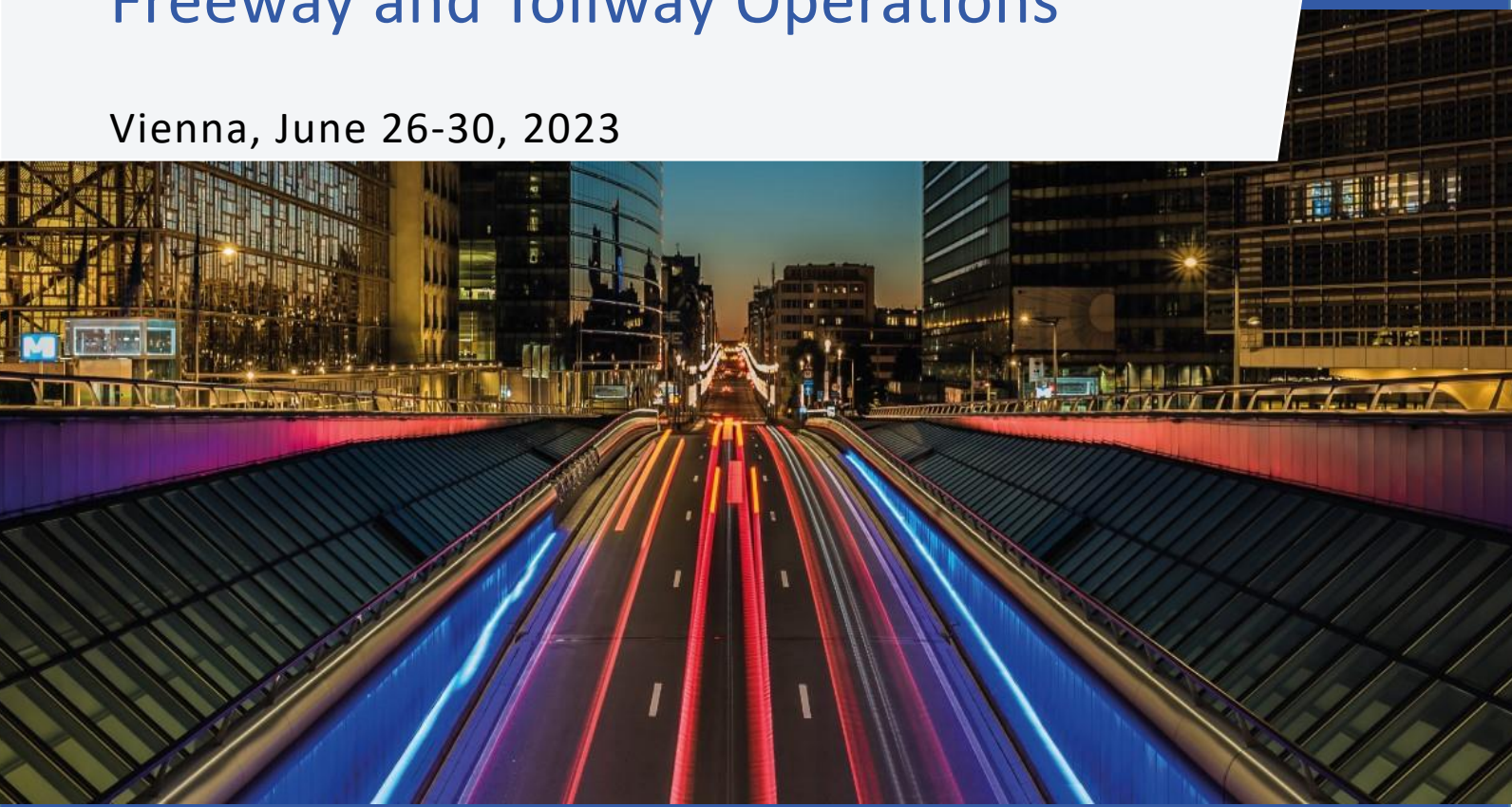
ISFO
4th International Symposium on Freeway and Tollway Operations

ISFO 2023 - Summary Report

4th International Symposium on Freeway and Tollway Operations

Vienna, June 26-30, 2023



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December 2023

The Future of Managing Traffic

The fourth International Symposium on Freeway and Tollway Operations was held from June 26 to 30, 2023, at TechGate in Vienna. The event brought together 320 experts from the transportation industry, government agencies, and research and development to discuss current issues in the mobility industry. The experts engaged in valuable discussions on important topics such as digital transformation in the transport system, data availability, and cooperation for greater efficiency along four conference-tracks. The inclusion of numerous students from around the world provided additional insights into their research work through posters and represented the younger generation on site.

Track A: `*Governance and Organizational Challenges*´

Track A focused on the challenges and responsibilities of governments and policy makers at the nexus of traffic management and climate change mitigation. The sessions explored opportunities within the domain of governance, with attention devoted to collaboration and data exchange for integrated mobility management. The discussions emphasized strategic corridors for harnessing the full potential of digitization and advocated for a holistic approach to traffic management in urban landscapes.

Track B: `*Managing and Analyzing Operational Strategies and Performance*´

There are several options to improve traffic management, including utilizing new technologies and methods, incorporating new data sources, and implementing innovative methods such as HOV, HOT, and reversible lanes. Additionally, sharing information with other systems and service providers to incorporate mobility services can also be effective. Traffic management during emergencies and severe weather, such as hurricanes and evacuation scenarios, is a crucial challenge. Additionally, post-COVID, road safety and traffic management will become even more critical as accidents and fatalities increase. Relevant topics include the digital twinning of traffic management systems and the use of artificial intelligence and machine learning to improve operations.

Track C: `*Next Generation of Traffic Management Systems and Services*´

Track C focused on exploring innovative technologies that affect the management and operation of highways and toll roads. Extensive discussions were held on key topics, including active traffic management/managed highways, artificial intelligence, and digital twins. The discourse also covered methods and technologies used in emergency situations, such as severe weather and pandemics. The conversation centered around advanced technologies, including digital twins, fleet management tools, and the strategic integration of artificial intelligence. These technologies aim to enhance the safety and resilience of the transportation system, even in the face of extreme challenges such as major events or severe weather conditions.

Track D: `Innovative Financing to Build and Operate Motorways´

Track D focused on the importance of innovative strategies in financing and allocating resources for investments, operations, and maintenance within the transportation sector. The aim is to secure adequate funds and provide effective options to achieve broader policy goals. The track-sessions explored how financing and pricing options could be strategically employed to address challenges such as congestion, climate change, safety considerations, and the evolving dynamics of public and private roles in project delivery. The track also addressed the diminishing financial contributions of fuel taxes, particularly in the context of the increasing use of alternative fuels.

