TRAVISIONS 2020

TWO ACADEMIC
ON INNOVATIVE TRANSPORT CONCEPTS
COMPETITIONS

#TRAVISIONS

www.travisions.eu

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TRAVISIONS 2020

Dear Reader,

by organizing bi-annual young researcher contests, TRA VISIONS has achieved the development and wider dissemination of a wealth of innovative ideas, essential for the competitiveness of the European transport industry and also necessary for solving current and future challenging problems related to energy, transport, climate change and other key issues. Several innovative ideas were submitted by students around Europe during the young researcher competitions. Many of these have inspired the research community to propose innovative projects and the industry to adopt these or very similar ones. Furthermore, leading researchers have been awarded during the senior researcher competitions.

TRA VISIONS 2020 is a coordinated commitment of partners from all of the relevant stakeholders' organisations in transport in Europe funded by the European Commission H2020 research and innovation programme (Grant Agreement N. 723037; http://www.travisions.eu). This cooperation has allowed them to embark on a strong communication campaign to stimulate the participation of young transport researchers as well as to identify the top performing senior transport researchers in EU-funded projects by means of a precise evaluation process that acknowledges their achievements. This level of coordinated effort is impressive and shows the commitment of the European Commission and the European transport industry towards competitiveness and innovation.

TRA VISIONS 2020 aim is to carry out two competitions in the field of transport. The YOUNG RESEARCHER COMPETITION, which targets students and early stage researchers (BSc, MSc and PhD), and has the aim of approaching young researchers in the transport sector, to stimulate their minds and give them the chance to interact with a strong scientific community on transport research and showcase their ideas. The SENIOR RESEARCHER COMPETITION, on the other hand, is addressed at senior researchers and has the goal of acknowledging the excellence of the already existing EU-funded research in the field of transport. Both competitions share a common goal which is the creation of a scientific community made of young and senior researchers in the field of transport. Indeed the interaction between different generations of researchers and different transport modes (road, rail, waterborne, airborne, cross modality) will enable the achievement of the overall objective of TRAVISIONS 2020

which is the development and deployment of innovative and cross-cutting transport solutions. In this framework, we would like to thank the young and senior researchers that participated in the competitions and put their enthusiasm and effort into the preparation of their works. Thanks to them, TRAVISIONS 2020 has been a great success!

This book includes the abstracts of all the project ideas submitted for evaluation to the TRAVISIONS 2020 competitions. The TRAVISIONS 2020 winners were awarded on the 29th of September 2020 during a TRA 2020 remote Strategic Session. The book was prepared by the TRAVISIONS 2020 consortium and was designed and directed by Ms. Micol Biscotto, project manager at Deep Blue ltd, Mr. Carlo Abate, consultant, Ms.Chiara Muccitelli, graphic designer at the same company and Mr. George Smyrnakis, Secretary General of WEGEMT with the support of Prof. Alistair Greig (UCL).

George Smyrnakis
TRAVISIONS Project Coordinator
WEGEMT

TRAVISIONS Consortium

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INTRODUCTION

Ever more people and goods are moving around the world in constantly shorter timeframes. This makes innovative transport solutions an important necessity. What could future transport look like? How can existing systems and infrastructures cope with the rising strain, be it road, rail, air, waterborne or cross-modal transport systems? Which are efficient and sustainable solutions to the arising questions on mobility issues?

The series of EU-funded projects TRA VISIONS invited young and senior researchers from all over Europe to enter their ideas concerning these and other questions to the competitions. The aim is to showcase European excellence and to increase the competitive advantage of the European transport industry by generating innovative concepts and solutions through a Europe-wide competition for both young and senior researchers in the sectors of road, rail, waterborne, airborne and cross-modal transport. The core activity of the TRAVISIONS 2020 project was the organisation of two competitions for transport research awards to be announced at the TRA 2020 conference on 27-30th April 2020 in Helsinki, Finland:

The TRAVISIONS 2020 Young Researcher Competition, an academic competition with the goal of stimulating interest among young researchers and students in the field of sustainable transport.

The TRAVISIONS 2020 Senior Researcher Competition, a competition for senior researchers in the field of innovative transport concepts based on results only from EU-funded projects.

The Young researchers' competition aims to target undergraduate students and early-stage researchers in the transport sector, stimulate their minds and give them the chance to interact with a wide scientific community on transport research and show off their ideas. The senior competition, on the other hand, is addressed at established senior researchers and has the goal of acknowledging the excellence of the existing research and innovation potential in the field of transport in the EU. Although the two competitions have separate evaluation procedures and different rules, they are aimed at reaching a common goal which is the creation of a scientific community made of young and senior researchers in the field of transport. The interaction between different generations of researchers and different transport mode research fields enables the achievement of the overall objective of TRAVISIONS, which is the development and deployment of innovative and cross-cutting transport solutions.

Objectives

The objectives of the TRAVISIONS 2020 project are to:

Build a vibrant community of transport innovators and researchers in Europe to foster interaction between specialists working in transport sectors.

Promote an inter-disciplinary approach, linking basic science, socio-economics and applied sciences/engineering.

Disseminate knowledge and project findings to develop innovative transport solutions in Europe.

The TRAVISIONS 2020 project builds on the success of the H2020-funded TRA VISIONS 2018 and TRA VISIONS 2016, FP7-funded TRA VISIONS 2014, FP7-funded Young European Arena of Research (YEAR) competitions that took place at TRA in 2008, 2010 and 2012, as well as the VISIONS (FP6) and VISIONS OLYMPICS (FP7) competitions. Together, these competitions captured the imaginations of more than 2.000 students around Europe. TRAVISIONS 2014, 2016, 2018 and 2020 aimed to develop this impact even further by extending the awards to include a new competition for senior researchers to acknowledge excellence in transport research projects.

Impact

The expected strategic impact of TRAVISIONS 2020 includes:

Stimulating young researchers and students to submit their research work to the competition and attracting them to transport related studies.

Encouraging partners from EU-funded projects to further develop innovative ideas from their projects.

Supporting the TRA conference, which is considered as the first transport research conference in Europe, with a successful and high-quality scientific competition and strong and high-level media coverage.

Efficiently disseminating knowledge and results of European and national research projects in the area of sustainable transport and thus improve the coordination of research, technology development and innovation and the deployment of innovative solutions in the transport sector in Europe.

TRA VISIONS
SUCCESS STORIES

By organising bi-annual young researcher contests, EU-funded TRA VISIONS projects have achieved the development and wider dissemination of a wealth of innovative ideas, essential for the competitiveness of the European transport industry and also necessary for solving current and future challenging problems related to energy, transport, climate change and other key issues. Within the TRA VISIONS framework, several innovative ideas were submitted by students around Europe during the 2014, 2016 and 2018 competitions. Many of those ideas have already inspired the research community to propose innovative projects and the industry to adopt these or very similar ones.

Looking back, it can be argued that the TRA VISIONS process of cyclically inviting young researchers to participate in an academic contest aiming to develop new transport related concepts and ideas for the future has succeeded in inspiring the European transport industry with fresh, out-of-the-box novel ideas that are now being developed as new products essential for the future of the industry. It also clearly demonstrates that even if there is no direct relation between the original concepts developed by the students and the universities and the products that are now coming to market, the ideas generated through the TRA VISIONS process reflected the future needs of the European transport industry. Many of the TRA VISIONS ideas have started to appear on the market and many more are likely to follow. Moreover, there are many new concepts that are now under development that seem to have considered many of the concepts and proposed technologies that first appeared in TRA VISIONS. As an example, three case studies (for road, rail and waterborne respectively) are presented as follows.

ROAD MODE

Tyre inflation pressure has a critical impact on rolling resistance and its impact on vehicle fuel economy and CO2 emissions is huge due to the low attention paid by drivers to tyre maintenance. Safety, comfort and tyre life are also negatively affected by incorrect tyre inflation. Simulations show that maintaining the tyre pressure at the nominal value would reduce fuel consumption up to 2%, taking into account that most of the passenger vehicles in circulation present tyres that are under-inflated at 75% of the nominal value. Further advantages can be obtained by varying pressure according to the vehicle working conditions.

To address this issue, a team from Politecnico di Torino presented a study that aimed at developing an on-board electro-pneumatic system for the automatic control of tyre inflation pressure (ATPC system) on passenger vehicles in the TRAVISIONS 2016 competition and won third prize in the road mode.

The design focused on the reduced impact that the product should have had on the standard production process of vehicle subsystems and assembly. A highly fail-safe layout was produced which allows the tyre to be isolated when the system is not actuated and in any case the minimum in-tyre pressure to be limited by very simple and robust mechanical actions. The system was produced as a prototype and tested on a static test bench. System control logics were developed on experimental data.

Some pressure management strategies were proposed and effects on vehicle dynamics were studied.

