromobility;

WHAT WAS NOT POPULAR

Given the frequent delays in supply chains being experienced in the wake of COVID-19 it was surprising that the application of technology to resolving logistics issues was only mentioned in one session. Electric mobility was not as popular as expected given the amount of press it attracts in the industry. Kerb management was rarely covered. Enhancing and expanding the ITS workforce and the impact of ITS on the environment were only mentioned in two sessions. Ways to enhance rural mobility using technology were not covered as widely as in past World Congresses; and cybersecurity had limited coverage in this topic but featured elsewhere.

This Congress was perhaps the first since 2015 where MaaS was not a dominant topic. In the MOD/MaaS Global Forum items familiar from past World Congresses were discussed:

- MaaS was being integrated more into businesses (eg provision of mobility options rather than giving a company car) and into rural areas (where there were fewer mobility options).
- The industry needed to deliver an integrated mobility network in an equitable way. If the MOD/MaaS solution did not provide access to mobility for all travellers, then it was not a valid solution.
- Open data continued to be a barrier with many sectors worldwide not sharing mobility data.
- We STILL did not know what constituted a successful business model for MaaS!



MaaS Customer View (Roelof Hellemans in SIS 30)

However in a few sessions MaaS visions were revisited. The MaaS Alliance sees an open system consisting not only of public authorities interacting with mobility service providers, but also containing the appropriate policies and regulations to govern access to all types of assets (owned or shared, public or private) and to share data among mobility providers using standards, data models and programming interfaces. This reimagined landscape took the travellers and various business models into account as shown above:

OLD VS NEW

OLD:

Several ITS technologies covered in earlier World Congresses seemed not to have moved on very far. Mobility network management had been discussed in the past but we heard about an approach by AustriaTech called Service 1st. that changed the overall focus:

- From HOV Lanes and ramp metering To Service 1st Lanes
- From managing capacity To guaranteed slots for user groups
- From reducing accidents and incidents To reducing environmental burden
- From managing road infrastructure To efficient energy provision
- From informing via different channels To setting fleet requirements

Other subjects covered in prior ITS World Congresses and also LA were:

- The potential for MOD and MaaS to reduce private car use.
- Optimal rebalancing of micromobility devices (eg e-scooters)
- The opportunities and challenges associated with automated vehicles in rural areas.
- Simulating the use of automated vehicles to provide improved mobility.

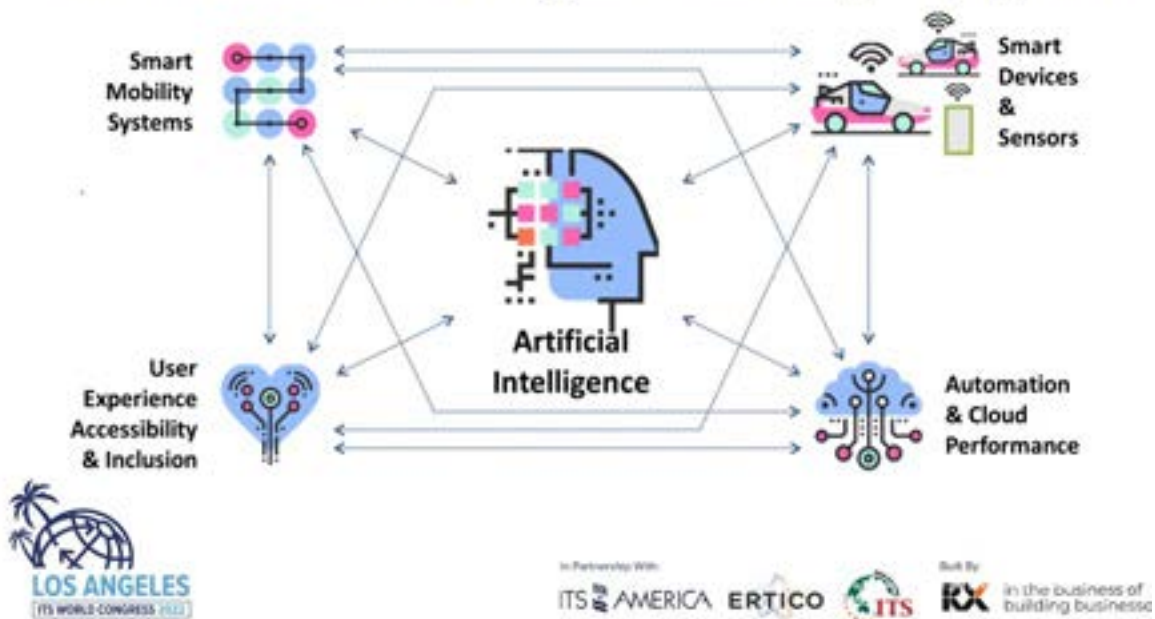
NEW:

A new type of automated shuttle was introduced at this Congress with the term “robotransit”. It was designed to improve access and mobility; provide equitable transit; reduce congestion and emissions; reduce demand on infrastructure; and create jobs. A robotransit demonstration started at the end of September 2022 –the first ever accessibility-focused, rural, self-driving pilot.

By leveraging technology and behaviour analysis, the integration of Management and Operations (TSMO) and Active Demand Management (ADM) with multi-modal demand/mobility management was expected to influence commuter behaviour towards more sustainable mobility options while optimising available capacity and achieving operational objectives. A three-year deployment program in Houston was demonstrating this integration via a new mobile application.

“Universal Basic Mobility (UBM),” was discussed in a several Congress sessions and is being used throughout the world. It was the idea that all citizens should have a decent range of affordable transport options, regardless of their socioeconomic status or disabilities. UBM pilot projects were demonstrating how innovation and technology can fill gaps to reach marginalised communities, and the ways in which equity and transport intersect. These pilots were just the beginning in thinking about technology-enabled mobility as a fundamental human right. A new and innovative design for UBM was shown [below].

Cubic & McMaster Uni: An Integrated & Multidisciplinary Approach



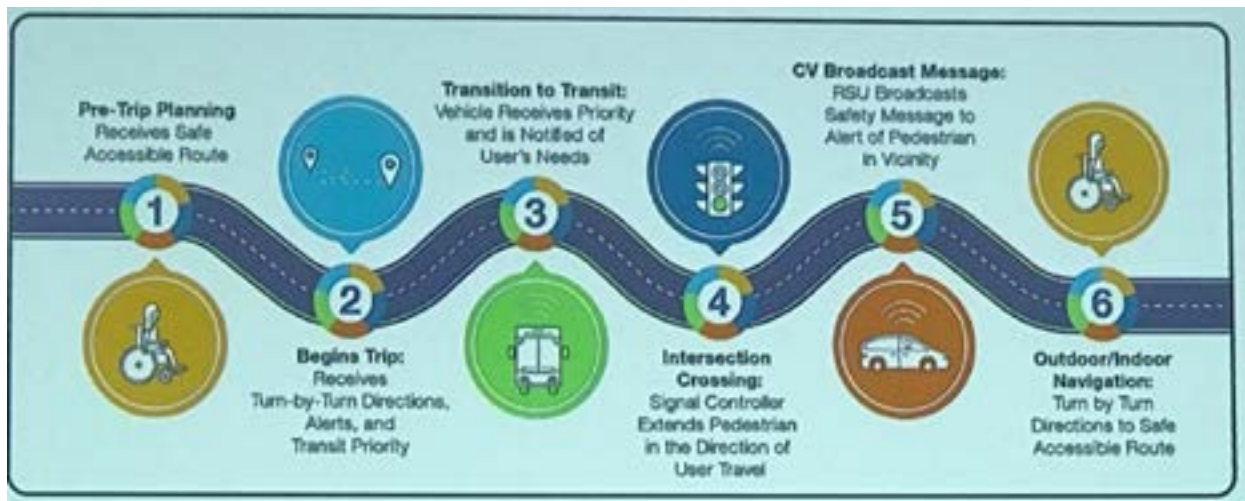
Partnership for Universal Basic Mobility (Bruce Newbold in SIS 1)

Other new technologies and systems discussed in the Congress included:

- An Intelligent Charge Planner that used artificial intelligence to plan and schedule e-vehicle charging which addressed the pain points of all relevant stakeholders – charging point operators, eMobility Service Providers, energy suppliers and cities.
- Predicting the numbers of empty seats on buses and other operational analyses using 5G real-time payment data and cellular-based vehicle probe data
- Utilising multi-criteria analysis (MCA) to rank various pedestrian/cyclist detection technologies
- Using an agent system together with a data space to enable a “super app” that supported modal shift from trips by personal car to intermodal travel using an open, transparent and secure digital ecosystem, where data and services could be made available, collated and shared in an environment of trust.

A new technology deployed at two sites in Japan was presented – the use of directional speakers at the side of a highway ramp to provide driver assistance information. In one site no traffic accidents had occurred in a year since the voice alert system was in operation and the average velocity of the vehicles during not congested traffic had reduced by 4%.

A project in Georgia had developed a mobile application for pre-trip and in-trip planning, including technologies like connected vehicles.



Safe Trips in a Connected Transport Network (Maria Roell in SIS 92)

FORWARD VS CONSTRAINED

FORWARD

Although 5G already existed the ITS applications were still evolving. In a workshop devoted to 5G it was clear that it delivered a capable solution to a variety of issues including Connected and Automated Mobility (CAM), could be used now and would evolve further. 5G facilitated seamless cross-border mobility, provided significantly better performance than 4G and showed room for growth. However, collaboration with mobile network operators was key for further evolution. There were ideas for universal support that should be implemented in the future, only co-creation of mobile network operators and service providers would unlock the full potential of 5G.

Taiwan was using 5G to support a smart payment platform for buses as well as big data analytics applications. Applications included bus empty seat prediction and multi-payment ticket data analysis, which included operational status of the transit system, origin-destination demand and distribution, information on travellers, waiting times, seat utilisation and transfer hot spots.

Phase 1 of ERTICO's City Moonshot program collected and analysed data collected in 150 interviews regarding the needs, challenges and solutions of cities worldwide, for the mutual benefit of all cities as well as other actors in the transport and mobility sector, such as industry, service providers and researchers. In LA Phase 2 was announced and a workshop discussed the new topics to be covered – Sustainability, MaaS, Electromobility and Urban Air Mobility. A wide range of discussion conclusions included:

- Further investment in public transport was the best option for addressing climate change, but a combination of several actions would be most effective. Other actions could include reallocating road space in a city, land use planning and designing smart cities from the start to keep cars outside as much as possible. A potential action often overlooked and missing was kerb management.
- A good climate plan could end up being a bad fit with equity and accessibility. The transport sector has to learn how to work with other sectors like the housing sector to address climate change.
- There was no meaningful business case yet for UAM in cities primarily because of the infrastructure requirements. However, there were some use cases for goods movement.
- Safety was uncertain with UAM. We did not know the origins and destinations of UAMs.
- Air space was nationally regulated, which could create a problem
- There was no one size fits all – cities had very different characteristics.