A brief look into ISFO-history

The inaugural International Symposium on Freeway and Tollway Operations was held in Athens, Greece in 2006. Bill Halkias, the CEO of Attica Tollway in Athens, Greece, explains that as the hosting agency, they agreed to incorporate their European counterparts, including ASECAP and IRF Geneva, as well as IBTTA.

The trip to Greece for the Symposium was combined with a technical scan tour of the leading freeway operations efforts in Europe. This tour was supported and funded by FHWA and AASHTO. The Symposium, technical visits, and deliberations were instrumental in the concept of Active Traffic Management (ATM), which supports actively managing traffic on the main lanes of freeways.

The first TRB ISFO facilitated the research on ATM and related practices. Furthermore, it highlighted the implementation of various operational strategies, such as shoulder use, in the US, drawing from the experience and practices in Europe. To promote further research and the development of ATM concepts, TRB established the Joint Subcommittee on Active Traffic Management among several technical committees in 2009. The joint subcommittee collaborates on sharing practices, proposing research, and promoting information sharing within TRB through activities such as TRB panel sessions, workshops, and webinars. The Athens Symposium in 2006 was successful in engaging interests and allowing AHB20 to coordinate with other professional organizations on issues related to managing and operating freeways.

The success of the Athens Meeting prompted AHB20 to organize similar international gatherings periodically. As a result, only three years later, in 2009, the 2nd International Symposium of Freeway and Tollway Operations was held in Honolulu, Hawaii. Due to the success of this symposium, attended by people and organizations from all over the world, the third International Symposium of Freeway and Tollway Operations was organized in Berlin, Germany in 2016.

The idea of hosting an International Symposium on Freeway and Tollway Operations in Vienna took root in 2018 when the Transport Research Board approached ASFINAG, the Austrian Motorway and Expressway Financing Company, and AustriaTech, a company of the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation, and Technology, proposing a jointly organized conference in Austria. Subsequently, the organizing committee rapidly expanded to include many more partners from international organizations, underscoring the significance of the conference and garnering full support for its ambitions and goals.

Content

Preface

The fourth International Symposium on Freeway and Tollway Operations was an outstanding opportunity for transportation professionals to exchange experiences and innovative advancements in mobility management from across the globe.
Over 320 experts from 36 countries shared their knowledge, solutions, and experiences in addressing the challenge we all face to manage the transportation network in the best way possible to ensure safe, efficient, and sustainable mobility for all system users.
I was inspired by the breadth and depth of information offered in the program. True to its origins nearly two decades ago in Athens, Greece, the ISFO brought together international experts, transportation professionals, academics, industry leaders, and students to discuss how we are all addressing mobility challenges and how we can be part of the future of mobility management. The unique opportunity to interact on a global level can help advance innovative solutions that we might not have thought of before because we had the opportunity to engage with each other at the fourth ISFO.

Beverly Kuhn
Texas A&M Transportation Institute|
The Texas A&M University System

ISFO 2023 takes a human-centric approach to advance traffic management, aiming to adapt future mobility to evolving demands rather than solely relying on the introduction of new technologies. Despite advancements in safety tools, safety remains a critical driver for implementing new solutions, as evidenced by the `traffic safety crisis´ in the United States. Even with improved tools and safer cars, the trend is moving in the wrong direction.

The conference emphasizes environmental responsibility and highlights the significance of traffic management in reducing energy consumption per passenger and freight kilometer. Further, it stresses the need for innovative mobility services and fleets including electrification.

Measuring the benefits and efficiency of traffic management plays a central role. It is important to evaluate success from multiple perspectives, including those of customers, society, and value for money. This is especially crucial in the context of new solutions and future transport scenarios.

In this regard, optimizing organizational structures is essential. Enhanced collaboration between operators and industry/service providers is required, which can be achieved by establishing interoperable standards for operation, as well as leadership and workforce development.

Next generation infrastructure and services require also new ways of financing and funding. Traffic management should not be treated as an add-on but should be deeply integrated into investment strategies. A holistic approach is necessary to make traffic management an essential element in shaping the future of transportation.

Martin Russ
Managing Director
AustriaTech

1. The Conference Tracks

1.1. Track A - Governance and Organizational Challenges

Track A provided a substantial path planning for the mission of delivering `directionality´ towards common goals for all relevant stakeholders in traffic management. In addition, the governmental roles need to be redefined and reconsidered, to face future challenges and force the necessary solutions.

Session 1A focused on collaboration and added value in traffic management, highlighting challenges in effective collaboration between public authorities and service providers. Notable challenges included sharing temporal/conditional traffic management measures and addressing policy differences across different jurisdictions. Ongoing research presented a positive example of reducing evasion traffic through data use and legal adherence. The session discussed non-research actions such as translating legal rules into digital services and leveraging Millennials' openness towards collaboration. It emphasized the enabling role of Real-Time Traffic Information (RTTI) in large-scale Public-Private routing collaboration, using positive incentives. Additionally, it recognized the importance of sharing data without specific expectations as a form of collaboration.

Session 2A discussed the challenges of meeting user and operator needs in traffic management. The challenges identified included balancing customer optimization, ensuring reliable map alignment, and maintaining consistency in Traffic Management (TM) policies. Ongoing research has shown the benefits of public-private collaboration, as demonstrated by a feasibility study in Finland's Oulu region. Recommended research should focus on fundamental aspects such as road closures and data-driven quality monitoring.

Workshop 4 emphasized the importance of collaboration and understanding for effective Traffic Management. It addressed key gaps in mobility management and highlighted the shift from car management to mobility network management. Ongoing research showcased the integration of National Access Points (NAPs) in Dataspace and Mobility as a Service (MaaS). The workshop also highlighted impressive collaboration between the Austrian VAO platform, MaaS, Navigation providers, and Road authorities. The workshop suggested advocating for the Mobility Data Space (EU) and early collaboration between transport operators. It is recommended to harmonize Key Performance Indicators (KPIs) for integrated mobility management.

Workshop 5 focused on optimizing scarce infrastructure by proposing the digital allocation of truck parking bays based on departure times. The workshop concluded by emphasizing the expected increase in curbside management in logistics domains and the need for effective slot management through collaboration along the logistics chain.