A first-attempt evaluation of the possible manufacturing cost was discussed together with a rough estimation of the economic advantage which can be obtained per year on a passenger vehicle: the predicted cost is about 500-600 €/vehicle, half of which would be paid back to the customers in terms of fuel economy over the vehicle life. Additional benefits and customer value would come from safety improvements. The novelty of the product is both in the field of application and its aim. Up to recent days, similar systems have been considered as a technology not suitable for passenger road vehicles. On the contrary the solution developed by Politecnico di Torino is intended for passenger vehicles and aims to produce a relevant improvement on real-world fuel economy of cars and, as a consequence, a significant reduction of CO2 emissions.
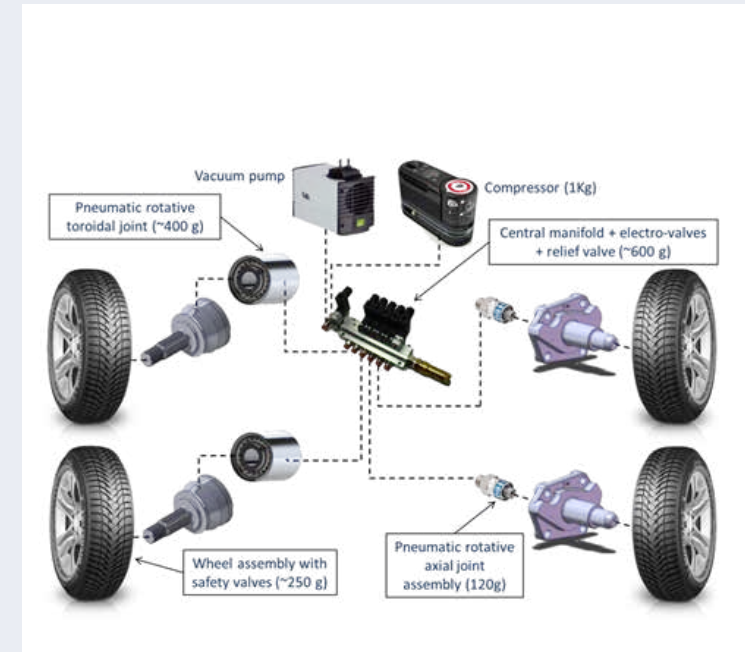
Architecture of the ATPC system

After the competition, the winning team was contacted by IVECO and received a grant to study and develop the system for the application on light-duty and heavy-duty commercial vehicles. Furthermore, the team is working on two control algorithms to estimate the vehicle mass and its distribution on the tyres and evaluate the inflation pressure to maintain the original dynamic behaviour of the vehicle while vehicle mass increases. Patents are pending.

RAIL MODE

The winner of the 2014 edition of the TRAVISIONS student competition was awarded for research exploring the development of an innovative self-pre-stressed concrete (SPC), addressing major shortcomings of materials applied to the construction of rail infrastructure e.g. the need for high strength, high resistance to dynamic loads and fatigue as well as durability in harsh environments.

This novel material, termed SPC, was based on a particular fibre reinforced cementitious matrix demonstrating excellent performance when compared to traditional fibre reinforced concrete matrices. The innovative aspects of this material are related to its ability to neutralise the matrix expansion due to its chemical activation properties, using the restrain action of the fibre reinforcement. This, in turn, acts as a bond at the interface putting the fibres under tension while the matrix in under compressive loads, protecting the latter against cracking.

This has resulted in a material that has advantageous characteristics when compared to concrete traditionally used in rail infrastructure construction in general and rail bridges in particular. Specifically, SPC provides:
. Improved tensile or flexural strength;
. Cost reduction due to the use of concrete with lower strength requirements as well as smaller quantities of steel reinforcement;
. Significantly improved durability and mechanical performance (e.g. post-cracking behaviour).

The innovative idea on Self-Prestressed Concrete of this team won the first prize of TRAVISIONS 2014 in the rail category. It was the first step of a winning race to the market. In 2016, a spin-off company, INNOVACRETE srl (http://www.innovacrete.it/en/) has been set up by the Università Politecnica delle Marche to exploit this technology. The research has continued and resulted in the patent-protected (Corinaldesi and Nardinocchi, 2016) HERACLEX technology based on the original idea awarded with the TRAVISIONS Award 2014 in Paris. Since 2018 HERACLEX is on the market and has been sold to several customers (which are companies involved in precast concrete manufacturing) around Europe (Italy, Portugal, Poland) with increasing revenues up to more than 5 million euros in 2020.
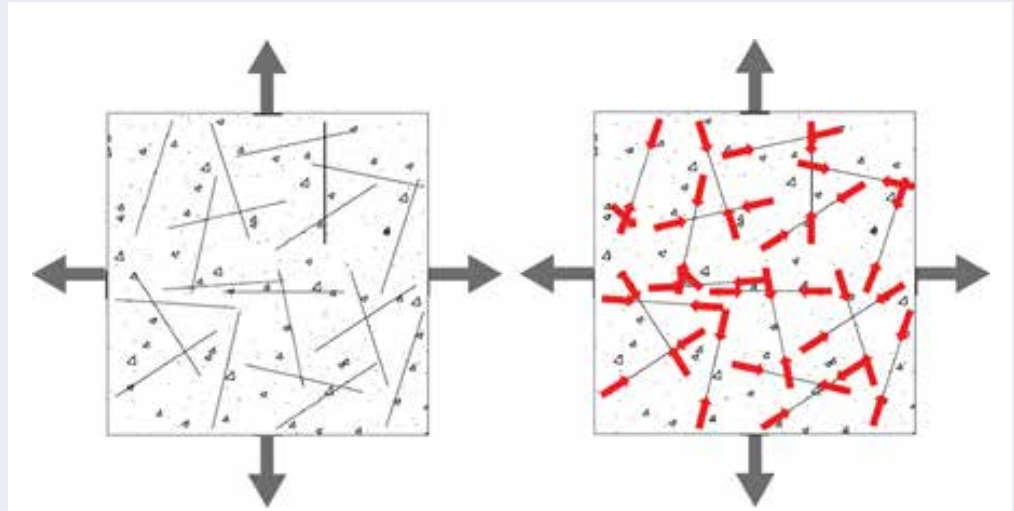
Matrix expansion (left) and fibre counteraction (right)
(Innovacrete, 2017)

Four-point testing of prototype beam manufactured using HERACLEX concrete without the need for steel reinforcement rods (Innovacrete, 2017)

WATERBORNE MODE

During TRAVISION 2014, a novel idea was entitled *Floating Power Generation Plant* (FPGP). This idea was for an installation that would load Liquid Natural Gas (LNG) from shuttle tankers, vaporise it, and use the fuel to generate electric power. This electricity would then be transmitted ashore to land-based establishments. The platform will have the capability of moving around as required from one terminal to another as the supply and demand chains fluctuate.

This concept eliminates the requirement for shore-based LNG storage tanks, re-gasification equipment and power generation machinery, hence allowing the consumer to make savings in construction time and costs. The FPGP could also operate as an emergency source of power. 'Modec' announced in November 2016 their development of a power plant ship that uses liquefied natural gas as the fuel for electricity generation (http://asia.nikkei.com). Moored to a pier or anchored offshore, the vessels will receive LNG from tankers. They will gasify the fuel on board to generate electricity for transmission to the onshore grid via undersea cable.

Wison Offshore & Marine announced in January 2017 that they developed a range of products with integrated functions of LNG loading and storage facilities, regasification and power generation. The similarities of the two aforementioned commercial projects with the idea of the students are obvious.

Modec's power plant ship
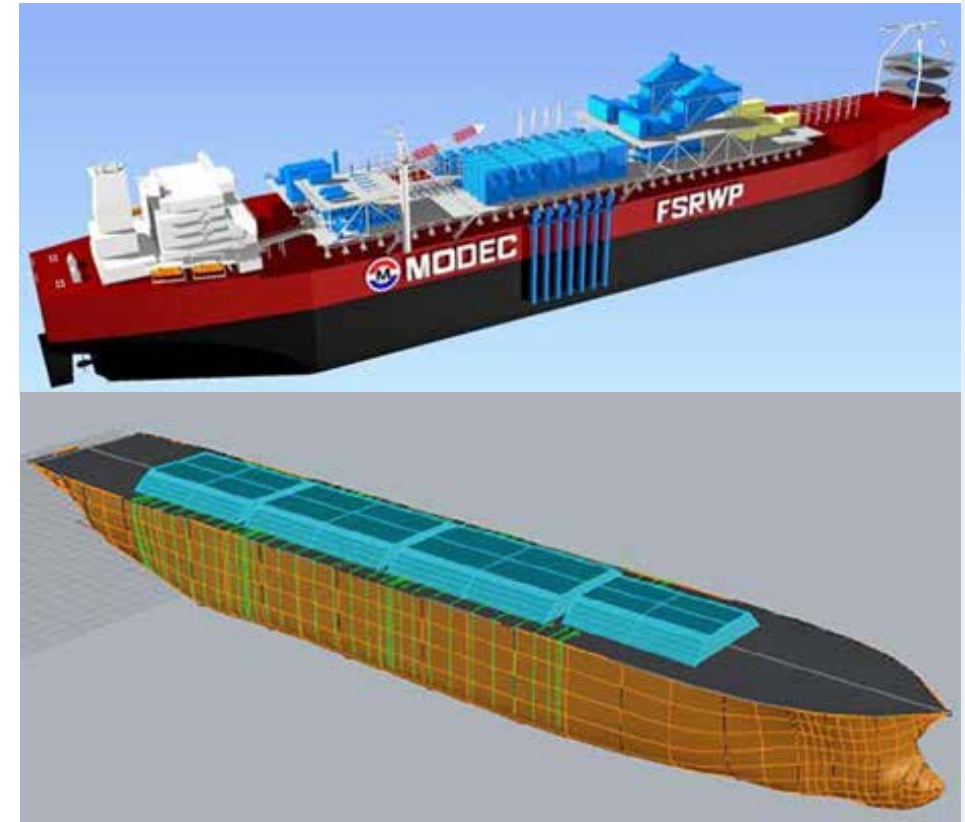
TRA VISIONS 2014 computer model of the FPGP

TRA VISIONS
STORY

Celebrating the 11th edition of the VISIONS competitions.