Transport for New South Wales was moving from an asset management to a customer-focused vision. This included making 30-minute cities and 15-minute neighbourhoods, targeting zero emissions buses by 2040, development of micro networks (which would involve working with mobility service providers and connecting their services to the public transport system), using drone and satellite technology to learn how to build resilience, and using quantum computing to optimise the transport network. Data was their biggest challenge in this approach.

Other forward-looking technologies and ideas presented included:

- Several systems across the world were piloting new mobility on demand services to fill public transport gaps leading to more agile and flexible networks that better serve travellers while also improving cost-effectiveness and quality of service.
- The linking of two innovations mentioned earlier, an agent system together with a data space, could eventually improve modal shift from personal car trips to intermodal travel through incorporating standard components, such as connectors, a broker, and identity management in a mobile app, together with specific data usage policies and enforcement.

- The European Commission's European Mobility Data Space was a first step to map and identify gaps and overlaps between existing standards and mobility service initiatives. The goal was to facilitate access, pooling, and sharing of data, thereby ensuring that more data became available for use in the economy and society, while providing better control to companies and individuals who generated the data.
- Applications and the expected future impact of quantum technology on transport efficiency, safety and the environment were described. Integrating quantum technology with transport solutions may have the potential to improve mobility, although much more exploration is needed.
- Technology for freight logistics had the potential not only to reduce greenhouse gases but also to improve the efficiency of shipping. Many logistics hubs had been located in disadvantaged areas so improving the environment in these locations would begin to address the years of negative impacts as a result of logistics traffic.
- Technology could help with environmental justice by reducing the need for trucks to queue at weigh stations and could direct them to parking to reduce trucks driving around looking. While a truck was travelling at highway speeds, data could be transmitted about the truck and what it was carrying so it did not have to stop for any reason.

CONSTRAINED

One aspect of equity not discussed in prior World Congresses was the topic about achieving environmental justice through innovative freight logistics and decarbonisation. The key equity-related issues were:

- Trucks which transported freight over short distances from ports emitted more greenhouse gases (GHGs) than ships. Half of this type of operator in California had four trucks or less making this an equity issue if they were forced to buy a more expensive truck such as an electric truck. So how might government help small operators make the transition to cleaner trucks?
- All types of freight trucks often travelled through low-income neighbourhoods.
- The subjective nature of freight enforcement before technology caused inequities – trucks with operators of colour were being stopped more than other people. Now that enforcement could be done with technology it became a much more equitable process.
- Lower-income neighbourhoods tended to be near industrial areas because they could afford the housing in these areas. People with money did not want to live near industrial areas. But in some cases the industrial areas were built in existing low-income neighbourhoods because there had been no way to stop their being located there.

A number of constraints to seamless mobility were identified:

- Data needed to be open and shared, and accessible to application programming interfaces . Monopolies still existed which did not level the playing field among private sector providers in technology-enabled mobility solutions such as MaaS.
- Some technology was not well understood by the local authorities, and there was financial and societal pressure for change including reallocating road space. However the political environment was not keeping up and policy makers often did not know how the data worked.
- In the UK's Future of Mobility: Urban Strategy nine principles were identified as facilitating innovation in urban mobility for freight, passengers and services including "the marketplace for mobility must be open to stimulate innovation and give the best deal to consumers".

Quantum computing showed the potential to improve a variety of transport services including the integration of first-mile/ last-mile mobility solutions, crew timetabling and dynamic train/bus scheduling. However, while quantum computing solutions already existed in transport and logistics the size of devices limited the range of problems that could be tackled and they were exceptionally unstable and error-prone. There were five critical needs to make QC useful to the ITS industry: (1) an empowered customer and user base; (2) user-focused applications; (3) optimised algorithmic modules; (4) larger hardware systems; and (5) augmented hardware performance.

Other constraints in ITS discussed in this Congress included the following:

- While this and the prior World Congresses had numerous sessions addressing equity, inclusion, accessibility and diversity in ITS, there were a limited number of tools to measure these factors and whether or not we are truly addressing them in the ITS industry. Several frameworks were beginning to be used to measure if and how equity was being addressed, but they are not well known.
- User acceptance was missing from several automated vehicle concepts, such as the demonstration and simulation study that modelled an management system that allocated automated vehicles to operational states: eg a vehicle operating from a waiting place for non-revenue vehicles; and delivering mobility on demand trips and then returning to the base.



TOPIC 3 INTELLIGENT, CONNECTED AND AUTOMATED TRANSPORTATION

THE OVERALL SITUATION

As with earlier Congresses this was the most popular topic accounting for over 35% of all activities and covering a very wide area. There were some strong common themes emerging across the multiple presentations and also a sense of coalition between these themes. They focused on four important areas:

- Safety
- Collaboration
- Rural
- Lessons Learned

There were also some sub themes running through the sessions which gave an additional breadth and depth to the discussions. This demonstrated that there were some real-life examples of the technology being deployed and some tangible benefits being realised. However it also highlighted that there were still significant challenges to be overcome to deliver intelligent, connected and automated transportation systems. These sub-themes looked specifically at:

- Net Zero 'Vision Zero'
- Health, society and equity
- Legalities of Autonomous Vehicles (AVs)
- Sensor technology in AVs
- Data
- Sustainability
- Digital infrastructure

By contrast new topics included truck automation where there had been major advances recently with more real-world testing. There were still challenges with regard to incorporating the first/last mile and yard/terminal movements but collaborations again seemed plentiful and problems seemed to be on the way to resolution. Bus automation also attracted much attention with demand not just from cities but rural areas too.

WHAT WAS POPULAR

SAFETY

ITS was founded on safety; and safety was the primary motivation for AVs – to maximise the impact of the technology so that safety was improved across the transport sector with zero incidents being the only goal. Low Speed Autonomous Driving was expected to resolve several problems such as reducing accidents and wrong way driving and supporting the increasing number of older drivers. AVs need to be connected to the infrastructure to get road condition information and traffic information to enable safer roads and there was strong agreement that all sectors needed to work together – from OEMs to solution providers to regulatory authorities – to deliver on the safety priority. Without collaboration, no one would win.

There was agreement that Regulation and Technology had critical roles to play to deliver the safety benefits; key considerations were:

- The cloud would play a huge part in safety and ensuring it was fit for purpose and cyber resilient was critical.
- It was unclear what new regulations were needed to support safety and Vision Zero. The key success factors were innovation and safety, flexibility to test and evolve, and trying not to be too restrictive with policy.
- How would technologies such as AI, map data streaming and sensor-fusion be used to meet these regulations? Machine learning and standardisation would help but with different providers finding different solutions and developing different technologies to improve mapping the way forward was unclear. If maps were not updated in real time, and if there were still limitations such as missing data, variations between countries, weather variations, special zones such as schools, hospitals, and legislations progress would be limited.
- The democratisation of safety was seen to be a fundamental requirement – for example V2X had the potential to prevent over multiple school zone injuries and fatalities annually – but what if people could not afford or were not willing to pay for the additional safety features?
- Technology was not expected to be a barrier as the markets and suppliers would find the right solutions. However, a consensus on the most appropriate technological approach may be a barrier. Traditionally there had been global agreements on transport technologies and approaches through standards and technology evolution, however this was changing and different approaches were being adopted.

COLLABORATION

Collaboration was seen as critical and was cited in many sessions as well as the sessions dedicated to the topic. There was clear agreement that safety must be both a shared responsibility and a collaborative effort. There must be collaboration in creating policies, but to do that, a better understanding of the technology was needed, particularly in the case of autonomous vehicle policy. In order to advance, we needed collaboration at local, state, national, and international levels, as well as across the various sectors.

The UK was recognised as an area where there was a real sense of collaboration between industry, government, and academia; with all the UK organisations seen as “buying in” to the connected and automated mobility agenda. This included a shared focus on safety, putting people first, giving people mobility, growing the economy etc. In comparison the focus in the US had been to ‘let the technology evolve’, but national and local governments needed to convene and lead with a concise focus of what they are trying to do, and then let the private sector respond. A sense of urgency was needed to reduce the loss of life in the US.

Japan was also considered to be joined up regarding the policy development and deployment of Connected and Automated Mobility with a top-level integrated, cross-government collaborative approach, incorporating over six departments and Ministries. CAM was seen as a potential societal benefit which must bring tangible benefits to the population as well as gains and because of this approach there was high acceptance and satisfaction levels within communities.

Japan was taking a strong international engagement approach to ensure that it was a leader in the development of standards and innovation. Regulations were reviewed and updated regularly and deployment projects were aimed at specific challenges with the use of simulation to create safe technologies. The issues that they aimed to resolve included business models (cross sector), interoperability and scalability, infrastructure, safety and social acceptance and the regulatory framework. There was a need for ‘collective intelligence’ to solve these issues, and CAM was seen as an enabler to solve social issues such as shortage of labour, increases in marginal costs, traffic accidents, support ageing population who could no longer drive, climate change and well-being.

Japan’s vision of mobility and society for 2022 comprised 5 main areas:

- Service design from the citizens’ perspective
- Community and trust – Mobility was seen as a basis for additional services such as a childcare sharing application
- Communication and decision making with people, by data – by examining the driving routes of autonomous buses, big data from mobile phones can be used to identify human flow
- Architecture
- Regulatory reform – Provision of a technology map to refresh all regulations, and consideration of system architecture to establish new regulations. By using digital technology regulation becomes more effective and more business friendly and brings about more innovation.

It was generally agreed that the role of government would change as we moved towards autonomy. Government was currently the interpreter between transport, industry providers and people, but in the future it would become the governors of the infrastructure to ensure safety etc which meant closer relationships would be needed between government and industry. Collaboration between competitors was also required, especially in V2X, as well as collaboration regarding the ongoing spectrum frequency debate, specifically in the US but in other countries too.