Workshop 17, `Traffic Management and Climate Neutrality´addressed the need to quantify the climate impact of traffic management. Ongoing research is being conducted to cover EV grid impact and emissions monitoring. Recommended actions include aligning measurement methods and anticipating EV charging demand for grid planning. The workshop emphasized the importance of accurate measurement for quantifying emissions, potential stress on electricity grids due to EV charging, and ways to reduce carbon emissions.

Session 3A explored innovative methods for sharing data, highlighting challenges related to data standards and access points. The session concluded by noting the availability of data-sharing platforms but emphasized the need for alignment and data source availability.

1.2. Track B- Managing and Analyzing Operational Strategies and Performance

The latest of operational strategies for managing freeways and toll roads have been investigated. Various management methods were discussed and analysis of the strategies and their performance was conducted. During this track, the latest strategies and performance for managed motorway, management during emergencies, post-covid management, digital twinning and the utilization of artificial intelligence for freeway and tollway operations was addressed.

Track B explored advanced operational strategies for effectively managing highways and toll roads. The sessions within this track cover a range of topics, each addressing specific challenges and opportunities in traffic management.

Session 1B dived into the latest advances and emerging technologies used for managed motorways (also known as active traffic management or ATM). Presenters shared insights on implementing advanced strategies and utilizing sophisticated technologies and data sources.

Session 2B focused on traffic operations during emergency and severe weather events. It discussed how agencies handle critical situations such as hurricanes, snowstorms, earthquakes, hazmat spills, and evacuations. The session provided valuable insights into the actions and systems implemented by public agencies to respond to these challenges.

Session 3B discussed post-COVID safety management, examining the rise in accidents and fatalities despite reduced traffic volumes. The panel investigated policies, strategies, and technologies used to address these issues, providing valuable lessons for future similar situations.

Session 4B discussed the concept of digital twinning for the future of freeway and tolling operations. This involves creating a virtual replica of physical objects, systems, or beings for testing and development purposes. The session explored possibilities for designing and operating freeways and tollways by leveraging digital twinning.

Session 5B focused on the use of Artificial Intelligence (AI) for freeway and tollway operations. It delved into the application of AI technologies, including basic AI, machine learning, and deep learning, in improving operational systems. The topics covered in this text included the utilization of cloud-based AI tools, predictive algorithms, machine vision, video analytics, and event prediction.

Track B was complemented by three workshops.

Workshop 7, titled `Intelligent Asset Management´, emphasizes an information-driven, integrated, and sustainable approach to managing traffic infrastructure. It discusses the importance of understanding assets in-depth and choosing the right combination of data, sensors, and tools for effective decision-making.

Workshop 11, `Benefits and Challenges for Integrating Fleet Operations and Traffic Management´, examined the possibility of a cooperative approach where decisions in one field directly influence decisions in the other. It identified stakeholders, branches, and potential scenarios for integrated fleet and traffic management.

Workshop 18, `Managing Traffic for Planned Special Events´, focused on the challenges and strategies involved in maintaining transportation system safety, mobility, and reliability during planned special events. The workshop provided insights into managing travel demand, capacity constraints, travel choices, parking demand, and pedestrian flow. It reviewed proven strategies and presented the state-of-the-art in effective transportation system operations for such events.

1.3. Track C – Next Generation of Traffic Management Systems and Services

The next generation of agencies traffic management systems (TMSs) and their operations centers (TMCs) offer the potential to improve safety and mobility. To achieve these goals, it is important to build and maintain the support and resources needed to enhance services, plan and pursue improvements, and develop a strategic direction and chart a path to prepare for the next generation of the agencies TMS. Opportunities continue to emerge for agencies to improve the capabilities and performance of their TMSs by taking advantage of new technologies, advances in telecommunications, and new and emerging sources of data generated from connected and automated vehicles (CAVs), travelers using connected devices, and service providers.

The sessions emphasized the potential advancements in Traffic Management Systems (TMSs) and their operations centers (TMCs) to enhance safety and mobility. Agencies were advised to secure support, resources, and strategic direction for the next generation of TMSs, with opportunities lying in leveraging new technologies and data sources. Ongoing projects aim at continuous improvement, emphasizing the importance of adequate resources.

The discussion highlighted the need for agencies to understand the capabilities and performance of TMSs to address issues related to strategic direction, planning improvements, and resource allocation. Opportunities for improvement involve leveraging new technologies and data sources, such as connected and automated vehicles, to enhance existing TMS capabilities. Challenges include the lack of formal assessments for TMSs and the need for strategic planning.

Key challenges identified include insufficient resources for TMS assessments, the absence of multi-year plans, and difficulties in sharing and using data from external sources. Challenges in managing TMS assets include limited inventories and difficulties in determining data needs and asset conditions. Recommended research topics span assessment applications, strategic planning, data integration, and asset management.

In summary, ongoing research and initiatives are addressing critical aspects of TMS to enhance capabilities and performance. Collaborative studies explore emerging topics, asset conditions, and effective information sharing. FHWA initiatives focus on assessments, strategic planning, and data management. Challenges in TMS operations and asset management were identified, emphasizing the need for strategic planning, multi-year plans, and resource allocation for the continued evolution and optimization of Traffic Management Systems.

» It was fascinating to learn on the different approaches in US and Europe for tackling challenges in technology, on system level but also in society. There is a huge potential to learn from each other! «

Wolfgang Ponweiser, Senior Research Engineer AIT – Austrian Institute of Technology

1.4. Track D – Innovative Financing to Build and Operate Motorways

Track D explored different approaches in project finance involving public or private partners, congestion pricing to promote reliability and efficient use of the transport system, distance-based pricing to address declining motor fuel tax revenue, safety considerations on priced roads, and how pricing and financing decisions contribute towards net zero emissions goals to meet the global climate imperative.