Back in 2005 a European competition targeting young researchers working on innovative and visionary concepts was established. As part of the FP6 EU funded project VISIONS the first ever European competition on visionary concepts for ships and offshore structures was successfully organized and run on an annual basis for four consecutive loops covering academic years 2005-2006, 2006-2007, 2007-2008 and 2008-2009.

The competitions generated many interesting and groundbreaking concepts that were widely disseminated to the WATERBORNE industry and inspired a lot of professionals and design offices to think out while also discovering new solutions and concepts with potential to become successful products in the market. Fueled by the success of the VISIONS project, the entire WATERBORNE community as well as the European Commission further supported and embraced the activity of organizing and running a European competition on visionary concepts for ships and offshore structures and as part of the FP7 EU funded project VISION OLYMPICS the competition was organized and run for three further loops covering academic years 2009-2010, 2010-2011 and 2011-2012.

The winners of 2011-2012 VISIONS OLYMPICS were awarded their prizes in a prestigious award ceremony during TRA 2012 in Athens which further inspired the entire European transport industry and the European Commission to adopt the same approach of generating new and innovative concepts for all the different transport modes.

For this reason, the TRA VISIONS competitions were born with the aim of collecting the most innovative transport-related ideas covering all surface modes of transport (road, rail, waterborne and cross-modality), and in 2020 also airborne, from young researchers all over Europe and awarding their excellence every two years during the TRA conference.

Four bi-annual competitions were organized as part of the FP7 EU funded project TRA VISIONS 2014 and the H2020 EU funded projects TRA VISIONS 2016, TRA VISIONS 2018 and TRA VISIONS 2020. Such projects generated a plethora of innovative concepts for all transport modes and further awarded the excellence of the young researchers during the TRA conferences in Paris (2014), Warsaw (2016), Vienna (2018) and Helsinki (2020).

VISIONS AND VISION OLYMPICS

Visionary concepts for vessels and floating structures or in short VISIONS commenced in 2005 as an FP6 EU funded Network of Excellence, involving the European shipbuilding industry, maritime universities and the leading research institutes and run till 2009.

In 2009 VISIONS was followed up by VISIONS OLYMPICS, an FP7 EU funded Coordination and Support Action which continued on a similar range of activities all the way till 2012. In the course of the two projects, seven annual academic competitions were organized and run, involving students and young researchers of European universities who were asked to generate and develop concepts for future maritime products relevant to five European maritime business areas, namely: maritime tourism/leisure, short sea Shipping, inland Waterway Shipping, deep sea shipping, floating infrastructures. During the four VISIONS and further three VISIONS OLYMPICS competitions that were run:

521
young researchers
were engaged as team members of the teams responsible for submitting 136 ideas while more than 650 registered and were engaged in competition activities.

From
22
different universities
located in 12 different European regions covering all the major marine universities.

136
innovative projects
made it to the finish line while may more registered and participated with more brief descriptions.

More than
70.000
of awards for the young researchers
were secured from the WATERBORNE industry showing the strong commitment of the sector.

RA6
Energy efficient ship

RA7
Alternative products for the Marine Industry

MARITIME TOURISM AND LEISURE

RA5
Green logistics

INLAND WATERWAYS

SHORT SEA SHIPPING

RA3
Sustainable marine transportation

RA1
Sustainable energy generation and conversion from sea

DEEP SEA SHIPPING

RA2
Sustainable food generation from sea

FLOATING INFRASTRUCTURES

RA4
Safety at sea

WEGEMT · ALSTOM · BALance Technology Consulting · BMT · CESA7 · CETENA · CMT

CONOSHIP · CTO SA · DNV·GL · ECSA · EMEC · EVMAR · IMAWIS · JAFO Tecnologie · Navantia

Rolls-Royce · SSPA · stX Europe · Universität Rostock · University of Strathclyde · Sixth Framework Programme Seventh Framework Programme

TRAVISIONS

TRA VISIONS is a series of EU-funded projects whose core activity is the organization of young and senior researcher competitions for transport research awards.

The award ceremonies are organized every two years to take place at the Transport Research Arena (TRA) conference (TRA 2014 in Paris, TRA 2016 in Warsaw, TRA 2018 in Vienna and TRA 2020 in Helsinki).

2020 / 2019	LOOP 11		105	TRAVISIONS 20
2018 / 2017	LOOP 10		76	TRAVISIONS 18
2016 / 2015	LOOP 09		70	TRAVISIONS 16
2014 / 2013	LOOP 08		52	TRAVISIONS 14

ROAD RAIL WATERBORNE AIRBORNE CROSS MODALITY

The chart above shows the number of young researchers' ideas per year and per mode. Road has traditionally been the most popular transport mode overall while it can be seen that every year the number of submitted projects increases as the TRA VISIONS brand increases in popularity and recognition.

In the course of the four projects, four bi-annual academic competitions were organized and run, involving students and young researchers of European universities who were asked to generate and develop concepts for future transport related products in the sector of road, rail, waterborne, airborne and cross-modality. During the four TRA VISIONS competitions that were run:

303
innovative ideas
made it to the finish line while many more were submitted as abstracts.

556
young researchers
were engaged as team members of the teams responsible for submitting these 303 ideas.
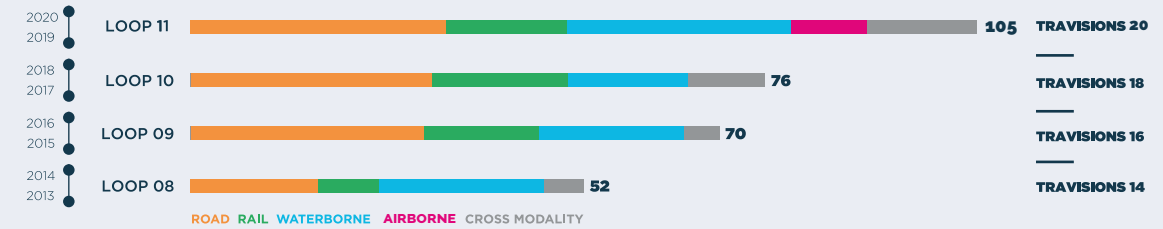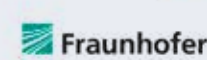
From
90
European universities
located in 26 EU countries covering all major transport related universities.
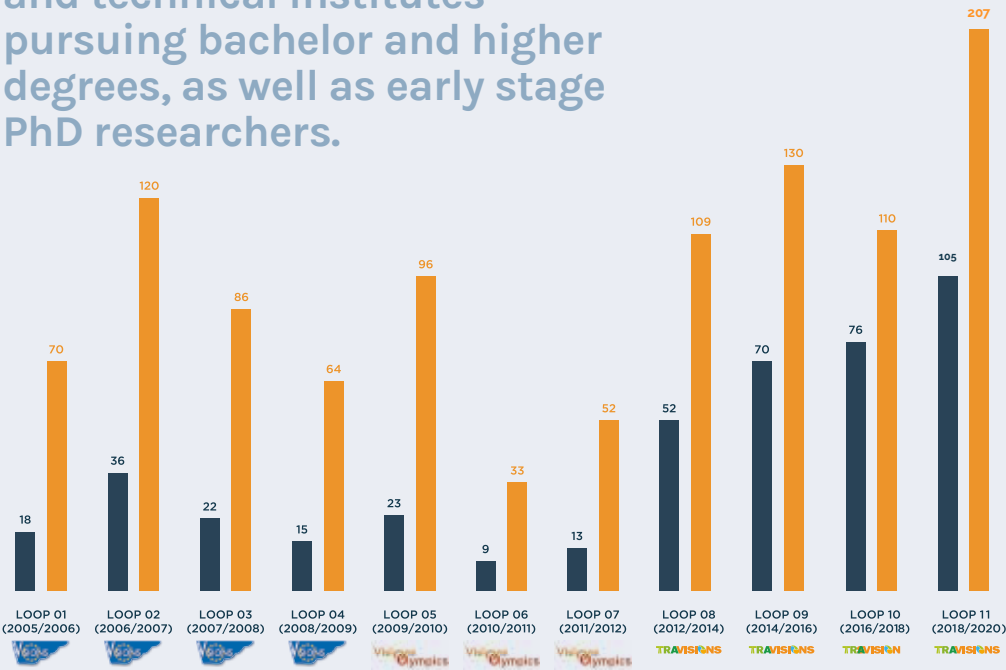
More than
138.000
awards for the young researchers
were secured from the European transport industry showing the strong commitment of the sector.

The **VISIONS, VISION OLYMPICS and TRA VISIONS** competitions targeted young researchers at universities and technical institutes pursuing bachelor and higher degrees, as well as early stage PhD researchers.