Key challenges from a number of speakers highlighted the importance of establishing a joined up government approach:

- Test and learn
- Vehicle agnostic collaborations
- V2X Technology concerns
- Security and safety features
- OEM feedback
- Remote command and control capability
- L3 Launch then elevate to L4
- Importance of community education and acceptance
- Dedicated routes and features
- Workforce development
- EV infrastructure

AIR MOBILITY

Whilst most discussions addressed mobility on land there was a session on air mobility where the main points were:

- Collaboration was needed between governing agencies; main stakeholders in the ecosystem could not continue to operate in silos if we were to deploy these technologies. Traffic management at ground level needed to be joined to air traffic management.
- In the USA working groups and advisory committees were needed to address future UAM policy, planning and vision.
- Engagement with the community/public was critical. Communities needed to be a part of the process so that organisations could understand potential concerns and prepare solutions.

RURAL

Creating connected and automated transport services for rural environments posed significantly different challenges to those of urban environments which were arguably easier to replicate from one urban environment to another. Rural deployments were likely to have stronger and more impactful societal benefits but urban systems and had potentially stronger business cases.

In the sessions the societal opportunities and challenges that rural communities would be tackling in the coming years were highlighted, with the introduction of new mobility technology (specifically with micro-transit and autonomous vehicle solutions) as potential solutions. A publicly shareable database accessible to all was key along with the use of edge computing to support the use of digital twins. There was no 'one size fits all' with regards to rural policies, and using AI and digital twins could accelerate the deployment, and therefore benefits including safety, of ITS for rural communities.

A detailed report on a Japanese case study described the challenges facing rural areas, particularly the comparative age of the population, combined with the reduction in public transport routes, increase in the number of older people who could not drive and the lack of home deliveries in rural regions due to the lack of truck drivers. Different solutions had been deployed in 32 rural areas across Japan trialing the use automated driving vehicles to enable a variety of activities and bring agricultural projects to the morning food markets. User feedback had been very positive with 60-70% satisfied with the automated driving service.

LESSONS LEARNED

A session 'No Success Without Failure' had a wide-ranging panel of representatives who agreed overwhelming that there was no better way to learn than through deployments, and that to have successful deployments there should be constant review and learning, adapting the programmes based on what had been learned along the way.

There was also strong consensus that it was critical for different projects, within States, across the country and globally to share the lessons of their project with a more systemic method of sharing to avoid wasting money, repeating the same mistakes and all learning the same lessons in silos.

Where we are now

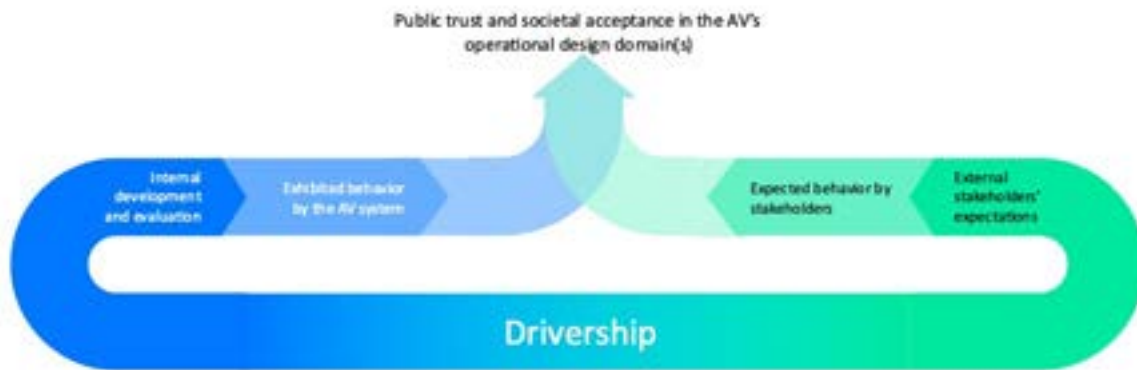
- Arizona's AV permitting process
- Testing/Operating with a Driver & without a Driver
- Testing everything from small delivery vehicles to commercial motor vehicles.
- Arizona municipalities are actively involved in the safe development of these innovations.

Lessons Learned

- We are constantly learning and evolving.
- We had to be willing to challenge the status quo.
- Utilize the authorities we already had.
- Collaboration with the manufacturers, the various levels of government and the community is critical.



The research concept of Drivership can build trust
by meeting and exceeding stakeholders' positive & reasonable expectations
on how autonomous driving systems behave on the road.



Laura Fraade-Blanar in SIS 10 Highlights from the ARTS 2022

WHAT WAS LESS POPULAR

Equity was a strong theme of the overall conference but seemed to feature less in Topic 3. There was little discussion on affordability of AVs, who would be able to travel in AVs, and how they could be made an option for all. The Net Zero goal was expected to be a strong theme if not the main one in this topic but the emphasis was on safety. Transport accounts for 29% of greenhouse gas emissions in the USA but we had very little on how deployment of connected or automated vehicles might enable reductions.

The legislative issues around CAV's were not a popular theme, possibly due to the complexity and diversity between global nations so we had less than in previous years on regulatory and licensing issues.

WHAT WAS NEW

Post Covid Automation was a new topic not existing a few years ago but the almost universal drop in public transport use after Covid has prompted the question – how will this trend impact automated travel, which is predominantly a shared travel experience? Many speakers agreed that failure was an integral part of innovation, but it was inevitably expensive and difficult to acknowledge publicly. Nevertheless live v virtual testing was a common discussion point. Some studies were using live components in real-world situations either on test tracks or by deploying technology at public intersections. Others examined the technologies in virtual or constructed settings. A hot topic for the next Congress is likely to be how can we enable more cooperative testing and allow multiple participants to examine their technologies in environments that can include interactions between live and virtual components.

The new concept of “Drivership” was presented in the context of AVs developing from just ‘safe driving’ to ‘good roadway citizenship’ in the sense of going beyond driving safely eg not just going because there is a green light but letting people pass on a zebra crossing, dropping off a passenger at a location a few metres away if it is safer to do so. The research concept of Drivership could build trust, by meeting and exceeding stakeholders’ reasonable expectations on how autonomous driving systems should behave on the road. It was a social concept – more than safety alone and, more than the absence of bad driving; it was an interesting evolving concept.

FORWARD VS CONSTRAINED

FORWARD:

The uses of Machine Learning, Virtual Reality and sensor technologies all appeared to be moving forward. Similarly experience of using 5G and V2X in automated transport was making progress albeit too slowly from some.

CONSTRAINED:

A global area which seemed to be constraining was achieving a commonality of policy. This looked to be a major challenge in Europe with so many countries each with different regulations and laws but the European Commission was visible and active in setting a framework for the 27 Member States and other associated countries. The USA had difficulties with different approaches across different States. Globally the complexity of this challenge is immense. Future Congresses needed to organise sessions on how we work could together on AV policy as a planet policy not a city, region, country, or even continent.

A session delivered an update from the Automated Road Transportation Symposium and the clear message was that significant research was still needed to enable progress in the next few years on a wide range of CAM related areas including:

- Human factors
- Standards
- First responders
- Equity
- Data sharing
- Roadway operations
- Safety topics such as freight, transit, and passenger vehicle commercialisation
- Safety and cyber security assurance
- Sustainability and climate change
- Digital and physical infrastructure
- Formulating legislation and policy for use of automated driving systems.

The industry needed to move from collaboration to integration in three main areas:

Geographic Level	System Level	Data Level
<ul style="list-style-type: none"> • Isolated, local solutions are not the way forward and what is needed are global, national, regional approaches covering numerous areas including • Strategies • Roadmaps • Frameworks • Standards • Terminology & definitions • Policies 	<ul style="list-style-type: none"> • Coordinate human and ADS performance - Leverage strengths, address weaknesses - and infrastructure • Trucking • Teleoperation • Traffic management • First responders • Construction & inspection zones • Rural use • Climate change • Transit • Digital infrastructure • Cybersecurity 	<ul style="list-style-type: none"> • Including: • Test data • Live & historical road network operational data • Asset/road environment data • Monitoring data • Modelling data • Sharing data via Research, Planning, Operations and Capture & Communications • Open standards & specifications

Other areas where progress was not straightforward included:

- Support from and interaction with the infrastructure were necessary requirements for future traffic systems with connected and automated vehicles eg for improving the Operational Design Domain or implementing traffic rules.
- We needed to ensure the quality and security of the data exchanged among vehicles and between the vehicles and the infrastructure.
- Traffic management systems needed to be integrated with the deployment of automated vehicles to address unanticipated negative effects eg impacts on traffic efficiency.
- Human factors must be incorporated in the design of automated vehicles and traffic management strategies and responses. Further research on behavioural factors, with particular emphasis on edge cases and an acceptability of traffic management measures, was overdue.
- There needed to be more collaboration among stakeholders (eg involving vehicle manufacturers) to better frame the problems and seek better solutions.



TOPIC 4

ORGANIZING FOR SUCCESSFUL POLICY & GOVERNANCE, BUSINESS MODELS, INTERNATIONAL COOPERATION

OVERVIEW

Most of the sessions under Topic 4 focused on the disruption and organisational challenges created for public and private sector professionals by new digital technologies and advancements in micro/E-Mobility. Whilst the high level focus was policy, business models, organisation, standards, and governance, the continuing theme throughout was all about “sharing” – bringing together the lessons learned, data and intelligence gathered to understand how the sector could come together to accelerate transformation.

We heard how new technologies had enabled new value propositions such as automated driving, intelligent parking, digital kerbs. These propositions had brought potential but also uncharted challenges, for example separating hype from fact when considering risks and opportunities and misconceptions of application and usage (customers feeling safe vs being safe, in an AV). We were frequently reminded not to forget business basics – don’t get carried away with the tech and before considering the business case for any new value proposition first ask; “What is the purpose; who will it serve? who will pay?”

We saw examples of where the pace of change had been further driven by private sector investment influencing the AV sector and new mobility, creating even more complexity for public sector and organisations servicing public sector clients. With fast evolving tools for digitalisation and new data technologies such as “data in the cloud” and edge computing creating more realistic opportunities for C-ITS (as the backbone for automation, connectivity, and new mobility), came recognition that the evolution of ITS did not match the ability of organisations, particularly those in the public sector, to keep up.

There was a key message across the topic: The current protracted models for decision making, governance processes and procurements resulted in delays so extensive that by the time we got to implementation the technologies and markets would undoubtedly have moved on.

It was also very clear that transport generally had not avoided the global phenomenon of skills shortages exacerbated by an ageing and non-diverse workforce. As a sector ITS must broaden and diversify if we were to overcome the challenges of transformation. We must learn new ways of working and build partnerships with new players such as start-ups and product developers. Diversity had a broad span: age, education, disability, ethnicity. The challenges were visible, many groups were unable to participate as they were under-represented in the industry in the first place. We heard how non-diverse decision making frameworks had left unwanted landmarks of legacy infrastructure, in-equity in transport, unsafe liveable places and economic poverty.