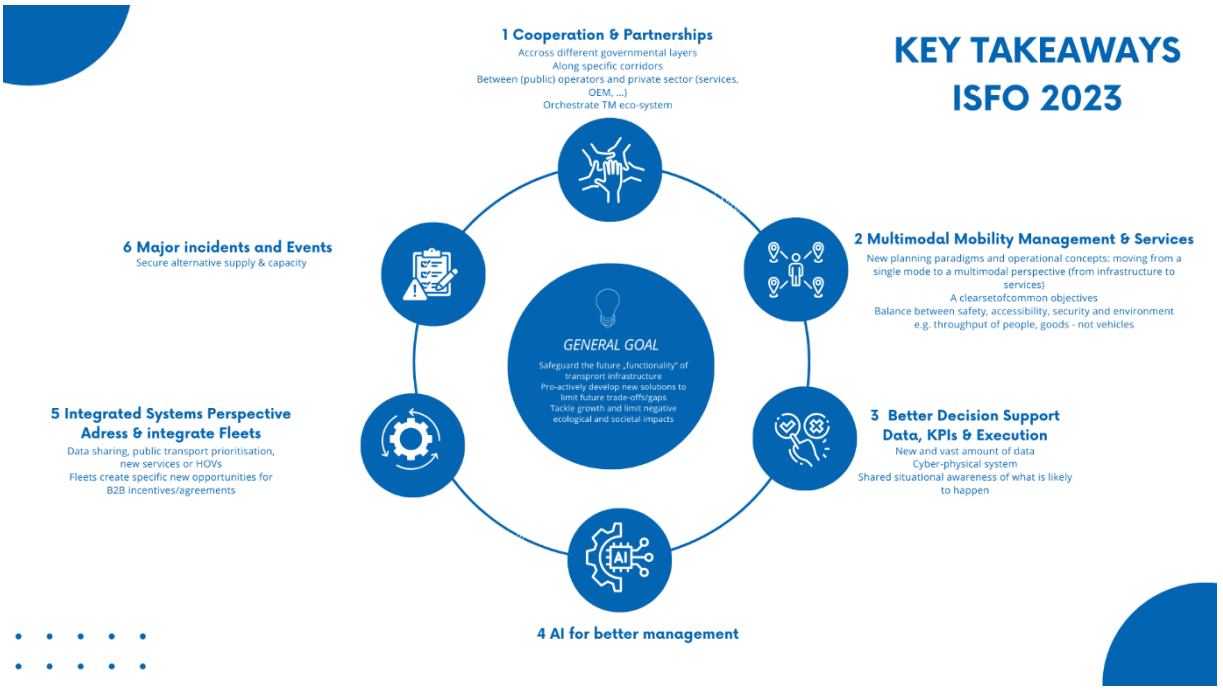
» (...) The symposium provided a platform for leaders from 36 different countries to collaborate and discuss opportunities to collectively pursue research and deploy innovative practices to advance the use of operational strategies, traffic management methods, and techniques to improve the safety, mobility, and convenience of travelers on Freeway and Tollway facilities around the globe. «

Jon Obenberger, Senior Transportation Research Engineer, FHWA

2. Six Key Themes for the Future of Traffic Management

Six themes emerged as particularly important from the discussions and presentations at the conference. This text provides a brief overview of the current status quo, potential next steps towards scaling up implementation, and the opportunities they create for improving traffic and mobility management.

Key Takeaways ISFO 2023, AustriaTech



2.1. New collaborations and partnerships

Collaboration was a central theme discussed and emphasized during ISFO2023. It is essential to achieve a clean, safe, and efficient mobility system. However, it should not remain just a metaphor. To put collaboration into practice, we must be aware of the various forms of cooperation, which are required to manage our transport system effectively:

- In many cases, traffic and mobility do not occur along a single corridor or network, or using only one mode of transport. Therefore, cooperation between the involved network operators, public transport operators and public authorities is necessary, to combine the strengths of the individual systems into an optimized comprehensive mobility system. This applies to major corridors as well as local systems.
- In the past decade, various new mobility solutions have emerged, including sharing and micro mobility. Electric mobility is on the rise and offerings are being consolidated into Mobility-as-a-Service-platforms. In addition, information and navigation solutions are influencing people's choices and behavior. Cooperation between public infrastructure and transport service providers and private solution providers is crucial not only to enable new services but also to add value to all partners. To fully realize their potential new forms of integration into the mobility system necessary to avoid rebound effects.
- Mobility is closely linked to other sectors, such as energy supply, e.g. for charging stations for electric vehicles. Therefore, it is crucial to collaborate with stakeholders outside the mobility sector to align the systems and reduce negative effects in other sectors.

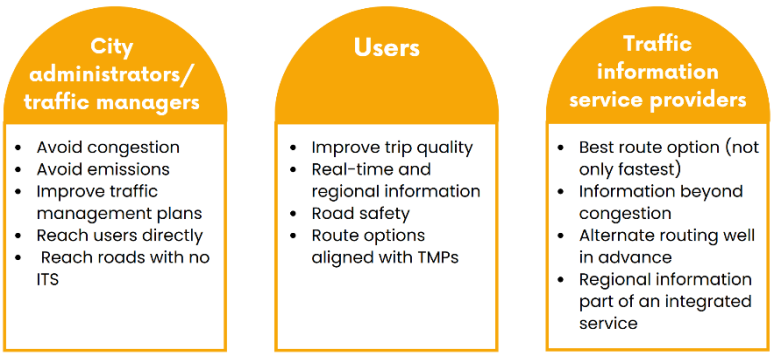
Each stakeholder group has distinct goals. Understanding the objectives of the other involved stakeholders is a critical first step in developing common solutions. The symposium was an opportunity to discuss different approaches to collaboration and mutual learning

Under the leadership of the American Association of State Highway and Transportation Officials (AASHTO), three `pillars´ have been developed over the past decade to collect and share knowledge about TSMO (Transportation Systems Management and Operations). The first pillar is the figurative `library´, the National Operations Center of Excellence (NOCoE), where current research, case studies, and papers on transportation are first reviewed and made available. The second pillar is the `classroom´ - the Regional Operations Leadership Forum, or ROLF, which focuses on the continuing education and training of `true champions´ in the field of TSMO. The third pillar is the Transportation Operations Manual (TOM), a compact summary of transportation systems operations designed to help manage what is already in place, such as existing infrastructure, more efficiently.

Three Pillars of Transportation Systems Management and Operations, December 2023

In Europe, the Traffic Management 2.0 platform (TM2.0) was initiated by ERTICO in 2014 to bring together stakeholders from the entire traffic management value chain, including public authorities, associations, research, suppliers, service providers, and TTI. The goal is to achieve mobility network management through collaboration, trust and co-opetition, which combines cooperation and competition depending on the specific aspect. A concept that benefits all parties involved (city administrations/traffic managers, user and traffic information service providers) should be implemented to ensure a long-term cooperation between mobility stakeholders. Annual task forces and the exchange of best practices in traffic and mobility networks are key topics. For more information on the TM2.0 platform, visit https://tm20.org/

TM20 - benefits for stakeholder, TM-2.0-brochure-2023, December 2023



Although the importance of cooperation is widely acknowledged and there are numerous efforts to achieve it, challenges persist. Conversations regarding cooperation are often only superficial, which is unsuitable for actual agreements and effective collaboration. Delivering deeper into the matter increases the complexity and, as a result, the necessary resources. Next steps to address these issues include reducing complexity by implementing good practices and making the potential and benefits of collaboration more visible and quantifiable:

- Intensify the possibilities for `shared learning and knowledge´ e.g. by providing a more detailed account of specific implementation projects, such as Socrates 2.0. This will result in a catalogue and framework for classifying collaboration benefits along specific use cases and contractual schemes for different stakeholder groups
- Intensify collaboration between TSMO and TM2.0 on regular basis, for example though common workshops and seminars, to leverage the different approaches of the two networks (work with good practices as done in TM2.0 and give clear guidance with regard of common standards and frameworks as in TSMO).
- Make results and learnings transferable to similar scenarios or other locations
- Develop a holistic perspective on trust, encompassing technical, regulatory and governance aspects as a key requirement for cooperation.
- Develop new concepts for private-public partnership to harmonize physical, digital and organizational infrastructure.
- Create clear evidence of the benefits of these new partnerships and along pilot implementations for future-proofed multimodal and resource-efficient transportation system e.g.
- This includes slot and access management in freight transport,
- alignment of transport and energy management
- Service 1st – Service priority on networks to shift and avoid peaks.

  In order to ensure the ability to assess and monitor the effects of solutions, it is necessary to agree on aligned measures and benefits. This requires the appropriate selection of Key Performance Measures (KPIs) and the availability of tools as described in the section on Artificial Intelligence (AI).

2.2. Multimodal Mobility Management and Services

Urban areas are a specific focal point for future traffic management systems. They must address urban mobility needs and ensure the productivity of our economy, also considering environmental concerns.

- A comprehensive situational awareness is pivotal for the development of services and operation of these systems. Improving the interaction between various stakeholders is essential to gain a comprehensive perspective based on all available data.
- Collaborating with private data providers can help avoid fragmented solutions and providing efficient services.
- The biggest challenge in urban mobility management is in finding an appropriate balance between holistic setups, which can be complex, and delivering significant results and benefits. Cross-modal and cross-network solutions should focus on specific areas, corridors, or target groups to develop and address clear targets. This approach could enable stakeholders to reach clear agreements.

» Providing true positive impact all starts with the willingness to engage with each other, being aware that we are all part of a wider ecosystem of mobility, and that only together we will be able to work towards truly safe, clean and effective mobility systems «

Jop Spoelstra, Innovation Program Manager at Technolution

The Socrates 2.0 project demonstrated the complexity of decision rules necessary for real implementation. A workshop dedicated to the topic of environmental zone management discussed data exchange and digital solutions for implementation. In Europe, the "Urban Vehicle Access Regulations"

(UVAR), restricts access to specific areas of the city for certain vehicles or emission types, limiting pollution in that area, ultimately making urban areas more livable for everyone. One challenge is to facilitate access to all vehicles registered in Europe, regardless of the owner's country of residence. Another important aspect of making dynamic UVARs effective for traffic management is to mandate the use of digital messages, such as C-ITS messages. However, achieving this goal will require significant effort.

In the future of urban mobility, a transition from traffic management to mobility management is necessary. This is a shift from managing volumes of vehicles to managing travelers and goods. The task is to balance the need to travel from point A to B with certain constraints (such as arrival time) and preferences (such as price, travel time, comfort, safety…) while considering available capacity and utilizing a multimodal optimization approach. This becomes even more complex when considering the entire automated. Multi-modal and multi-actor mobility offer.

For the next steps, it is important to consider the following aspects:

- Consideration of all road users, particularly vulnerable groups
- Initiatives such as parking sharing, time slots, and pedestrian zones should be taken into account.
- Embrace Urban Vehicle Access Regulations (UVAR).
- Keep the complexity of the required decisions in mind. Implement simple steps whenever possible.

2.3. Data Competence and Decision Support

As in many other fields and industries, data plays an enormously important role in transportation and mobility management. Data is the basis for almost all services and solutions, such as development and planning of traffic management solutions, operational decisions based on situational awareness, monitoring of impact, maintenance, and - one of the most important aspects – providing complete information to users. However, there are still several issues to be solved, such as:

- There is a huge amount of data already available today, but sharing it is still one of the major challenges. There is a strong lack of willingness to share data, legal obligations to share certain types of data are already being discussed, for example through the European ITS Directive.
- The required data quality depends on the service and purpose it is used for, particularly it is difficult to indicate data quality when data from different sources are combined (e.g. data from vehicles directly, OEMs, fleets, navigation systems, traditional sensors, social media). Some applications, such as the evaluation of long-term effects especially require stable data sources over a long time.
- Missing business cases for some of the applications and avoiding dependencies on a single data source. One of the main questions is how to spend the budget on the best option.
- Privacy and data protection issues have to be solved in a way that user data is protected and applications are facilitated as much as possible.

» This event has been an excellent opportunity for trans-continental opinion exchange on probing questions of road safety and modern traffic management. Pointing out major challenges like accident prevention, Vision Zero, climate change mitigation, and the preparation of highways for automated driving, it underpinned the crucial role of Intelligent Transport Systems in handling such challenges. «

Richard Neumann, Senior Manager Communications and Events at SWARCO AG

Discussions on data aspects were held in numerous sessions. In EVIS.AT the Austrian framework for the creation, provision and exchange of comprehensive and harmonized real-time traffic information data of all federal states, police, ÖAMTC and ASFINAG (motorway operator) as well as Cities (tools and agreements) has been set-up. It is the basis for traffic management and analytics as well as for end user

services. EVIS provides traffic data for the whole Austrian road network – and could be seen as important international reference.

European Transport Ministers, the European Commission and several industry partners established the Data for Road Safety Collaboration. The aim is to improve road safety by using safety related data generated by vehicles and infrastructure. Evaluations of ASFINAG showed that a 14 min. latency reduction in incident detection (compared to information received via other channels) is possible. Together with C-ITS information received from Cooperative Awareness Messages sent out from vehicles a much more comprehensive information on the situation on the road is achieved. ASFINAG is in the mid of a large scale C-ITS deployment, where 525 C-ITS road side stations will be deployed until 2025, which means one road side unit every 4km. Use Cases as road works warning, emergency vehicle approaching or stationary vehicles are already operational.

The Florida Department of Transportation has set-up a V2X data platform, which inquires data from connected vehicle devices, ITS devices and from third parties and allows data to be shared between data systems and users. The Indiana- Department of Transportation uses connected vehicle data as an important source for identifying hot spots on its network to better localize maintenance and improvement measures.