STUDENTS PER COUNTRY

A total of 1069 young researchers from 26 countries and 90 universities

were engaged as team members of the teams responsible for submitting 439 ideas throughout all the 11 competitions that were organized.

AUSTRIA 11
BELGIUM 95
CROATIA 25
CYPRUS 1
CZECH REPUBLIC 8
DENMARK 8
ESTONIA 1
FINLAND 5
FRANCE 62
GERMANY 80
GREECE 41
IRELAND 11
ITALY 117
LATVIA 2
MALTA 3
NETHERLANDS 22
NORTH MACEDONIA 4
NORWAY 58
POLAND 37
PORTUGAL 15
SERBIA 1
SLOVENIA 1
SPAIN 14
SWEDEN 34
TURKEY 68
UNITED KINGDOM 345
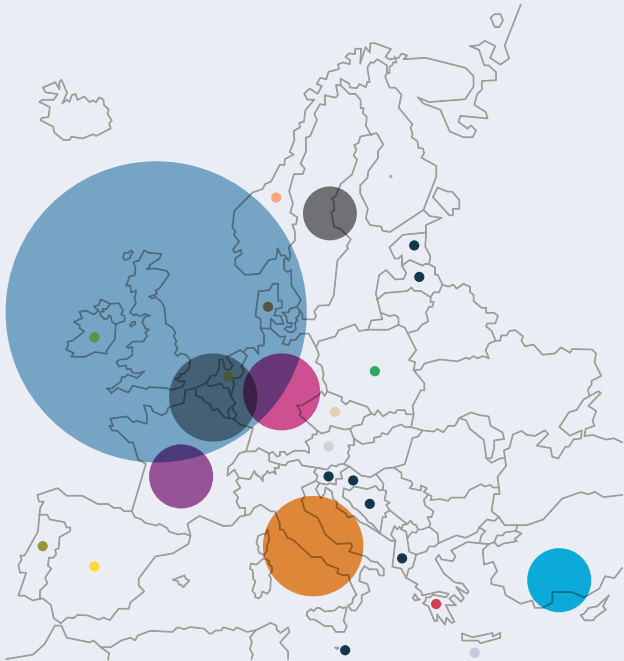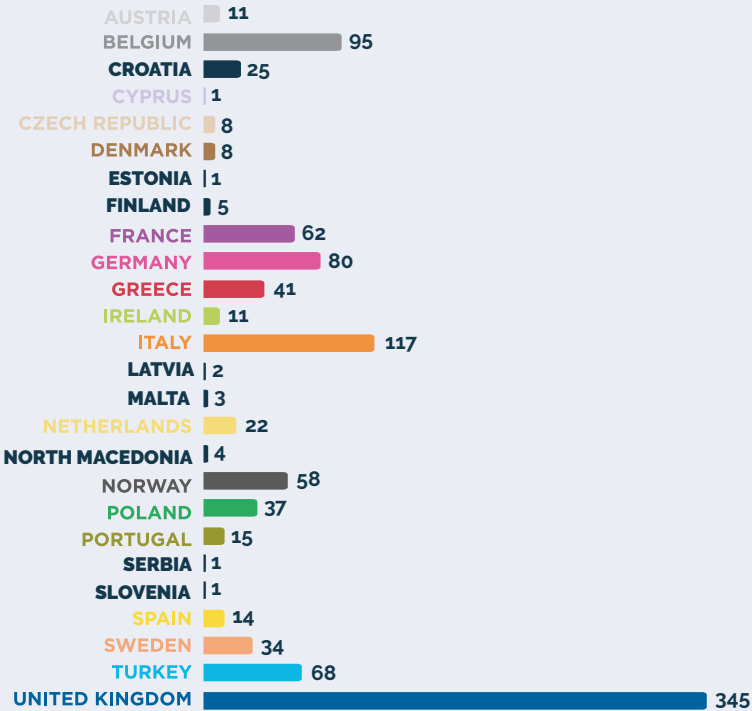

The graph shows the number of young researchers' ideas (blue bars) and the number of students (orange bar) registered per competition.

The map shows the number of these 1077 young researchers per country. United Kingdom was the largest contributor followed by Italy and Belgium.

COMPETITION PILLARS/ TRANSPORT MODES

In both competitions the participants are asked to apply for one of the following pillars/transport modes:

TRANSPORT MODE
ROAD

highways, urban and rural roads

passenger and freight transport

cycling

pedestrian

TRANSPORT MODE
RAIL

high-speed

passenger and freight transport

urban and light rail systems

TRANSPORT MODE
WATEBORNE

maritime

inland waterborne

short sea shipping

deep sea shipping

passenger transport and cruises

floating infrastructures and support vessels

aquaculture

dredging

TRANSPORT MODE
AIRBORNE

ATM and UTM

drones

automation and autonomy concepts

aerodynamics, acoustic and aero elasticity

aircraft avionics and systems

cabin design and passenger comfort

future aviation

systems emerging aviation risks

material research

TRANSPORT MODE
CROSS-MODALITY

co-modality

inter-modality, ITS, logistics

combined transport

interfaces

intermodal terminals

integrated infrastructures

public transport

airports

ports

RESEARCH AREAS

The research areas/topics for both competitions are:

RA1: CLIMATE CHANGE, MITIGATION AND RESILIENCE

. Climate change
. Mitigation
. Adaptation
. Global warming
. Sustainability
. Resilience
. Environment
. Waste
. Recycling
. Extreme weather
. Disaster resilience
. Emissions
. Critical infrastructure
. Disruption management
. Impact assessment

RA2: DIGITALISATION, DIGITAL SAFETY AND SECURITY

. Digitalisation
. Digital economy
. E-commerce
. Digital technologies
. Visualisation
. Mobile technologies
. Big data
. Blockchains
. 5G, 6G
. IoT
. Digital infrastructure
. OGD
. MyData
. GDPR
. Privacy
. Digital platforms
. Intelligent systems
. ITS
. ICT
. Information society
. Cyber-security

RA3: AUTOMATION AND ROBOTISATION

. Automation
. Sensors
. Artificial intelligence
. Robotisation
. Autonomous driving
. Autonomous vessels
. Platooning
. Driver-assisting systems
. Human-machine interface (HMI)
. Human factors
. Liability and ethical issues
. M2M models
. Robotised/automated terminals

RA4: ELECTRIFICATION, ENERGY AND POWER ALTERNATIVES

. Electrification
. Batteries
. Alternative fuels
. Biofuels
. Hybrid technologies
. Emissions
. Fuel cells
. Hydrogen
. Solar energy
. Emission reduction
. Energy storage

RA5: USER-FOCUSED MOBILITY SERVICES, SERVITISATION

. User needs
. Servitisation
. Consumerisation
. Mobility-as-a-Service
. Car-as-a-Service
. Product-service combinations
. Sharing economy
. Shared assets
. New services
. Prosumerism
. User behaviour
. User-centricity

RA6: SOCIAL CHANGE AND QUALITY OF LIFE

. Urban planning
. Urban mobility
. Urban environment
. Habitat
. Public transport
. Urban logistics
. Rural mobility
. Ageing
. Children
. Impaired
. Special groups
. Disabled
. Cultural diversity
. Societal impacts
. Equity
. Gender issues
. Transport poverty
. Affordability
. Externalties
. Social issues
. Environment
. Emissions
. Noise

RA7: TECHNOLOGY AND ENGINEERING

. Engineering
. Technology
. Product design
. Material's engineering
. Manufacturing
. Transport equipment and vehicle industry
. Ship building
. Logistics
. Supply chains
. Recycling
. Circular economy
. Infrastructure
. Construction technology
. Terminals
. Hubs
. Nodes
. Ports
. Inland waterways
. Railway yards
. Airports
. Asset management
. Road engineering
. Railway engineering

RA8: PLANNING, MODELLING AND SYSTEM DESIGN

. Transport planning
. Transport engineering
. Traffic modelling
. Transport modelling
. 3-D modelling
. Simulation
. Algorithms
. Building information modelling (BIM)
. Land use planning
. Regional planning
. Urban planning

RA9: POLICY AND REGULATION, MARKET EFFICIENCY, COMPETITIVENESS

. Regulation
. Policy
. Market efficiency
. Consumer benefit
. Competition
. Externalities
. Taxation
. Pricing
. Transport economics
. Industrial relations

RA10: TRANSPORT SAFETY AND SECURITY

. Safety
. Security
. Incidents
. Injuries
. Fatalities
. Impact assessments
. Emergency management
. Risk management
. Illegal transports
. Policing
. Customs operations
. Industrial relations

RA10: TRANSPORT SAFETY AND SECURITY

. Safety
. Security
. Incidents
. Injuries
. Fatalities
. Impact assessments
. Emergency management
. Risk management
. Illegal transports
. Policing
. Customs operations
. Industrial relations

RA11: INVESTMENTS, FINANCE AND PUBLIC-PRIVATE PARTNERSHIPS

. Financing
. Funding
. Public-Private Partnerships
. Procurement
. Asset management
. Value
. Infrastructure
. Investments
. Regional economics
. Employment
. Growth
. Contract management
. Trans-European networks

RA12: INNOVATION AND HUMAN CAPITAL

. Education
. Training
. Human capital
. Education policy
. Capacity building
. Workforce
. Innovation
. Pre-commerce procurement
. Entrepreneurship

YOUNG RESEARCHER COMPETITION

The TRA VISIONS 2020 young researchers' competition targets students at universities and technical institutes pursuing bachelor and higher degrees, as well as early career PhD researchers. Initially, participants are invited to submit an abstract under one of the TRA conference Topics (*Call for Ideas*).