WHAT WAS NEW

ORGANISING FOR SUCCESSFUL POLICY AND GOVERNANCE

In a way the whole Topic was new – organising for successful policy and governance was not programmed as a separate subject in earlier Congresses. Over the past 10 years we had seen a global increase in E-Mobility services across our cities and public spaces. Customers were engaging directly with these providers, utilising their services and the convenience they could provide, giving them data, journey records and intelligence on needs and wants from a publicly available on-demand service. This in turn had created more challenges for authorities. Local authorities needed this data for equitable, accessible, and effective evidence-based policy making. This made E-mobility an innovative space where public and private sector collaboration could catalyse new mobility services for places and the people who lived work and played in them.

Sessions demonstrated that the key challenge was to set Standards that would both support interoperable accessible services and at the same time allow for innovation, and form a broad marketplace providing best value and options for users. The rules for engagement needed to ensure everyone could get what they needed, and everyone needed data. The richer the data, the more effective the policy making, the user services and system design. Cities needed data sets; E-mobility services needed cities, customers and the data; and customers needed smart and integrated mobility options.

Standard setting must reflect these needs if we were to have an effective eco-system and there was an example that worked: the Open Mobility Forum. The OMF is a not-for-profit organisation working as a collaboration hub to understand what was needed to inform the standards that would deliver an effective eco-system for new mobility. The OMF had been developing standards for cities with CAVs in mind and had adapted the specifications to create the Mobility Data Standard (MDS) for e-mobility. Over 300 cities had adopted the MDS standard – a set of KPIs and rules for compliance and access for the service provider to use the city, customers to have their options and cities to be guardians of the data. Service providers received a permit to deliver their services in an agreement to comply with the Standards. The key was for cities to be clear and robust about what data they really wanted that was purposeful for their needs, rather than just ask for everything.

INTERNATIONAL CO-OPERATION

Looking globally Automation and New Mobility were the top two focus areas where there were many unanswered questions. What purpose do they solve? what are the legal implications? what are the customer perceptions of safety and security and regulatory challenges? If customers did not feel safe, they believed they were not safe. The need for international cooperation to address this type of challenge was extensively discussed. There were intriguing regional differences – the UK sector was seeking standards from the insurance sector; the US transportation market was seeking use cases to set precedents. The overwhelming message was that with greater international cooperation in the sharing of data accumulated from pilots, multiple collaborations and trials the sector could learn at pace and catalyse the transition to an environment where autonomy and new mobility could thrive. Regulatory controls were critical but potentially easier to navigate when in controlled environments.

Again regional differences were interesting: in the UK an activity not prohibited was permitted; in the US if not prohibited it was assumed to be permitted. Either way cooperation – open sharing with no quid pro quo – would catalyse the route to regulatory certainty which all agreed was a “must have” for autonomy and new mobility to thrive.

PERHAPS WE COULD HAVE HEARD MORE ABOUT...

Revenue deficits arising from increased autonomy, zero emission fleets and a shift to MaaS and micro-mobility would impact future ITS funding. The subject of road pricing within this Topic area was missing, perhaps because the words “road pricing” were taboo for many; perhaps because the content had been exhausted over the last 30 years.

FORWARDS VS CONSTRAINED

CONSTRAINED

It was recognised that we needed to learn more from Human centred research linked to Automation and Artificial Intelligence. There was still much to be understood regarding artificial intelligence in transport. As an industry we did not yet fully understand the complexities of product liability v human liability when it came to automation, or how we balanced the benefits and risks, concerns of safety, privacy and equity. Further to that the discussion around AI in AVs agreed there would need to be trade-offs, as AVs were purported to be safer than the alternative there was a need for a fundamental shift in the legal eco-system to a more product liability basis.

Sessions reviewed some examples of AI deployments in the field for example how AI was improving traffic management. Junctions could be decentralised, in effect controlling themselves and sending messages to neighbours forcing “collaborative decision making” in the field. Trials conducted so far had tested the technology in a “clean” environment with no humans in the system; we had yet to understand how humans might perform when AI was making the decisions. The early trials did not measure impacts on pollution but the available data was indicating up to 21% lower emissions achieved from managing road junctions with AI.

All speakers agreed level 3 automation was the most dangerous but no use case data or evidence was presented during the sessions to substantiate this statement. Further trials were welcomed for human centred research, as a key concern was the impact of humans in the vehicles and pedestrians in the system. For example how did users learn to trust automation when AI-based services were running the system?

It was recognised that automation could solve some transport challenges such as the skills shortage of HGV drivers but it was likely that the increase in AVs would generate more automated vehicles miles v human. Against this argument, data analysed during the pandemic crisis revealed that whilst human vehicle miles reduced, incidents did not. With more automation comes more movement and a demand for new skills to modernise infrastructure and to implement and support a digital ecosystem. It was agreed that more research was needed, more use cases tested with the human in the system.

FORWARD

We heard about successful progress with Infrastructure design in California. The key to success was incorporating multiple stakeholders in the eco-system who could benefit from sharing their data and would do so openly. This was emphasising the message “collaboration is critical for the future of transport”. Relating to the Congress’s top level theme, transformation in transportation could only be enabled by multi-stakeholders and that in turn required transformed regulatory control and equitable policies so that innovation could thrive.

The Californian example of collaboration was the State's transport agency Caltrans and SANDAG the association of local San Diego County governments. SANDAG had very clear goals:

- Repurposing assets more effectively using technology.
- Preparing for CAVS and Smart City technologies.

Importantly, it was also recognised that transport authorities were slow to organise and deliver projects in a marketplace where technological advancement was moving at pace. They had therefore taken an innovative approach to how to organise themselves to deliver projects within a governance framework maximising agility and innovation. This involved innovative public private partnerships and collaborative project delivery:

- Attracting private investment
- Jumpstarting development
- Testing new tech and delivery models
- Stimulating innovation

Innovative delivery:

- Proving Ground Partnerships reducing project delivery from 7-10 years through concept testing
- Planning and pilots creating opportunities to solve real problems
- Project delivery with an iterative process

For the past 75 years vehicle manufacturers and infrastructure design had been influenced by “Green Book” rules. Given the exponential progress in the last 10 years with V2I, V2X and V2V technologies the next 10 years of infrastructure design were critical to the future market for AVs. CAVNUE, one of the partners collaborating with SANDAG in delivering their vision, had reimagined the driving environment fusing road infrastructure with automated vehicle technologies. Their solution bridged the gap between vehicle technology and roadside design.



Alex Estrella et al in SIS 77

TECHNOLOGY TO CREATE SAFER ROADWAYS

This popular subject combined both big data and Vision Zero thinking. The technical papers explored how the ever-increasing pool of crowd-sourced connected vehicle data was being leveraged to improve our understanding of driver behaviour and to advance machine learning capabilities. This, in-turn, had enhanced decision-making regarding human-centred design, and initiated the advancement of automatic detection of traffic events (eg debris in-road, vehicle tracking, wrong-way driving, vehicles driving at speed, pedestrians in-road and weather alerts). One paper also presented the use of simulation to improve highway operator training packages, where on-road scenarios (built using real-world connected vehicle data) could be modelled and adjusted following the actions of the operator within the training environment. Wrong-way vehicle driving was another well reported subject area, where trials had been undertaken to identify the most effective mechanisms of reducing the likelihood of wrong-way driving, and of mitigating the risks to other road users during a live event.

HOW TO ACHIEVE VISION ZERO

This high-level session saw thought leadership articles presented on the imperatives of eliminating road fatalities and why the time was ripe to focus on Vision Zero. Urban roadways were now considered to be the most harmful roadways (in comparison to interstate roadways, freeways, and motorways), especially at interfaces between motor vehicle traffic, and active travel road users (eg at roundabouts, intersections, pedestrian crossings, and non-grade separated junctions). This, combined with growing and ageing urban populations, and the ever-increasing deployment of connected vehicles, built a picture of a highly kinetic transport environment where all road users needed to adhere to the concept of shared responsibility.

In addition to the focused academic nature of the papers sessions, broader themes emerged from Special Interest Sessions. Main themes included:

THE NEED FOR THE AUTOMOTIVE INDUSTRY TO BE COLLABORATIVE IN TERMS OF DATA RECORDING, DATA SHARING AND DATA ANALYTICS.

Discussions were clear that the industry had moved on from collision counting and hotspot identification, to making data-driven, proactive decisions. However, the automotive industry must take collective responsibility to achieve Vision Zero targets. Firstly, data gatherers (eg original equipment manufacturers (OEMs), third-party crowd-sourced data facilitators) needed to ensure data was recorded and shared. Secondly, data enablers (eg third-party data corporations) must disseminate the data, enhance access, and educate the industry on what information was available. Finally, consultancies (eg transport planners or engineering professionals) then needed to leverage the data and provide feedback to the OEMs and network operators in order to implement countermeasures.



The Federal Highway Administration Systemic Safety Project Selection Tool shown in SIS78

THE IMPORTANCE OF MAKING FULL USE OF AVAILABLE CROWD-SOURCED CONNECTED VEHICLE DATA.

Panellists agreed that the automotive industry must leverage crowd-sourced connected vehicle data in order to better understand vehicle performance, driver behaviour and road operator performance. It was considered that this, in-turn, would facilitate the ongoing development of CAV technology. Advancements in connected vehicles, coupled with mobile phone-vehicle integration, meant that driving behaviour and vehicle performance data had never been more accessible, with very few roads now considered to be 'data-less'. Highly granular data sets were considered to be the main driver in future innovations for OEMs, network operators and technology providers alike. In particular there was a focus on driver behaviour data, where great attention had been placed on understanding how drivers interacted with highway infrastructure.

However, it was agreed that a focused vision, and clear objectives must be set in order to navigate the vast quantity of available crowd-sourced data, in addition to strict legislation regarding data protection. The use of near-miss and collision data was also well covered, where proactive, data-driven solutions need to be implemented to influence driver behaviour, reduce the likelihood of road traffic collisions, and ultimately achieve Vision Zero targets. However, a lack of cross-governmental policy and support was considered a key blocker to achieving this vision.

THE COMMERCIAL VIABILITY AND OWNERSHIP OF CAVS.

There were energetic discussions on the problems and possible solutions around financing and taking ownership of the extensive networks required to operate CAVs in the future. These looked at vehicle maintenance and programmed driving behaviour, instalment of roadside units, maintenance and operation of data transfer telecommunication networks, maintenance of smart infrastructure, maintenance of the road surface and lane markings, operation of data centres etc.. Although no firm conclusions were reached it was noted that strong cross-governmental and regulatory framework support must be leveraged to make CAVs a reality across the globe.