The NAPCORE Community in Europe is working under a dedicated EU funding line in order to coordinate and harmonize the structure of National Access Points (NAPs) in the EU, through which multiple sets of data from multiple sources can be accessed by any interested stakeholder. This is the largest cooperation scheme of mobility data platforms in the world and it is led by National Ministries for Transport in Europe. At the same time, the private sector is being requested to provide and make use of data offered in the NAPs while adjusting its business models accordingly. Experiences and best practices from different countries, the potential for complementarity in activities that the various data sets offer and the potential that data offers for further innovation have been discussed in a dedicated session.

Important next steps are:

- Further work on a "data ecosystem" in which private and public stakeholders collaborate and make data available in an efficient way – go Data-Space!
- Identify and integrate the demand side – understanding user needs and patterns are key to influence choices and behaviors
- Improve the utilization and quality of data as basis for decision making and also regulatory decision, e.g. environmental data; Integrate medium/long-term assessment perspectives
- Look into additional data sources (weather, events, …) which help improving a common situational awareness (towards decision making, building scenarios, …); This could also help emergency responders in case of incidents and accidents
- Integrate multimodal data and information to improve decision making and create complete information for the user

2.4. AI in Transportation and Infrastructure management

Artificial Intelligence, including basic AI, machine learning and deep learning are in common use today and are increasingly taken up in the transportation domain, e.g. automated mobility services and vehicles or navigation applications. We are on the edge `from applied AI to applying AI´, and AI solutions show a great potential to improve traffic management effectively.

AI will deliver three different key functionalities: extract data more accurate and timely, fusion of data sources and better reasoning and decision support. But at the same time, AI will also bring great challenges to the transport community - New data, at new speed, in a tremendous amount!

There are several areas where AI applications can substantially improve the current status, e.g.:

- The amount of available data is increasing. This huge amount of data is to large to be digested with traditional techniques. AI applications are used for handling high volumes of data including fusion of data from different sources and of different quality.
- AI tools are used for object detection and tracking and therefore facilitate new infrastructure support services, such as supporting automated and connected vehicles or better management of infrastructure due to a more detailed knowledge on what is happing at specific locations.
- In a multimodal mobility management scenario across single networks and modes the estimation of impacts and so the significance of strategies and tactics is limited. AI is used for prediction and for decision support in complex situations. Ideally, traffic events are anticipated before they occur, and measures can be set and communicated adequately.
- Understanding the behavior of people, so the reasons for their decisions and demand is prerequisite to provide high class and quality services, which are accepted and beneficial. AI solutions have the potential to better understand and address specific user needs and wants.
- Maintenance can be carried out in a more efficient way by improved sensing and prediction.
- Traffic safety hotspot can be more effectively identified by the fusion of several relevant datasets

One example presented at the conference was a solution for a traffic light system based on microsimulation and deep learning, which is able to optimize traffic over several intersections. The system was compared with the currently implemented and showed considerable better performance in cases of low and medium traffic volumes.

Another example presented was how several different parameters as street layout, traffic density and vehicle types or weather situation can be combined to the real-time risk and hazard information.

An exciting project from Virginia, USA, is `RM3P´ - Regional Multi-Modal Mobility Program. One of the goals of this project is to improve safety, reliability and mobility itself through AI. One tool of this project is the `AI-Based Decision Support System´(AIDSS), which monitors the transportation network using travel data and estimates the impact of a disruption to the transportation system. When an event occurs, it provides plans for coordinating the situation and inter-agency responses to congestion, accidents and incidents.

Key areas for AI use and future activities are:

- A new level of `situational awareness´, by fusing data from multiple sources in real time to detect events and understand problems in (near) real time
- Understanding demand and how to influence decisions
- Prediction of impact of measures and events and provision of decision support
- Improving safety, reliability and accessibility and capacity
- Enabling the management of new infrastructure (planning, construction and operation)
- Facilitating the handling of the increasing amount and speed of data and information and contributing to the understanding problems in (near) real time
- Future data will comes in „Real real-time´ - this means faster and more effective feedback and re-calibration possibilities.
- It will be crucial to understand and frame the problem right…
- Explainability of results and establishing confidence in the applied methods (inc. empowerment of road users)

2.5. Integrated Transportation Systems

In our current transportation system, many problems such as congestion, pollution or safety are present. There is considerable potential for improvement of the overall system if the different elements and means of transportation are combined. Several areas need to be addressed:

- Traffic management is often carried out only within one network or mode of transport. As traffic does not end at the boundaries of one network, it is important to implement solutions beyond single modes or networks. They need to be integrated to facilitate a cleaner and more efficient transport system.
- The transport system is used by different actors, like individual persons, operators of public transport fleets or private companies operating logistics fleets. Their behavior influences the transport system and they have different requirements towards the transport system. Currently there is only a vague alignment between fleet operation and traffic management. In addition, the integration of automated vehicles is a key element for future traffic management solutions to sustain a clean and efficient transport system.
- In order to take decisions and agree on cooperation between different authorities and public and private operators the impact and effectiveness of measures has to be monitored by standardized KPIs.

» When we talk about traffic management, there are various goals. For example, reducing congestion aims to reduce emissions. This in turn has a positive impact on the economy, as time otherwise spent in traffic jams can be used for more productive activities, which pays off for the well-being of every individual. These arguments for proactive traffic management should also be planned for by the authorities from the outset. It is therefore important to bring all stakeholders to the table to jointly address the issues at hand. Innovation does not take place in silos, but through the exchange and combination of knowledge across the industry. «

Carolin Treichl, Executive Vice President of EMENA Region at Kapsch TrafficCom

Since the requirements towards the transport system depend on the respective stakeholder group, it could be more beneficial for group if their specific needs are taken into account individually than if all stakeholder groups receive the same share as it is often the case at present. Addressing the needs specifically, could also increase the acceptance of measures and so facilitate new management methods. Workshops have been dedicated to the topics of integrating fleet operations and traffic management and on implementing connected and automated logistic solutions into the overall traffic management as well as on the efficient use of scarce infrastructure.

One of the first steps in integrated mobility management is integrated mobility information. An integrated mobility information has been realized in the Austrian Multimodal Traffic Information Platform VAO. The platform provides Austrian-wide information for all modes of transport (Public Transport, Individual Transport, Bikes and Pedestrians, Sharing and all combinations) of high quality and in non-discriminating ways.

Several options to support public transport and private ride sharing on motorways have been presented and discussed by the Austrian motorway operator ASFINAG. They have set up a network of park and ride facilities along their motorway network, which are well utilized, and are investigating options to include public transport.