This is the registration period where all the participants are invited to register their ideas and submit a title and a short abstract of their ideas. The participants then usually have a three-month period to further develop their proposals into a final project following a very clear template (*Submission of Ideas*). This is normally followed by an *Evaluation of Ideas* period, divided into two steps- a first remote evaluation by two evaluators and a second step in which the shortlisted ideas (10 per mode) are evaluated by a judging panel during the *Shortlisting Event* in which the three top ideas per mode (road, rail, waterborne and cross modality) are identified. The winner certificates and the prizes are awarded at the TRA conference during a prestigious award ceremony.
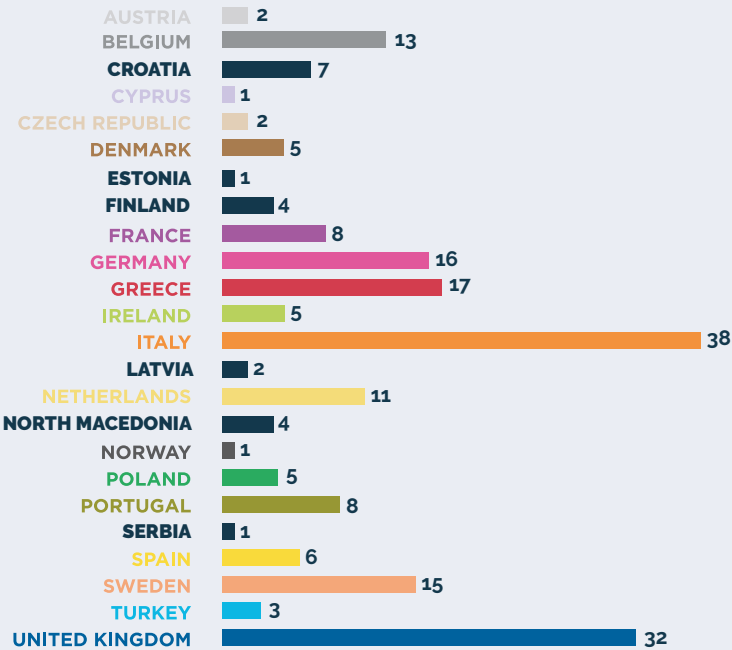
The TRAVISIONS consortium works closely with the organisers of the TRA conference in order to ensure that the competitions have maximum exposure and impact during the conference and beyond. To ensure the active and large participation of students and early stage researchers an extensive and well planned promotion phase is carried out.

STATISTICS AND OVERALL RESULTS

In the TRA VISIONS 2020 Young Researcher Competition, a total of 207 young researchers submitted 105 ideas. The participating young researchers were from 24 different EU countries and 91 different universities. The following charts contain some statistical information on all the ideas.
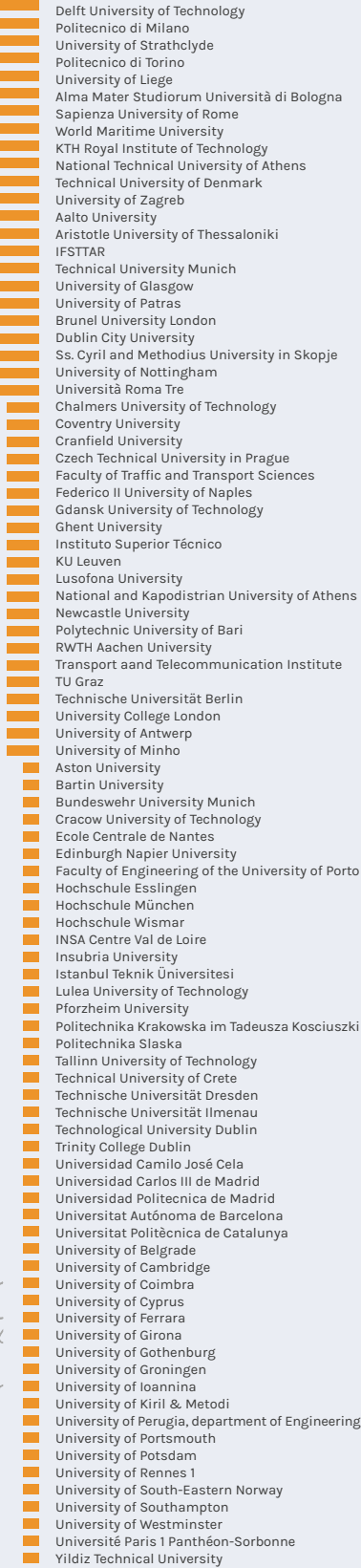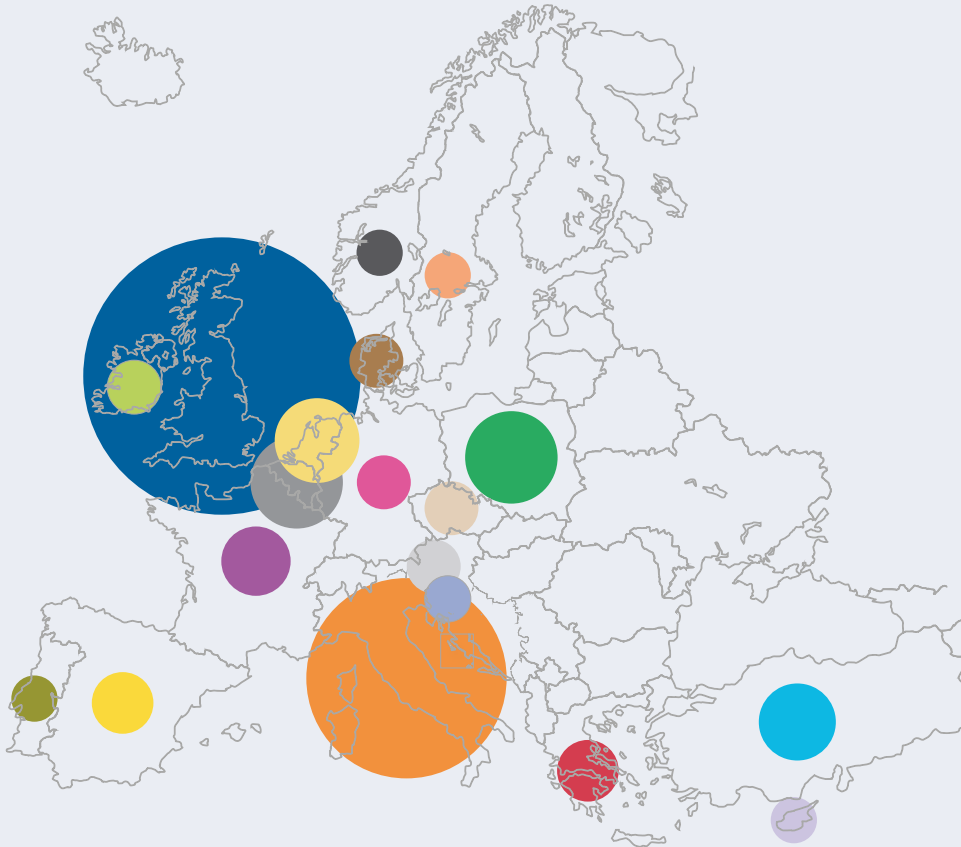
YOUNG RESEARCHERS PER COUNTRY

The table below shows the number of young researchers that participated per country. Young researchers were able to join the competition as individuals or as teams of up to 7 students.
The map besides shows the young researchers that participated on a geographical spread.

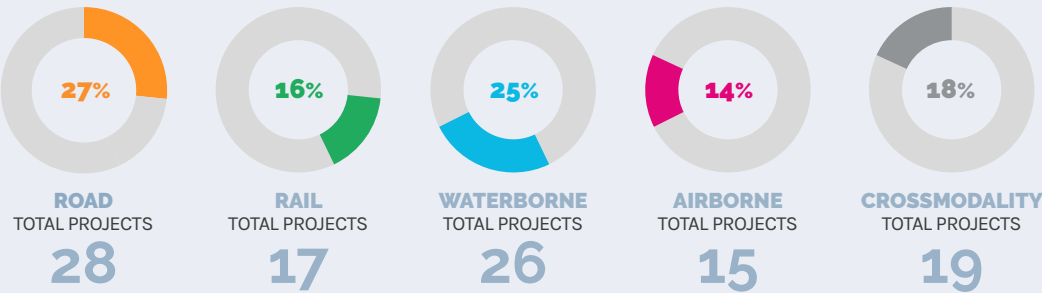| Country	Count
AUSTRIA	2
BELGIUM	13
CROATIA	7
CYPRUS	1
CZECH REPUBLIC	2
DENMARK	5
ESTONIA	1
FINLAND	4
FRANCE	8
GERMANY	16
GREECE	17
IRELAND	5
ITALY	38
LATVIA	2
NETHERLANDS	11
NORTH MACEDONIA	4
NORWAY	1
POLAND	5
PORTUGAL	8
SERBIA	1
SPAIN	6
SWEDEN	15
TURKEY	3
UNITED KINGDOM	32

NUMBER OF YOUNG RESEARCHERS PER UNIVERSITY

The diagram on the right shows the number of participating young researchers per university. Delft University of Technology from the Netherlands had the most young researchers participating, while Politecnico di Milano and University of Strathclyde came second and third.