THE IMPORTANCE OF HUMAN-CENTRED DESIGN. Panellists discussed the unpredictable, highly changeable nature of roadway systems across the world, where it was agreed that roads needed to be designed to be forgiving, even for the most inexperienced drivers. Furthermore, by placing human factors and human decision-making traits at the forefront of road design even the most inexperienced drivers considerable not be penalised by serious injury in the event of a driver error. The concept of 'applied' autonomous driving styles was also discussed. Panellists agreed that driving would be a human-dominated function for the foreseeable future. It was therefore imperative that autonomous driving styles complemented the local 'way of the road' in order to be successful, and gain confidence from global markets.

THE OVERARCHING AIM OF VISION ZERO. There was unanimous agreement in sessions that Vision Zero was the ultimate goal for the transport industry. However, the industry could only get so far without robust road safety policies endorsed by national governments. Discussions suggested that the fundamental next steps should be to facilitate long-term political engagement across governmental departments to ensure transportation policies were backed, implemented, and enforced.

OLD VS NEW

NEW

It was clear in all sessions that the concept of shared responsibility was impacting all technological advances. Rather than applying standardised vehicle-centric designs regardless of context land use planners, system designers and highways designers must identify the purpose of a road, what activities would be occurring on it, who would be using the public space, and then design accordingly. Road users are required to be mindful of all other road users and follow the rules of the network. Given that the potential for crashes resulting in fatalities and serious injuries reduces with lower speeds good speed compliance (from road users) and measures that control speed (system designers) had the greatest potential for achieving Vision Zero.



Adapted from the Swedish Transport Administration Original; shown in TS3

In addition, the rise of active travel in urban areas, and the associated safety impacts were frequently discussed at the Congress. In recent years, there had been a greater global emphasis on active transport and environmental consciousness, with an increased availability of electrified personal mobility vehicles. This had been particularly dominant following government endorsements during and after the Covid-19 pandemic. It was considered that many existing urban highway networks were ill-equipped to handle mixed use by pedestrians, cyclists, electric micromobility vehicles, and traditional automobile traffic, often contributing to crashes where one party was outside a vehicle and was seriously injured. This was a significant blocker to achieving Vision Zero targets. Empirical analyses had confirmed this trend, where urban roadways (particularly at intersections) were now considered to be the most harmful (in comparison to inter-state roads, freeways, and motorways).

Similarly, there was great emphasis on ageing urban populations (especially in Japan and Western Europe) and disabled road users, where additional consideration and bespoke technical solutions were presented in order to provide equitable transport options in urban areas (eg increased time to cross intersections/ roads, roadway infrastructure updated to account for increased use of mobility scooter traffic). There was a growing emphasis on human-centred design across the active travel landscape, where 'pedestrian calming' measures were being introduced to soften the interface between motor vehicle traffic and active travel road users (eg variable pedestrian crossing timings, countdown to 'green' pedestrian signals, and segregated cycleways).



Overview of roadside unit data collecting and providing process (Donghyun Kwon et al in TS 1)

OLD

There was very little coverage geared towards interstate roadways, freeways, and motorways. It was considered that due to the rapidly evolving urban mobility landscape, coupled with increased injury and fatality rates on urban roads, and previous long-term research and investment in motorway / interstate roadway safety, attention is being diverted to the more volatile, kinetic and unpredictable urban mobility landscape. Furthermore, following long-term trials of CAVs on unidirectional, 'linear flow' highways and motorways, attention was growing on testing the technology in more demanding, quick-decision-making, urban environments. Both of these trends were frequently raised at the Congress, where due to the rapidly changing transport system, the industry must focus its resources on the areas where most improvement could be made (out with the old and in with the new).

FORWARDS VS CONSTRAINED

The mobility landscape constantly evolves. Responding to and preparing for demographic, economic, environmental and technological developments, while new transport modes and technologies appear alongside traditional modes disrupting them, has been a permanent challenge for the transport industry.

As a result, the path to Vision Zero and the Safe Systems approach must always evolve in-line with the current mobility landscape. Therefore, Vision Zero thinking must always be forward-looking, and not constrained to be effective. Several innovative solutions with the potential to contribute towards Vision Zero targets were presented throughout the sessions (eg collision detection, disabled/stopped vehicle detection, wrong-way driving detection, congestion warning, merge lane assist, weather warning, green light optimised speed advisory (GLOSA)). However the common factor in all use cases was the integration with in-vehicle messaging (vehicle to infrastructure (V2I)). It was clear that in-vehicle messaging, the most basic form of the connected vehicle ecosystem, is an easily deployable method to improve hazard awareness and driver behaviour in the near future.

However, public acceptance of crowd-sourced data gathering, and concerns about data privacy, are considered to be potential blockers as CAV technologies become more advanced and readily deployed across the globe. Handling the volume of assimilated crowd-sourced connected vehicle data has its challenges, where advancements in edge computing, machine learning and computer power are required in order to fully understand and utilise collated vehicle data.



TOPIC 6 SUSTAINABILITY AND RESILIENCE

THE OVERALL SITUATION

Sustainability was a very broad term which had been used by a large variety of groups to their own ends. In general the term referred to sustaining the status quo for future generations. In modern research circles this was seen as comprising three primary areas (the “triple bottom line”):

1. **Social Sustainability** - This referred to the ongoing physical and mental wellbeing of a people. This could refer to the travellers and their ability to maintain a lifestyle while benefitting from new transport options, but it could also easily refer to the equity and welfare of a labour force.
2. **Environmental Sustainability** - Sometimes used synonymously with “Sustainability” as a whole, It referred to the planet and its ability to regenerate resources within the scope of humanity’s impact. These resources included obvious tangible assets such as plants, animals, minerals, or fossil fuels. Less obviously, resources like clean air and clean water must also be taken into account. Within transport the use and disposal of these resources must be considered when evaluating the sustainability of a network.
3. **Economic Sustainability** - This meant profitability. What economic value was created by the new service or product? Who would be willing to pay for it? For transportation programmes, the answer here was often the local, state, or federal government. But even for publicly-funded programs, this question remained vital to any service’s ongoing operation.

Resiliency referred to a system’s ability to respond then recover from emergencies. Within the higher-level of sustainable planning every transport service and network experienced more immediate cycles of emergencies, responses to them, then building back stronger. These cycles demonstrated a system’s resiliency. The emergencies themselves could take many forms, from natural disasters to other climate-related systemic changes like temperatures above or below the expected range for a region. Some emergencies were man-made like economic crises, cybersecurity attacks, or (literally) war. Transport – both commercial and personal – was susceptible to all of the above. The most resilient services responded to these emergencies in the moment as well as in their long term plans.

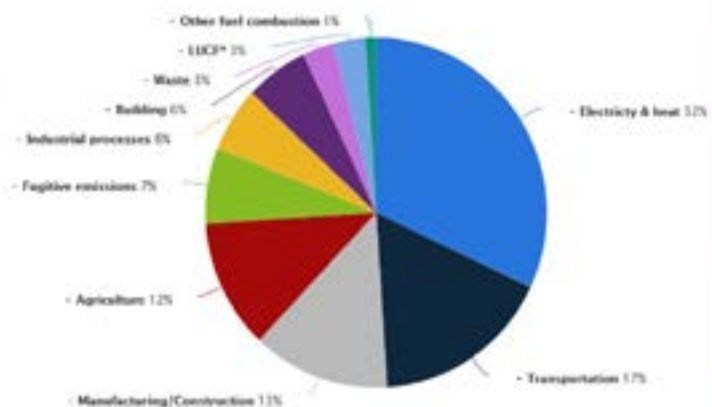
WHAT WAS POPULAR

Across the Topic as a whole the most popular topics were:

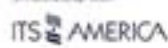
- Taking account of social factors (especially behavior)
- Transport operations
- Congestion mitigation
- Modelling impacts + emissions
- Electrification and related technologies
- Cybersecurity

Transportation GHG emissions

- Transportation is the fastest growing source of emissions worldwide
- Transportation is 17% of global GHG
- Road transportation is 12% of global GHG
 - 60% from passenger cars
 - 40% from road freight
- Immediate solutions are needed



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Sessions looked at aspects of improving efficiency such as ITS for emissions reductions and decarbonisation; safety improvements; and signal timing for improved transit performance. Many panels and papers discussed developments in cybersecurity to improve resilience with much sharing of best practice. Climate resilience featured prominently:–

- Optimising energy resources to support EV charging
- New tools for measuring climate impacts from energy usage and emissions
- Supporting cities towards meeting goals and regulations for pollutant reduction

WHAT WAS LESS POPULAR.

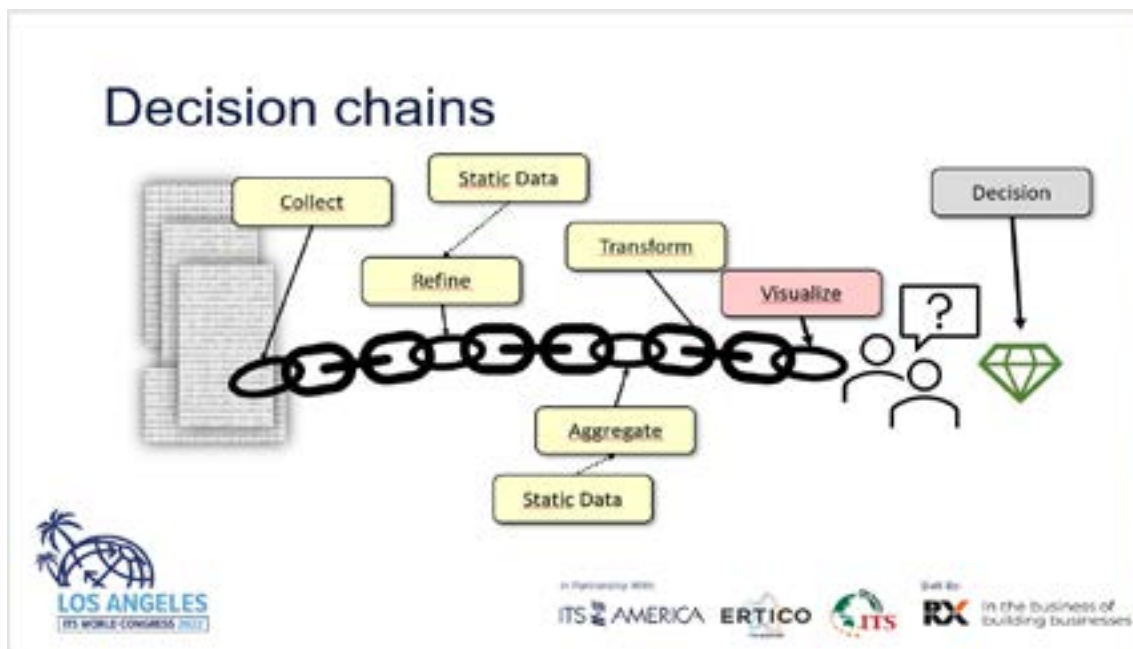
The sustainability and decarbonisation discussions had very little mention of hydrogen fuel cell electric vehicles; and there was little discussion of external resources resilience and the potential constraints on climate strategies (for example: world lithium reserves).