The combination of traffic management and Moblity as a Service can be used to meet the needs of individual users while guiding users to minimize the impact of traffic and use infrastructure and assets effectively and efficiently. To achieve this, options with benefits for both sides - MaaS and traffic management - need to be identified. The foundation for this is understanding users and their needs. Possible applications include incentives for carpooling and public transport (targeting commuters), an integrated view of charging and the grid (targeting electric fleets and vehicles) or providing insights or priorities for active mobility and guiding VRUs (targeting active mobility).

Measuring the impact of the measures taken is essential for a functioning mobility management and a possible optimization. This should be supported by standardized KPIs that make it possible to monitor the effectiveness of the measures taken. The balance between KPIs from the mobility area and relevant KPIs from other areas (e.g. energy area) is extremely important. It was also emphasized in the workshops that KPIs must be selected in a way that they are suitable for highlighting conflicts.

The following steps are important:

- Monitor the effectiveness of the measures taken, by standardized KPIs
- Scenario selection is critical: identify conflicts with wider/non-mobility aspects and select suitable KPIs
- Investigate how a system can be adapted flexibly to specific priorities
- Understanding of the needs of the involved stakeholders, particularly end-users
- Cooperation with fleet operators to optimize traffic management decisions and outcomes. Align operational decisions with those of fleet operators who send thousands of vehicles on the road every day with near-perfect internal traffic management.

2.6. Managing severe weather and major incidents and events

Significant events refer to external factors that disrupt typical transportation system operations and safety, such as severe weather (e.g. hurricane), natural disasters (e.g. flooding) and planned events (e.g. Olympics). The year 2023 has already been marked by severe weather disasters and events, such as wildfires, heat records, floods, landslides, rock falls, storms and hail, which destroyed crops, homes and infrastructure. Transportation system operators and government agencies must respond to these events to manage crises and keep people safe, especially through early warning systems and to ensure mobility of people and goods.

Major challenges in this area are:

- Cooperation and coordination of the various stakeholders involved and particularly considering transportation agencies in planning of procedures for emergency cases.
- Unpredictability of major incidents and to some extent of severe weather events.
- Communication of measures to traffic participants and to reach those who have not started their trip.

During the conference, examples and good practice have been provided for extreme weather events, for major incidents and for major events. For the Olympic Games in London 2012 demand management via communication campaigns was combined with active traffic management to optimize the supply side. During the Olympic Games in Athens 2004, amongst other measures, coordination between all transport operators was achieved and public transport was operated 24 hours. The measures were successful at both sites so that mobility of passengers and goods was maintained even during the challenging conditions during these major events.

The conference highlighted collaboration with private navigation service providers, especially during major events or accidents. In addition, public relations and active communication management to control traffic flow should be an integral part of modern traffic management. Since such severe weather events are expected to occur more frequently in the future due to climatic changes, traffic management must definitely be considered and included in disaster and civil protection plans.

Cooperation between the different actors can help prepare their own disaster and civil protection plans for situations that have not yet occurred in their own area of responsibility. Examples for such cooperation include the shared expertise of Houston and the Texas department of transportation, who shared their experience in managing hurricanes.

Key next steps are:

- Combine data from different areas to provide a basis for prompt and coordinated actions
- Traffic management as a resilience tool
- Establish a close cooperation with emergency responders
- Consider traffic management in disaster and civil protection plan
- Public relations and active communication management to control traffic flow
- Intensive collaboration with private (navigation) service providers

3. Technical Tours

The Technical Tours formed the side program of the conference offered participants the opportunity to visit innovative projects and key institutions in the field of (intelligent) transport planning in Austria.

3.1. City Intelligence Lab – An interactive digital platform for urban and mobility planning

During the Technical Tour, AIT Austrian Institute of Technology demonstrated the capabilities of integrated digital urban planning in the City Intelligence Lab (CIL). The CIL is an interactive digital platform that explores innovative techniques for future urban development practices. Functioning as an incubator for intelligent solutions, the CIL encourages the collaborative creation of digital urban planning workflows. It uses augmented reality, interactive design interfaces, mobility simulations, generative design, and artificial intelligence to facilitate advanced urban development processes.

» The City Intelligence Lab technical tour highlighted the seamless integration of AIT's expertise in energy systems, climate modeling, and mobility into early-phase planning processes. ”

Stefan Seer, Competence Unit ´Digital Resilient Cities”, AIT Austrian Institute of Technology, Center for Energy

The City Intelligence Lab (CIL) facilitates the use of complex data for critical urban and transportation planning decisions, and offers new planning experiences through AI, such as rapid urban planning prototypes. The AI-driven urban planning framework combines real-time simulation prediction and generative design, allowing for the exploration of large design spaces and serving as a powerful decision support platform. The exhibit demonstrated the lab's capacity to meet the requirements of citizens, city authorities, real estate developers, and various urban practitioners.

The CIL conducts cutting-edge research on urban resilience, generative urban design, environmental modeling, transport simulation and prediction, as well as collaborative and participatory design. To ensure scientific excellence and practical application, a board comprising representatives from the private sector, academia, and the municipal sector reviews and contributes to the lab's agenda.

At the technical tour, AIT Research Engineers demonstrated the CILs capacity for developing more effective traffic management measures building on an interactive platform that integrates advanced technologies and data-driven approaches and provided insights into the future of urban planning and facilitating collaboration among diverse stakeholders.

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The technical tour provided attendees with an immersive introduction to computational planning workflows, highlighting their interactivity, immediacy, and versatility. Real-time demonstrations

showcased the application of AI and hybrid tools like Augmented Reality for co-creation, emphasizing their adaptability across different scales and fields. Participants had the unique opportunity to actively engage with the tools, gaining hands-on experience, and reflecting on the demonstrated workflows for potential applications in their respective fields.

» Through a combination of physical and digital interfaces, the City Intelligence Lab is dedicated to enhancing tool accessibility, fostering inclusivity, and encouraging collaborative urban planning. The demonstration showcased AIT's innovative generative, simulation, and evaluation toolbox within co-creative workflows. «

Viktoria Sandor, Competence Unit `Digital Resilient Cities´ at AIT Austrian Institute of Technology Center for Energy

AI-based modeling, such as that enabled by CIL, will add great value to transportation planning. Well-founded simulation environments will significantly increase the predictability of traffic movements in the future and thus supports the adaption of TM measures to individual behavior and incidents.