Delft University of Technology
Politecnico di Milano
University of Strathclyde
Politecnico di Torino
University of Liege
Alma Mater Studiorum Università di Bologna
Sapienza University of Rome
World Maritime University
KTH Royal Institute of Technology
National Technical University of Athens
Technical University of Denmark
University of Zagreb
Aalto University
Aristotle University of Thessaloniki
IFSTTAR
Technical University Munich
University of Glasgow
University of Patras
Brunel University London
Dublin City University
Ss. Cyril and Methodius University in Skopje
University of Nottingham
Università Roma Tre
Chalmers University of Technology
Coventry University
Cranfield University
Czech Technical University in Prague
Faculty of Traffic and Transport Sciences
Federico II University of Naples
Gdansk University of Technology
Ghent University
Instituto Superior Técnico
KU Leuven
Lusofona University
National and Kapodistrian University of Athens
Newcastle University
Polytechnic University of Bari
RWTH Aachen University
Transport aand Telecommunication Institute
TU Graz
Technische Universität Berlin
University College London
University of Antwerp
University of Minho
Aston University
Bartin University
Bundeswehr University Munich
Cracow University of Technology
Ecole Centrale de Nantes
Edinburgh Napier University
Faculty of Engineering of the University of Porto
Hochschule Esslingen
Hochschule München
Hochschule Wismar
INSA Centre Val de Loire
Insubria University
Istanbul Teknik Üniversitesi
Lulea University of Technology
Pforzheim University
Politechnika Krakowska im Tadeusza Kosciuszki
Politechnika Slaska
Tallinn University of Technology
Technical University of Crete
Technische Universität Dresden
Technische Universität Ilmenau
Technological University Dublin
Trinity College Dublin
Universidad Camilo José Cela
Universidad Carlos III de Madrid
Universidad Politecnica de Madrid
Universitat Autónoma de Barcelona
Universitat Politècnica de Catalunya
University of Belgrade
University of Cambridge
University of Coimbra
University of Cyprus
University of Ferrara
University of Girona
University of Gothenburg
University of Groningen
University of Ioannina
University of Kiril & Metodi
University of Perugia, department of Engineering
University of Portsmouth
University of Potsdam
University of Rennes 1
University of South-Eastern Norway
University of Southampton
University of Westminster
Université Paris 1 Panthéon-Sorbonne
Yildiz Technical University

YOUNG RESEARCHER
IDEAS PER MODE

A total of 29 road related ideas were submitted, 17 rail, 25 waterborne ideas, 16 airborne ideas and 18 cross modal ideas. The charts above show the number of young researchers ideas submitted per mode in percentage terms.
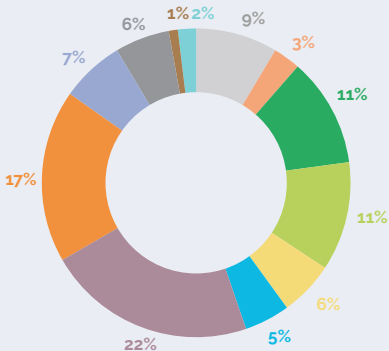
27%	**16%**	**25%**	**14%**	**18%**
ROAD TOTAL PROJECTS	**RAIL** TOTAL PROJECTS	**WATERBORNE** TOTAL PROJECTS	**AIRBORNE** TOTAL PROJECTS	**CROSSMODALITY** TOTAL PROJECTS
28	**17**	**26**	**15**	**19**

YOUNG RESEARCHER
IDEAS PER RESEARCH AREA

The table above shows the number of young researchers ideas per Research Area. The most popular Research Areas were RA7 Technology and Engineering and RA8 Planning, Modelling and System Design with 24 and 19 ideas, respectively, followed by RA3 Automation and Robotisation and RA4 Electrification, Energy and Power Alternatives with 12 ideas.
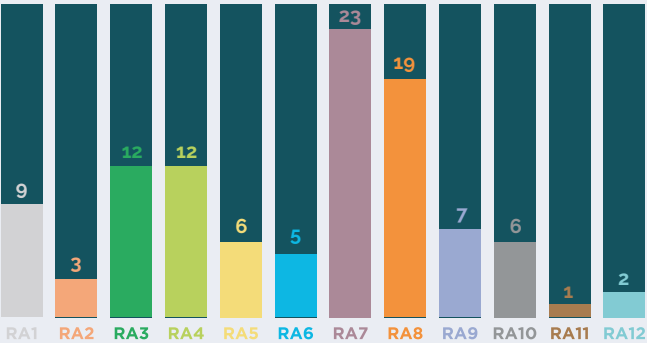
The chart below shows the number of young researchers ideas submitted per Research Area in percentage terms.

Bar chart values:
- RA1: 9
- RA2: 3
- RA3: 12
- RA4: 12
- RA5: 6
- RA6: 5
- RA7: 23
- RA8: 19
- RA9: 7
- RA10: 6
- RA11: 1
- RA12: 2

Donut chart percentages: 9%, 3%, 11%, 11%, 6%, 5%, 22%, 17%, 7%, 6%, 1%, 2%

UNIVERSITIES
PER COUNTRY

The table above shows the number of universities that participated in the young researchers competition per country. The map below also demonstrates the geographical spread of participating universities per country.

Country	Universities
AUSTRIA	1
BELGIUM	4
CROATIA	2
CYPRUS	1
CZECH REPUBLIC	1
DENMARK	1
ESTONIA	1
FINLAND	1
FRANCE	4
GERMANY	11
GREECE	6
IRELAND	3
ITALY	10
LATVIA	1
NETHERLANDS	2
NORTH MACEDONIA	2
NORWAY	1
POLAND	4
PORTUGAL	5
SERBIA	1
SPAIN	6
SWEDEN	5
TURKEY	3
UNITED KINGDOM	14

TRANSPORT MODE
ROAD

1
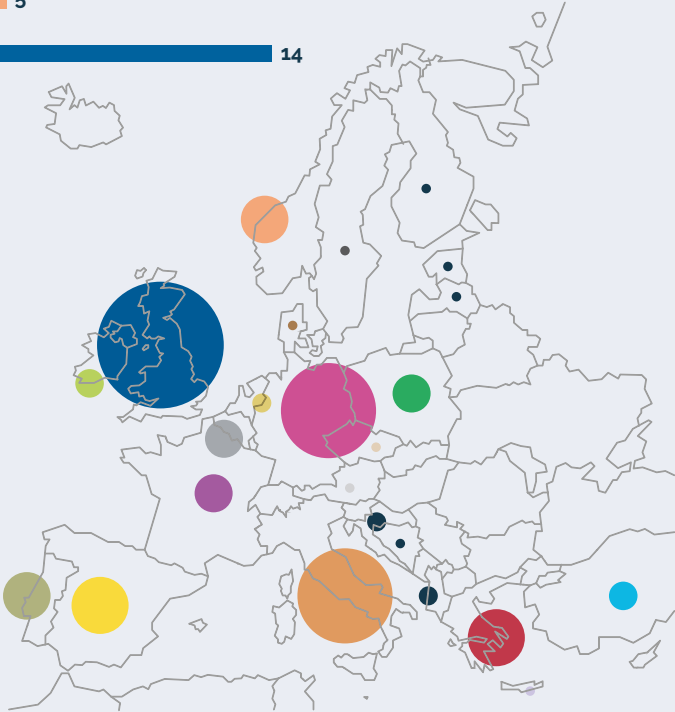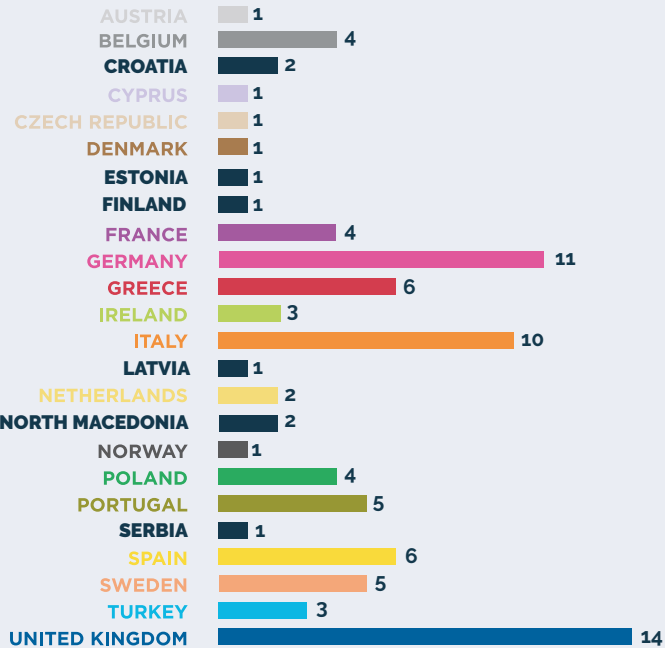
Pier Giuseppe Anselma, Claudio Maino, Alessia Musa
Politecnico di Torino