Panelists in International Forum 2 described physical vs digital infrastructure, and how both together represented a systems-level approach towards improving the versatility and resiliency of transport modes. An unusual reference to the past described multimodality in ancient Rome, where 75,000 miles of roads established the civilisation’s dominance. Congestion pricing was built into city centres and managed over a dozen classifications of carts (along with pedestrians and horses). Over a thousand years of technology set this example apart from modern times, but the obvious point was that collaboration could enable innovation just as much as technology.

Another speaker illustrated how data drives decision-making. In summary: “data has no value on its own until you make a decision; data needs to go through decision-makers”. If we viewed data management as processes in a data chain we could better understand how the chain was only as strong as its weakest link. Data processing must be decision-maker-centric. Decision-makers could be policy makers, operators, authorities, traffic management centres, or even users. Automated vehicles or automated traffic signals could ultimately only respond to the decision-maker who developed the system.

Ultimately, the panel focused on incentivising more sustainable behaviours through infrastructure and accessibility.

As more and more vehicle fleets electrified to help meet decarbonisation goals, the conversation around sustainability could sometimes centre on carbon goals. For some groups, this conversation was driven by regulatory efforts. For others, consumers’ demands kept decarbonisation at the forefront of an organisation’s efforts. This trend was not just land-based. One session demonstrated the intersection of both as an organisation with the example of ports across Europe having decarbonisation goals as a broader part of long term changes to ports’ Just-In-Time (JIT) operations. The goals would come alongside other JIT benefits such as reduced inventory at hand and faster times receiving and shipping new inventory.



Slide from IF2: Sustainability and Resiliency with Mobility Network Management

Many companies which relied on transit through ports had set their own commitments to consumers and governments for green transport, and in the case of maritime freight delivery part or all of those commitments were then passed along to the shipments themselves. In these cases technology was leveraged to prevent shipping delays and thus reduce unnecessary carbon emissions created by keeping ships away from port longer than necessary. While these goals were sometimes framed within environmental sustainability, the primary goal behind such decision-making seemed to be the organisations' economic sustainability.

Cybersecurity was a primary component of Resiliency across the conference. A specialist Session described the interoperation of the different federal agencies under the USDOT (including the Federal Transit Administration, the Federal Highway Administration, the National Highway Traffic Safety Administration and many other agencies) who had worked towards developing their own offices of cybersecurity under the guidance of the National Institute of Standards and Technology's (NIST) framework. A number of specific cybersecurity threats were identified together with the estimated impact on the normal operations of transport facilities across the US. This included impacts to passenger transport and freight deliveries, especially along US highways.

While cybersecurity was sometimes seen as the sole domain of IT departments within each agency the panelists stressed how important it was for everyone to learn the basics. This created fewer gaps in understanding across an organisation and more knowledgeable communications, both internal (such as memos and communications) and external (such as RFPs and job postings). Transport was international and the USA was also collaborating with partners in Europe towards these same goals. In Europe 30% of road users crossed an international border. Although that figure was much lower in the USA the lessons were the same: collaboration and partnerships were key to achieving resiliency goals.

At the Congress some of the discussion around sustainability focused less on "direct sustainability" (meaning deployment of technologies with direct impacts to carbon emissions, like EVs and wind farms) and more instead on technologies with "indirect sustainability" impacts. These technologies focused on improving overall efficiencies within an entire transport system and therefore reduced wait times and congestion — which in turn lead to excess emissions and wasted capital. Indirect sustainability impacts could be complementary to direct sustainability. One example was Xtelligent, a cloud-enabled congestion and asset-management service. It was built from a mindset where an entire system must be considered when changing any small piece of a transport network. No single emitter exists in isolation — a series of emitters interact with one another to form an entire system. The software helped guide and model signalisation with this entire system in mind.

A demonstration used downtown LA as an example, showing the potential for roughly 5-6% emissions savings simply due to congestion mitigation from signalisation. If traffic-coordinating and data around idling time was included then the figure could potentially be nearly 20%. It was emphasised that for any technology to enable such sweeping changes there needed to be trust between the private sector, public agencies, and ultimately the general public. While such solutions could be truly transformative the deployment process required a great deal of engagement with the public sector.

Many of the research papers presented at technical sessions explored the space between direct and indirect sustainability. While improvements to efficiency like corridor optimisation could lead to short term gains in terms of emissions reductions, historically, these gains had not been sustainable in the longer term. There were no examples of technological improvements where increased efficiency has led to less use of a resource in the long term — the Jevons paradox. In the 1860s coal usage increased following the introduction of steam engines. Similarly when cars became more fuel-efficient, people tended to travel more. The same was true of street space and travel time. Increased availability led to greater increases in usage. This distinction between efficiency and sustainability needed to be clarified.

There were also papers that focused on a more direct view of sustainability. Researchers presented data-driven approaches to measuring the impact of transport decisions across multiple geographies, including Wiesbaden, Germany, Seoul South Korea, and the US. Some of these papers also focused on optimisation problems, with the key difference being optimising the deployment of new electrification to reduce vehicle emissions. While electrification of new vehicles was not a complete solution to emissions reductions new technologies and their deployment still represented an opportunity for drastic reductions in the carbon output of the transport sector.

Other papers focused on resiliency, namely cybersecurity. As ITS became more and more integrated with public infrastructure and transport systems as a whole, cybersecurity took on a greater role. Multiple papers were submitted regarding specific cybersecurity issues around new technologies and best practices around protecting those technologies. In many cases this simply involved engaging leadership and educating them around the inherent threats with these new technologies. In some cases new management practices could help penetrate the silos between information technology and operations technology, as the latter became more and more deeply integrated into the former.

Many speakers sought to define “mobility” for this tech-focused audience for example: *“Mobility is the quality of a network or system to connect people to goods, services, and employment that defines a high quality of life.”* This helped define mobility for a specific area, especially compared to layering together individual, siloed metrics such as walk score, bike score, transit score, or average travel time by car. Plotting opportunities against travel radius could demonstrate how easy it was to get around without a car. The goal was improving the transit, biking, and walking maps to look more like the driving maps. Broadly speaking, this accessibility was a way to measure and define mobility.

The goal of mode shift went hand in hand with sustainability. A speaker argued “if a prerequisite for high quality transport is individual vehicle ownership, we will never address the inherent inequities in our society, nor substantially advance transport sustainability.” In addition to the direct sustainability implications of new technology reducing emissions (such as EV deployment and new charging infrastructure) we needed to remember the opportunity for indirectly sustainable solutions. This included congestion mitigation through optimised traffic patterns from real-time data integration.

OLD VS NEW

Some aspects of this topic were familiar – though not always framed as “Resiliency,” Cybersecurity had been a major concern for decades. When dealing with intelligent technology in transport systems this concern expanded to critical. Cybersecurity was a very popular topic across the conference, with many exhibitors demonstrating products extending beyond digital resilience and into physical infrastructure. Because the Congress was held in Los Angeles many important, geographic, sub-texts featured in discussions such as Southern California’s resilience through recent natural disasters such as drought and wildfires.



ITS directly engaging with sustainability was new. Topics such as electric vehicles or signal optimisation were seen in former conferences but not together under the banner “sustainability.” The earlier coverage of such technologies was driven by economic demand and market forces rather than equitable considerations or decarbonisation. This was understandable as public funding for these goals was not always abundant or readily available.

Optimisation had always been a primary use of ITS but seen through the lens of environmental sustainability its benefits could be translated to carbon reductions along with the usual time and resource savings. Technical papers described a plethora of optimisation strategies from agent-based models to AI methodologies. For the most part techniques aimed to optimise the throughput of travellers but the number of travellers was not always the same as the number of vehicles and newer modelling strategies seek to rectify this imbalance and put people before vehicles.

WHAT WAS MOVING FORWARD

Electrification was a natural focus for sustainability given the wave of public funding. In addition to personal EVs and electrified transit buses we saw innovative strategies for electric shared micromobility (bikes and personal scooters). These included not only deployment in new markets but also an emphasis on partnerships with public agencies, the gatekeepers to infrastructure. Successful technology companies developed partnerships with those agencies not just as a lead to funding, but ultimately, these relationships allowed new technologies the opportunities to integrate more deeply with public life.

One of the more intriguing challenges for EV charging networks involved rural geographies. A session by states in the Midwest



Slide from SIS2: Electrifying the Heartland

region discussed shared goals of decarbonisation through vehicle electrification. Representatives from Michigan described the partnerships behind the shared goals of expanding the domestic EV industry through product development, manufacturing and workforce training and expanding the consumer side to accelerate EV customer adoption and deploy smart and connected infrastructure throughout the state. This multi-faceted approach demonstrated the many benefits of electrification: while the state was concerned with the environmental sustainability of its transport emissions, the new technology could be a driver for the state’s economy and social equity programme through its application.

WHAT WAS CONSTRAINED

Although they were inexorably intertwined Housing and Transport were typically siloed and awareness that transport networks were a reaction to the built environment, rather than a progression from the available technology, hung over many sessions. Housing development (eg EV charging requirements for multi-family dwellings) and land use patterns were integral to the adoption of sustainable transport solutions and mode shift away from unsustainable, single occupant vehicle trips directly followed population density. Yet public transport agencies rarely had any say in housing or the built environment.

Another point heard in many presentations was so much of the developed world's infrastructure is nearing the end of its natural lifecycle. Governments were looking at replacing these roads, bridges, and railways. But by framing the conversation as replacing, these public agencies risked deepening economic inequalities and worsening the future sustainability of their transport systems. A speaker summed it up succinctly: "If a pre-requisite for high-quality mobility was individual vehicle ownership we would never address the inherent inequities in our society nor substantially advance transport sustainability." In order for new infrastructure to address these inequities planners needed to understand that replacing existing roads and bridges could not come at the cost of future innovation. The effects of such massive investments would be felt for many generations so the investments needed to be made with the needs and values of those future generations in mind.