3.2. C-ITS Tour to the ASFiNAG Traffic Management Center

The ASFINAG, in collaboration with Yunex Traffic and Kapsch, organized a Technical Tour to showcase the progress and implementation status of Cooperative Intelligent Transport Systems (C-ITS) in Austria. The tour included ten C-ITS-enabled vehicles and headed to the Traffic Management Center (VMZ) of ASFINAG in Inzersdorf. During the demonstration, a new traffic safety service was showcased. This service sends C-ITS messages directly from the road to the vehicle, providing information about construction sites and traffic disruptions due to accidents. The information is displayed in the cockpit, allowing participants with C-ITS-enabled vehicles to react more quickly to traffic disruptions, even those not yet visible to them.

» At ISFO2023, we presented the latest V2X applications together with our industry partners and showcased one of the most advanced traffic management centers in Europe. The international community was able to experience our digital road infrastructure services up close on the highway in the latest vehicle models and gain deep insights during tours and demonstrations at the Inzersdorf highway maintenance facility. Together we are shaping a safer and connected road transport future. «

Jacqueline Erhart, Program Manager for Cooperative, Connected and Automated Driving ASFiNAG

During the on-site event, participants were able to witness the practical application of C-ITS technology. Specifically, they were able to observe a simulation of a traffic jam on the highway. The C-ITS system is capable of detecting accidents, construction sites, and traffic jams within a radius of approximately 250 meters, and can alert drivers accordingly. This feature can help prevent rear-end collisions, thereby increasing the safety of all road users.

ASFINAG's Traffic Manager vehicle transmits the necessary position data and information about traffic events on the route to other C-ITS-enabled road users, ensuring that everyone is informed and prepared. The Traffic Managers are always on the move and can promptly assist in accidents or breakdowns. In case of disruptions, the Traffic Management Centers notify the Traffic Managers on-site. Conversely, the Traffic Managers inform the traffic control center when they are on-site for an incident.

During a guided tour to the Traffic Management Center, participants gained insight into the functioning of intelligent traffic management. They observed traffic experts who monitor and control traffic around the clock. Austria has nine Traffic Management Centers: eight at the regional level in each federal state and one overarching national center in Vienna-Inzersdorf. Specialized teams at each location oversee traffic and collaborate with other units of ASFINAG, as well as local response teams, in case of special incidents.

3.3. Technical Tour to Graz - C-ITS, Tunnels and More

The ALP.Lab is a comprehensive test and innovation lab for testing all levels of automated driving functions. Located in and around Graz, ALP.Lap provides a comprehensive test environment. In addition to public roads and dedicated test tracks, it includes state-of-the-art data acquisition technologies and a complete simulation environment. The goal of ALP.Lab is to offer a digital test chain from simulation to on-road testing on various public and private test tracks, starting with the A2 highway and urban traffic in Graz.

The ALP.Lab technical tour program included visits to various project sites, starting with a tour of Graz in a C-ITS-equipped public bus, followed by a visit to the ALP.Lab headquarters with presentations on Joanneum Research projects and the Center on the Mountain, where intelligent systems for tunnel applications are being tested. The tour concluded with a visit to the ADAS laboratory for a driving simulator demonstration and a presentation on mobile measurement technology.

As part of the "C-Roads Austria 2" project, a C-ITS testbed has been established in Graz, where numerous use cases are being implemented. In cooperation with Holding Graz Linien and the Road Department of the City of Graz, both roadside and on-board units were deployed in preparation for a large-scale rollout, prioritizing public transport in the city of Graz. Participants experienced a technical tour on board a bus of Holding Graz Linien, where use cases such as SPAT/MAP, public transport prioritization, level crossings, in-vehicle signage and congestion warnings were presented. Supported by Yunex Traffic Austria, the participants' questions regarding installations, deployment and future plans for C-ITS were answered.

ALP.Lab, the Austrian Light Vehicle Proving Ground for Automated Driving, provides extensive testing facilities on private and public roads. Its integrated data management and broker systems connect different phases of the test chain, including ADAS/AD test equipment, mobile HiL platforms, driving demonstrators, and traffic monitoring systems.

Joanneum Research presented projects including ESRIUM (Safe and Efficient Roads) for creating roadmaps for traffic management and maintenance planning, AKUT (Rapid Incident Detection in Tunnels by Acoustic Monitoring), and the latest advancements in spatial digital twin detection.

The tour concluded with the presentation of the 'Zentrum am Berg' (`Center on the Mountain´). This experimental and research facility comprises four 400-meter-long tunnels, including two parallel road tunnels and two parallel railroad tunnels connected by original cross-connections and tunnels. With a total of approximately 4 km of underground testing and practice areas, the facility also offers above-ground test areas for additional research projects.

4. Student Award

In order to provide a platform for young researchers from all over the world, young students up to the age of 27 were given the opportunity to submit their work on transportation and traffic for publication in the proceedings of this international conference. The young students were a tremendous asset to the symposium with their fresh approaches and perspectives.

The Student Paper Award was kindly sponsored by the innovation platform TM 2.0 to enable the students to travel to Vienna. Submissions were reviewed by a committee consisting of the following members:

- Johanna Tzanidaki, ERTICO / TM2.0
- Martin Russ & Martin Dirnwöber, AustriaTech
- Panos Prevedouros, University of Hawaii
- Jop Spoelstra, Technolution
- Haizhong Wang, Oregon State University
- Yinhai Wang, University of Washington, NW TTAP Center

Xuerun Yan, Tongji University in Shanghai
`A Simulation Platform for Truck Platooning Evaluation with Interactive Traffic Consideration´

© Hai Ma Ti photo studio

» This award holds great significance to me as it is a recognition for my hard work and research. It gives me an opportunity to showcase the research achievements I have made in China to the world. It also boosts my confidence and motivates me to continue studying hard. «

Xuerun Yan

Chintaman Bari, Sardar Vallabhbhai National Institute of Technology in India

`Establishment of Warrants for Electronic Toll Collection Lane (ETC) Operations in India.´

© Rohit Rathod

» I want to express my heartfelt gratitude to the conference organizers for providing this invaluable platform. I extend my sincere appreciation to my co-authors, colleagues, and supporting institutions for their unwavering support. […]This award is a testament to the collective efforts of my family, country, and institute. Thank you all for your invaluable contributions. «

Chintaman Bari

Junlan Chen, Southeast University and Monash University
`A Generative Deep Learning Approach for Highway Crash Severity Modeling with Imbalanced Data´

© Hippocampal Vision Photography Studio

» I am truly honored to have my work recognized among such esteemed researchers. I extend my heartfelt appreciation to ISFO for providing a platform to showcase our research and fostering a collaborative environment. Special thanks to the organizing committee for their dedication and hard work in ensuring the success of this remarkable conference. «

Junlan Chen

5. Acknowledgement

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