Category: **Road**   Country: **Italy**

Research Area 4: **Electrification, Energy and Power Alternatives**   Idea Number: **36**

Theo: a tailored hybrid emission optimizer for the drivers of tomorrow

The electrification of road vehicle powertrains has recently gained growing interest worldwide as an effective solution to comply with the increasingly tight CO_2 emission regulations. Particularly in hybrid electric vehicles (HEVs), multiple power components (i.e. internal combustion engine and electric motor/generators) enable higher flexibility in the powertrain operation, thus suggesting enhanced fuel economy over diverse real-world driving conditions. Car makers generally tune the heuristic HEV control strategies to maximize their performance solely over specific driving cycles. However, the claimed HEV fuel economy optimality may be compromised by both the various driving styles of users and the different real-world driving missions encountered. To overcome such drawback, this project aims at developing an intelligent and custom-made Tailored Hybrid Emission Optimizer (THEO), i.e. an HEV controller capable of maximizing the fuel economy performance according to the specific driver. Trip data are initially collected for a set of personal driving missions. Subsequently, the operation of the powertrain is optimized off-line for each considered driving mission. An artificial intelligence (AI) agent to be embedded in THEO is later implemented through a learning process for each considered driver using the data collected from HEV off-line optimization. The custom-made controller can be loaded in the on-board control unit before the corresponding user starts driving. Numerical results show that the developed THEO can remarkably improve the performance of current heuristic HEV control strategies, thus reducing the gap between real HEV fuel economy and the ideal optimal benchmark.

Key Characteristics
Electrification · Hybrid electric vehicles · Multiple power components · Tailored hybrid emission optimizer

Fig. 1. Workflow for driving an HEV using a THEO.
Fig. 2. Tailored calibration process of the THEO using data collected from personal driving missions.

2
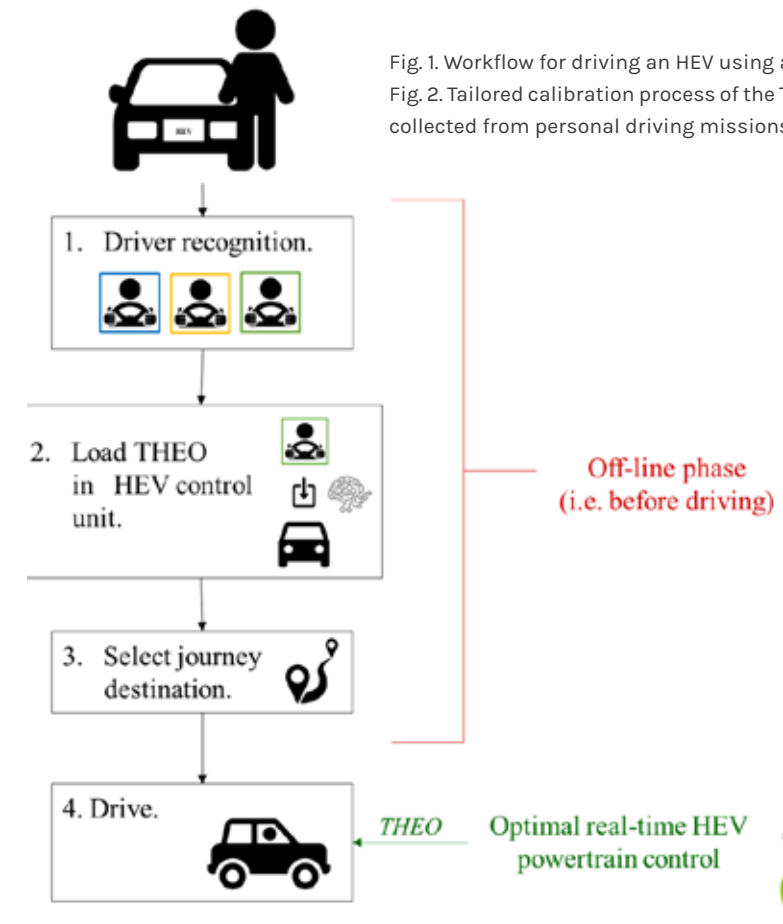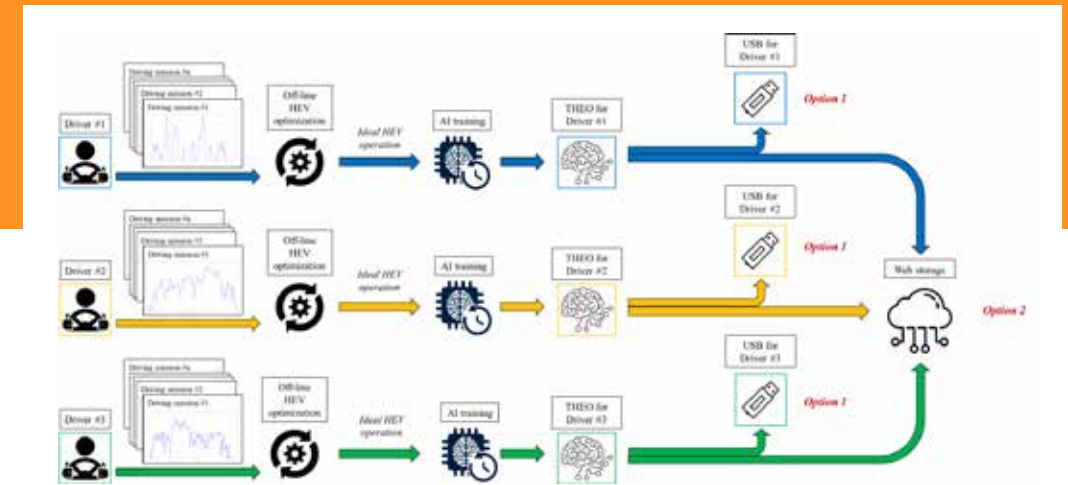
Milan Tešic
University of Belgrade

Category: **Road**   Country: **Serbia**

Research Area 10: **Transport Safety and Security**   Idea Number: **34**

Star rating road safety performances and identifying the most significant road safety indicators of a territory

The European Union defined a list of Key Performance Indicators (KPIs) within the "EU Road Safety Policy Framework 2021-2030" to improve road safety and help decision makers monitor the progress towards achieving the goals of "Vision Zero" by 2050. However, at an initial stage of monitoring, a low number of different KPIs are generally available in different territories. Consequently, progress tracking and territory comparisons are difficult. Hence, the first step should be to identify the most significant, minimum set of KPIs to be used. The main objectives of the project are to develop an original methodology for calculating a road safety performance index with a limited number of indicators (RSPIInn), and provide a reliable road-safety monitoring system and a star-rating scheme of a territory road-safety performance. This methodology is based on the Data Envelopment Analysis model already applied in Serbia by the Police Administration Units and in 21 European countries.

The methodology enables to perform the data analysis at spatial, temporal, and quantitative levels, by allowing to include data of multiple territories, multiple time series, and additional KPIs when available. Its applications can be local or global by including KPIs or indicators of sustainable development goals which are relevant for calculating a road-safety sustainable development index. The introduction of a star-rating system in new and existing web and navigation apps will ensure a wide dissemination of the results, thus making road-safety information of a territory available to all road users.

Key Characteristics
Road-safety · Road-safety performance index · Road-safety monitoring system

The comparison of country rankings (based on the specific level of RSPI,^{n} presented by star rating) -international level- 21 countries (six SPIs)-

Coloured a map of road safety performance index based on RSPI,^{F}: **2_5_6** in Europe

Coloured a map of road safety performance index based on RSPI,^{F}: **1_2_5_6** in Europe

Coloured a map of road safety performance index based on RSPI,^{F}: **1_2_3_5_6** in Europe

Coloured a map of road safety performance index based on RSPI (**all six indicators**) in Europe

Visualising of results and star- rating road safety performances

Optional add- in (off/ on) to existing navigation apps

Star rating- all ranks

5 Star- High RSPI,^{n}- Group I

1 Star- Low RSPI,^{n}- Group II

Ahmed Ayadi, Jakob Pfeiffer, Mohamed Ali Razouane
Technical University of Munich

Category: **Road** Country: **Germany**

Research Area 3: **Automation and Robotisation** Idea Number: **119**
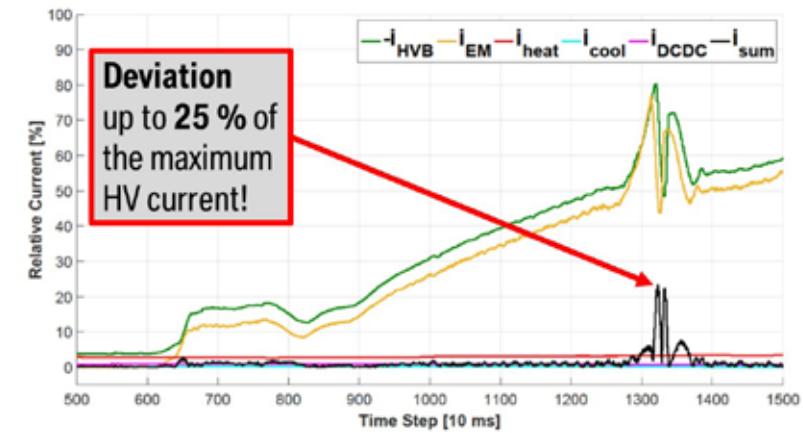
Self-Learning Enhancement of Measurement Quality with Artificial Intelligence