TOPIC 7 TECHNOLOGY FROM ENTRY TO THE LAST MILE

THE OVERALL SITUATION

Technology from entry to the last mile covered a lot of ground with key building blocks of communications, data and data analytics, integration, and pilot projects. Speakers in a number of sessions argued that the future of ITS was integration of data, and innovative techniques for sharing, processing, integration and management. Pilot projects reported work in a number of areas including software to collect multimodal travel behaviour data; and broadening the scope of multimodal services for underserved populations to improve access to jobs, healthcare, education etc.

Freight solutions continued to develop. Long-haul freight networks were evolving to streamline the movement of goods and improve efficiency. To combat multiple deliveries on the same day and to one address but by multiple companies last mile delivery by modes such as cargo bikes, eScooters or delivery robots with reduced environmental impact was being trialled. Emerging topic areas presented included enforcement, kerbside management, electrification and quantum computing.

THE TOPICS IN DETAIL

COMMUNICATIONS

Billions in government and private sector funds was being spent building wireless and wired networks in public rights of way, improving ITS infrastructure and erecting millions of 5G towers to move data from the transport network to the cloud and back to the edge. But the emphasis was mostly on the supply side and we needed to look from a user perspective and leverage our infrastructure in a different way. There was much activity with installing fibre across the USA and some towns were growing because of their culture, communications and connectivity although only a few Metropolitan Planning Organisations included connected vehicles and the associated communications in their long range plans.

This was not the busiest subject in the topic and the discussions tended to be very technical and focused on supply side issues.

DATA

There was strong agreement that data was the primary building block for ITS and sessions addressed many aspects. Cellular-based vehicle probe data was being used to provide real-time traffic estimations and an advanced Machine Learning trial was being used to estimate work zone traffic volumes. The US DOT reported work on developing data exchanges and specifications like the Work Zone Data Exchange (WZDx). This project aimed to get data on work zones into vehicles to improve safety and mobility by enabling better driver awareness of active work zones and helping automated driving systems and human drivers navigate more safely. WZDx was evolving to incorporate advanced technologies and unlock the possibility for future data exchanges

The DOT was also working on how to use data to power the future of ITS by integrating data, AI, machine learning (ML), and other innovative techniques for data sharing, data processing, bias mitigation, privacy preservation, data integration, and data management. Sessions also discussed, a new initiative, Research, Operational, and AI Data Integration Initiative (ROADII). This is a multi-year initiative with a focus on research-to-operations activities by identifying and prioritising research problems, identifying potential solutions using data and AI techniques, and rapidly investigating/testing the feasibility of such solutions by targeted prototyping.

A number of speakers from the US DOT reviewed the six strategic pillars:

- Innovation
- Advancing trustworthy AI
- Education and training
- Infrastructure
- Applications
- International cooperation

The ITS data hub, ITS code hub and secure data components were key elements of the CARMA programme on cooperative driving automation research, development, and testing together with an initiative on open source solutions for ITS.

Most presentations on data at the Congress were roads-related but a different aspect, based on future facing technologies, came from the Port Authority of New York and New Jersey who presented work on a \$30Bn programme to upgrade passengers handling facilities. The key elements were:

- Information availability
- Seamless connectivity
- Quality of pedestrian experience
- Vehicle management

Investments had been made in vehicle and pedestrian detection, video, lidar to collect data enabling real time decisions for the agency to support providing information through digital kiosks to travellers. Data hubs with analytics would identify the causes of any issues and monitor success of mitigation strategies. Early lessons learned from the La Guardia project stressed that data was the number one priority.

A number of excellent examples of the need for integration were presented in sessions addressing problems and opportunities for getting people to and from the venues for major events quickly, safely, and efficiently. Stadiums, concert halls, theatres etc were places where all forms of transport and mobility came together and had to work in sync. Facility operators were clear that bringing people to middle- to large-scale events was managed far more effectively and efficiently through mass transit rather than personal vehicles. This often needed a push for modal shift as it represented trying to bring back customers who no longer felt safe and comfortable. Clean public transport vehicles were essential during service, not just at the ends of the day. Reliability, safety and comfort were critical along with ease of use.

A key question was how to incentivise change? Traditionally event parking was essentially free and that might need to be amended. For a new stadium transit passes (or a parking charge) could be added to a ticket. A focused initiative was needed to address diversity, equity and inclusion in order to reduce the travel path for those who need it. There were no easy answers and developments with micro mobility were introducing new issues such as secure bike parking, e-bike charging, different traffic management arrangements etc.

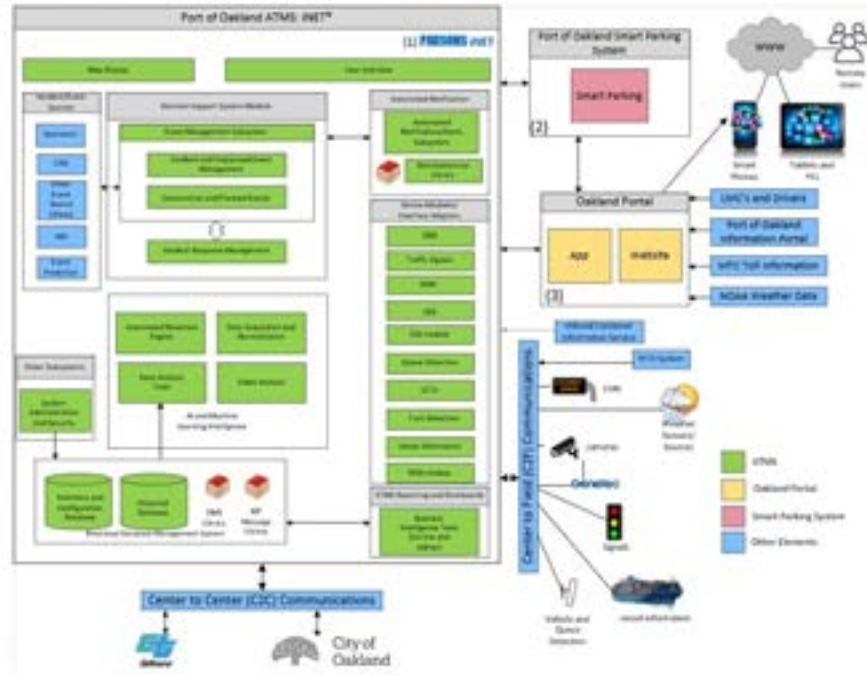
Los Angeles would have the Olympics in 2028 and a vast amount of infrastructure work was underway to manage not just the 'visible' crowd traffic but also the fast and reliable 'invisible' movement of athletes and the organising and support staff. The city viewed the Olympics as an opportunity; it was all about being proactive and coordinating and sharing to break down institutional barriers to deliver the Games. Goods movement was important and would be using the games route network off hours. The Olympics app would be integrated into public transport ticketing. Bike access would be crucial for the workforce; bike valets were being considered for the mobility hubs. Bikes would be used for last mile deliveries to minimise the number of freight trucks. The city managers hoped the Olympics would catalyse many additional users for public transport and have a broader impact on mobility in the region after the Olympics.

IMPLEMENTATION OF PILOTS AND PROJECTS FREIGHT

The freight and logistics sector offered perhaps the ultimate examples of Technology from entry to the last mile covered. The thoughtful application of technology had moved from a nice-to-have use case to a primary methodology to improve outcomes. As always freight congestion at the ports was a significant challenge, but long-haul freight movement networks were evolving to streamline the movement of goods and utilise advanced methods for improved efficiency. Commercial vehicle overloading directly affected road safety and also accelerated infrastructure wear. Last mile green delivery by modes such as cargo bikes, eScooters or delivery robots with reduced environmental impact were being used to combat multiple deliveries made on the same day and to one address but by multiple companies.

Ports (airports/seaports), cities, counties nationwide had important projects to share analogous to downtowns and dense developments involving: multi-modal connectivity, video, smart parking, and a data-driven approach to data collection and improving situational awareness and management. Discussions also included: use cases, stakeholder engagement, collaboration, and working through trade-offs. For example the Port of Oakland was implementing a complex system of 15 elements including fibre network expansion and optimisation, centre-to-centre communication, Wi-Fi network deployment for public use, and camera and RFID reader deployments enhancing incident detection. A new Advanced Traffic Management System to process and control all the new systems and information being collected was being developed in the updated Traffic Management / Emergency Operations Centre.

System Integration: ATMS

Hillary Hyland et al in SIS 25

A busy session explored the potential to leverage multiple emerging technologies to enable a trusted freight program that distributes security procedures and processes across the full lifecycle from origin to destination. The distribution of these processes mitigated congestion and gridlock at seaports, airports, customs facilities, and intermediate facilities. Proposed approaches included the integration of connected vehicles, RFID, weigh-in-motion, trusted carrier enrolment, and biometric access control systems to build an integrated platform to ensure physical and cybersecurity for pre-screened movement of goods.

The COVID-19 pandemic launched a market realignment, and though in-store shopping had largely returned the rate of kerbside orders and home food & goods delivery remained much higher. This realignment had sparked innovations in the freight ecosystem and in last-mile delivery technologies, including the use of autonomous delivery vehicles, urban air mobility (UAM) devices, and advanced use of kerb space in urban centres. These changes had not progressed without challenges. The increases in food and goods delivery put a tremendous strain on the already congested intercity and urban roads network. Existing system inefficiencies include instances where multiple deliveries were made on the same day and to one address but by multiple companies.

- ① Company founded in 2018
1400+ employees: CA, TX, AZ, NV, DC
- ② Fully autonomous, on-road vehicle
Battery-electric motor vehicle designed specifically for goods delivery
- ③ Delivering groceries, medicine, and pizza with leading retailers



Uber Eats



KERBSIDE MANAGEMENT

A number of cities were focusing on deploying the fundamental building blocks of kerbside management systems with the capabilities to correctly identify when a vehicle was present (ie kerbside occupied), when a vehicle was not present (ie kerbside was vacant) and determine the duration for which a vehicle had occupied the space.

Transport Agencies had procured and installed several video-based monitoring devices to test each system's respective accuracy, efficiency, and ease of use.

OLD VS NEW

Some of the topic areas had been around since the beginning of ITS like freight and multimodality and we saw evolution rather than revolution. It was clear that connectivity from the edge to the cloud and back to the edge would be key to making data driven, actionable decisions. The storing, management and exchange of data will be paramount as technology proliferates and creates more and more data. The deployment of AI and ML had gained a higher profile and particularly safety at work zones. New emerging topic areas included: enforcement, kerbside management, electrification and quantum computing. Might automated enforcement become de rigeur or would we require AVs to explicitly follow every “rule of the road”? One topic not developed much was using predictive technologies though it was mentioned in a number of sessions.

Laura Chace, CEO of ITS America, welcomed delegates to the Round Table the aim of which was a cross-sector group of experts exploring the theme: equitable sustainability – building a resilient, socially just future through sustainable climate technologies. The focus would be on how infrastructure investment could advance our global climate goals, grow job access, and promote a more equitable future. There were around 55 participants drawn from 16 countries.

KEYNOTE ADDRESS

The session opened with a keynote address by Michael Berube, US Department of Energy who said that he wanted to focus on ways to decarbonise the Transportation sector. There were powerful drivers for this: the impact on air quality and sustainability as well as an impact, only recognised quite recently, on societal equity. It had to be stressed that the clock was ticking and we urgently needed to amend our practices to address climate change. We had to face up to the reality: transport was the largest source (33%) of CO2 and was also 50% of energy expenditure. We needed a practical-to plan to address the 33% and it was useful to break it down further:

- 30% light trucks
- 21%-passenger
- 21%- heavy and medium trucks
- 11% aviation
- 9%- off road
- 2%- rail
- 3% marine
- 3%- other (pipeline, military, lubricants)

Looking at the categories it had been estimated that the passenger vehicles and light trucks (51%) could be largely electrified. However this was impractical for the remaining 49% so different solutions were needed – direct approaches such as hydrogen and biofuels as well as indirect methods such as diversification. He noted that there was no single “Silver Bullet” to reach the policy goals, the DOE was looking at solutions that could be incrementally deployed to deliver real results by 2030. Solutions must in addition address life-cycle emissions and also be able to integrate effectively with grid and energy infrastructure.

He stressed that both the problems and the solutions impacted every part of the economy so multiple solutions were necessary. There were some very significant costs: in the USA Government investment would be at least \$100 Bn in Transportation Decarbonisation Federal Investments and the private sector was estimated to invest \$85 Bn in EVs and batteries.

Nationally work was under way on the design of a comprehensive Transportation Decarbonisation blueprint. This was involving a range of Government bodies: USDOT; DOE; EPA; Housing and Urban Development. The eventual solutions package would need to meet everyone’s needs and must also address diverse communities, be affordable, and contribute to improved environmental quality (Greenhouse gases, quality of Water and Air)

INTERNATIONAL PANEL DISCUSSION:

Michael Berube then moderated a discussion with a range of speakers to explore what were the top lessons learned to advance transport decarbonisation, electrification, sustainability, and resiliency? What actions worked? The panel comprised:

Angelos Amditis, ERTICO – ITS- Europe

Anna Roach, Atlanta Regional Commission

Karl Simon, US Environmental Protection Agency

Roger Millar, Washington State DOT

Veronica Vanterpool, US DOT Federal Transit Administration

The moderator asked panellists to give a brief summary of the actions that had worked from their Region. What were the top lessons learned to advance transport decarbonisation, electrification, sustainability, and resilience? What actions had worked from regions?

Anna Roach said that the problems varied hugely between cities and so the solutions varied and were not necessarily transferable. The Atlanta focus was on improving internal local services. Federal funding was available but needed to be used quickly as fashions for different solutions changed and with that the types of funding available. Atlanta preferred investments that offered multiple family benefits such as Carpooling schemes, enhanced transit and ensuring that job centres had linked with walkable/commutable travel options.

Veronica Vanterpool explained that the Federal Transit Administration was planning to invest over \$100 Bn for a programme led by decarbonisation. A high priority was extending electric transit buses from 2% to at least 4% of the fleet. She stressed the keynote speaker’s point about looking at transport and energy use together; and to that end a Joint office had been established by FTA and DOE to provide funding resources, webinars, technical assistance at all levels of government.

Karl Simon described the work of the Environmental Protection Agency which related to a number of transport sectors. Policies needed to be discussed and set against information on available technologies and their application but also an understanding of what people really needed

Angelos Amditis described a major programme of research and development work in Europe organised by the European Commission. Priorities were decarbonisation and making communities climate neutral, seamless travel supported by the Trans-European Networks and measures on cross-border standards, encouragement of MaaS schemes and the production of reference document to guide all aspects of mobility. The Commission was working on a revision of its ITS Directive and wanted all cities to make new plans setting out the services, systems, technologies, and innovation they would use to deliver sustainability, and resilience.

Roger Millar said that for many years both nationally and locally America had underinvested in transit so a powerful weapon against sustainability, and resilience could not be properly used. Many areas had no access to shared affordable transport and many areas were fighting road space congestion. It was necessary to move from commuting in personal vehicles on highways to using public transportation, rail, active transport modes and much better land use planning. In Washington State transit used 2% of space but carried 34% of people. The Federal government had made ill-informed land use decisions and needed to think broader. At a local level multi family units must be integrated with transport.

The moderator asked panellists for succinct statements on measures that could be taken to enhance equity. Anna proposed putting any applications to state authorities for funding schemes should be examined with an equity lens to see how well, or not, they scored. There were many under-invested communities who would not necessarily submit the best cases for funding so assessment of proposals needed to be sensitive. Veronica focused on assessment – having the tools to measure the extent to which what you were doing and the investments you were planning actually helped communities. Karl agreed and reminded that very often small projects could work quickly and effectively to make a real difference in communities. Angelos said that many of Europe's problems derived from a simple lack of space so traffic management needed to be improved to help everyone. Local government funding needed to complement private sector investments not compete; and every new building should have charging infrastructure for universal benefit.

BREAKOUTS:

Michael thanked the panel for their thoughts and explained that for the next part of the HLPRT there would be a division into 4 breakout sessions for delegates to dig deeper into key issues. The topics were:

1. Demand management/mode shift (Moderator – Lilly Shoup, Rebel Group)
 - a. Multimodal transportation options
 - b. Technology and policy solutions
2. EV Charging Infrastructure (Moderator – Chris Gearhart, NREL)
 - a. Common global standards
 - b. Sharing best practices
 - c. Role of Public vs Private Investments
3. Resiliency and the Grid (Moderator – Kara Podkaminer, US Department of Energy)
 - a. Solutions for building resilient infrastructure
 - b. Managing increased Grid impacts for transportation electrification
4. Equitable and Affordable Access (Moderator – Jannet Walker-Ford, WSP)
 - a. Charging availability
 - b. Vehicle Cost/Incentives

KEY POINTS FROM THE BREAK-OUT TABLES:

After around an hour's vigorous discussion the groups reported back the key points from their discussions as follows:

DEMAND MANAGEMENT/MODE SHIFT

- Policy makers needed to be flexible and adaptable; there was no one size fitting all
- Be clear on the (community) policy goals
- Shifting travel demand was sometimes simpler than trying to shift travellers' modes
- You needed to recognise the diversity of rural and urban landscapes; problems differed
- Think carefully about the sequencing and timing of the carrot and the stick – it would need a large carrot to make some 'stick' policies palatable
- Need to invest massively in alternatives before resorting to the stick.
- Balance the 'stick' on unwelcome modes with incentives for the preferred ones
- Policies and practice
 - Get information on all modes out to users (reliability, cost, etc)
 - Need options for communities to assess and choose
 - New policies would probably some need initial incentivising and supporting
- Payment and pricing were key. Look at transit from the customer perspective and have integrated payment; ideally a single integrated fare.

EV CHARGING INFRASTRUCTURE

- Projects needed political buy in from the highest levels.
- Need standards to insure interoperability across communities
- Need to provide education and consultancy on the best places to put chargers.
- Avoid putting high performance chargers where they would not be needed – people see them taking up space and going unused.
- From the beginning you need to monitor utilisation and for this you needed access to data.
- Make sure that if you provide grants there will be someone in charge that understands the city's technical needs.
- Need criteria beyond price for selecting suppliers and installers of chargers. Examples – response time when chargers are down, do they have their own response team or do they contract it out, what are their sustainability metrics.
- Rate structures were often too complicated; we needed a homogenous set of rates and regulations
- Service providers would take good locations, but also needed to take poor locations. Perhaps attach a condition to good locations or subsidise the poorer ones?
- Good standards; sharing best practice
- Setting down good decision guidelines (not automatically the lowest bid) when procuring
- Good metrics on service time, reliability
- Get Communities, providers, users involved in conversations to make sure you meet needs

RESILIENCY AND THE GRID

- Resilience capability needed to reflect local grid infrastructure and generating methods – wind and solar were intrinsically unreliable
- Need consistency in technical standards
- The system interdependencies in information systems were not well developed or understood
- How the changing/evolving business model for funding transportation needs to be discussed. That discussion should happen now.
- Consumers were unsure of the value proposition – we needed a clear statement at national level.
- Resiliency funding needed higher priority at state level and above.
- Improving both resilience and charging infrastructure sometimes needed a carrot and sometimes the stick of regulation
- Lower income areas tended to have a low percentage of EVs in fleets – were there ways to assist getting to commercial fleets
- Rural areas preferred trucks to EVs
- Need to diversify the energy grid with more renewable sources. Need ability for central demand management – particularly during disruptions. Managers needed to know what was happening – the “intelligence”. How could we introduce a structure for information sharing?

- Everything needs to connect. Systems needed to effectively communicate.
- Biofuels will be part of solutions but awareness and production are uneven.
- Get the mobility right, so services are attractive -----smart mobility
- Are we clear we know what we should we be telling utility companies?

EQUITABLE AND AFFORDABLE ACCESS

- Visible support from senior leaders was important
- Equity is a permanent task and not a one-off; it permeates all work. We were learning how to be better
- We needed to stand back and consider if we were providing transport options equitably
- Delivering equitable systems needed prior work on engagement and planning aspects
- A key task was getting communities to the table when planning was underway to get real users' assessments of the convenience and affordability of different options
- Try to get personal discussions on organisational challenges around equity as a sustainable issue
- Make sure you assess progress: how did we do vs plans ?. Did we meet our targets? Would you have us back?
- Apply equity inclusion tools to all projects from beginning
- There seemed to be resources to help relatively small numbers of disabled users but much less for overcoming the larger groups with language or education barriers
- Think about how you reduce the gap (trust issues, perceptions) make sure you are addressing people where they live and work
- Building organisational culture – so not wild shift if leadership changes
- Tell people what you have done
- Recognise generational differences and challenges.
- Learn from your mistakes.
- Try to encourage a little more grace in the communication sphere (social media)

CLOSING

Michael thanked all attending for their wise and varied contributions. The issues discussed were far from straightforward but they were an important element of Transformation by Transportation.



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