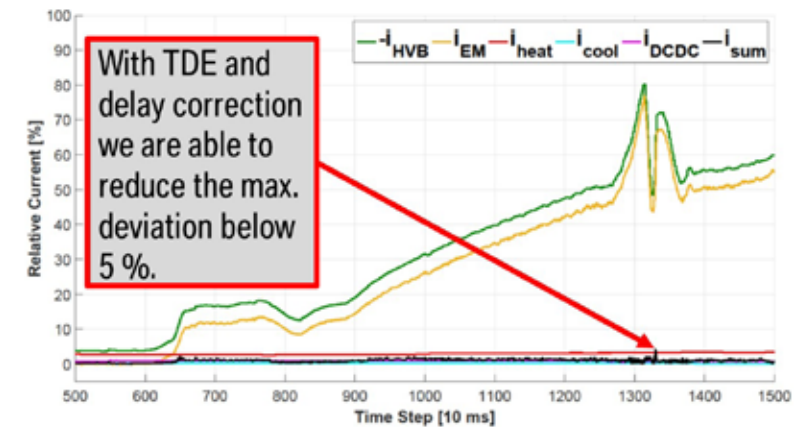Fig. 1. All HV currents of a single node system. Experiments show that the measurement deviation can be up to 25%.

Measurements play an important role in the power trains of Electric Vehicles (EVs). For example, the distribution and limitation of provided power per time step are based on High Voltage (HV) current measurements. A low measurement quality, that is large deviations between HV current measurements and actual values can cause severe problems in the power train of Electric Vehicles (EVs). As an example, they can lead to inaccurate performance coordination and unnecessary power limitations during driving or charging. Our goal is to minimize these deviations which are mainly caused by time delays between the distributed sensor systems of EVs and measurement inaccuracies. To correct the measurement inaccuracies, we propose a fleet-based framework to classify hardware faults and measurement faults. The detected measurement faults are then corrected with *Compressed Sensing*. To correct the deviations caused by time delays, we introduce a variance minimization-based time delay detection. We further evaluate several algorithms for time series prediction to retrieve measurement values in the actual time step of delayed signals. Our results show that we can minimize the deviations with the proposed methods from 25% to less than 5% of the maximum current. Thus, we are able to increase the performance as well as the cruising range of EVs without additional sensors. Because of our data driven approaches we have no need of manual calibration.

Fig. 2. As in Fig. 1, with Variance Minimization the maximum deviation is below 5%.

Key Characteristics

Electric vehicles · Fleet-based framework · Compressed sensing · Measurement inaccuracies

Panagiotis Typaldos
Technical University of Crete

Category: **Road**	Country: **Greece**
Research Area 3: **Automation and Robotisation**	Idea Number: **26**

Optimization-based path planning for automated vehicles

A path-planning algorithm for automated vehicles on multi-lane motorways is derived by tackling the issue in terms of an optimal control problem. Vehicle dynamics form the state equations of the problem. The road geometry, obstacles (e.g. other moving vehicles and road boundaries) and traffic rules are taken into account with appropriate potential-field-like functions to ensure path feasibility. For the numerical solution of the optimal control problem, an efficient feasible direction algorithm is used. A simplified Dynamic Programming algorithm is implemented to deliver the initial solution. Taking advantage of low computation times, the optimization-based path-planning approach is embedded within a *Model Predictive Control* (MPC) framework, which is implemented in Aimsun micro-simulation platform. Considering a homogeneous motorway stretch and alongside other vehicles following Aimsun's default driving behavior, one or more vehicles are instructed to follow a path produced by the MPC-based optimization approach. The path for each controlled vehicle is generated according to the current lane and speed of surrounding vehicles and is re-generated online in case of substantial changes. Aimsun's micro-simulation platform enables a thorough experimental evaluation of the proposed approach, by considering a large number of different traffic scenarios. In addition, this experimental framework allows the investigation of the impact of the suggested approach not only on the automated vehicles themselves, but also on the traffic flow as a whole for increasing penetration rates of automated vehicles.
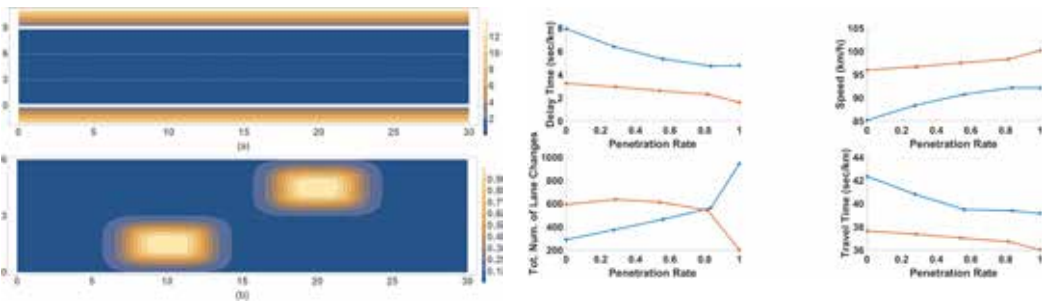
Key Characteristics
Path-planning algorithm · Automated vehicles · Multi-lane motorways

Gianmatteo Cannavacciuolo, Antonio Giuseppe Varrella
Politecnico di Torino

Category: **Road**	Country: **Italy**
Research Area 3: **Automation and Robotisation**	Idea Number: **125**

Smart Platoon Re-Start

In crowded cities, traffic jams occur regularly and most critically at the traffic light, where the first in line hesitates. The absence of a smart re-start, however, is frustrating for those who are in a hurry and hence start to push the accelerator pedal, going full throttle mode. When this happens, a considerable amount of pollutant emissions are released because of the temperature of the engine. Considering the technologies currently available, we found a simple but effective solution which re-interprets a pre-existent knowledge of the topic. Imagine how a communicative traffic light could influence the quality of the re-start: the first vehicle would be specifically informed about the upcoming green light such that, through an empowered system of *Stop & Start*, it could manage to be ready as soon as the light will turn green. In addition, with an on-board system of communication, the first vehicle would be able to share the information with the whole queue, creating a sort of platoon re-start. Environmentally, an electric engine is forecasted to substitute the common starter, helping the Internal Combusion Engine (ICE) reach the best working point. On the whole, we believe in the possibility of improvements in terms of the number of vehicle per traffic light cycle, up to 60% in medium traffic condition, and of an equivalent reduction of pollutant emissions.
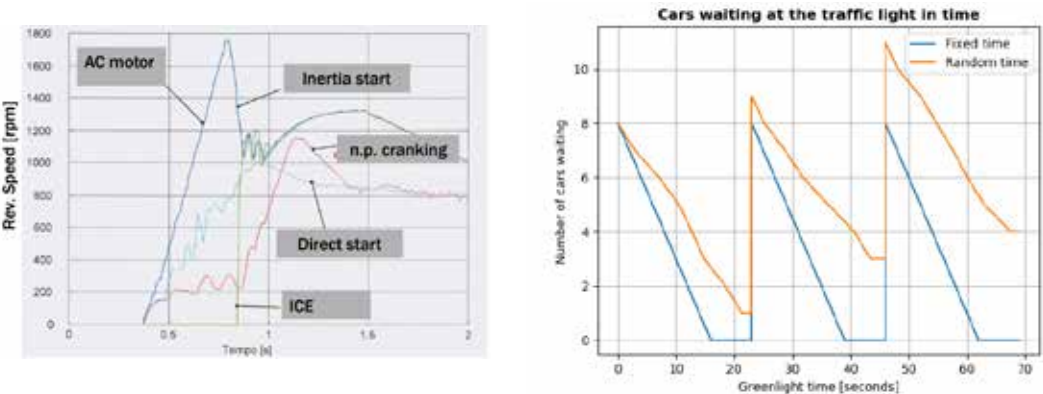
Key Characteristics
Platoon re-start · Stop&start · Smart re-start

Antoine Dubois, Fanny Vanrykel, Antoine Wehenkel
University of Liege

Category: **Road**	Country: **Belgium**
Research Area 9: **Policy and Regulation, Market Efficiency, Competitiveness**	Idea Number: **129**

Drive green and local: a technical and regulatory solution

Envision a future in which large-scale adoption of electric vehicles (EVs) is sustained by an increasing share of renewable energy production, drivers identify the most suitable charging station with their smartphones and sell any excess electricity produced by the solar panels on their homes to other EVs drivers. Our idea aims at making this vision a reality. We provide a two-pronged solution that encompasses a technical platform and a regulatory component. The technical solution focuses on optimizing charging strategies for a fleet of EVs where significant amounts of electricity are generated by (distributed) renewable energy. Our proposed platform would encourage people to be proactive in the energy sector by connecting local energy producers directly to consumers. Secondly, it would help distribution system operators modulate efficiently the load by influencing EV charging behavior in real time. In addition, we provide a general regulatory framework for developing such a platform. This framework consists of a three-step approach that identifies: 1) The socio-technical framework in which a technology develops. 2) The features of such technology and the changes it brings to the socio-technical framework. 3) The possible policy response. The goal of this theoretical approach is to assist policy makers when building a framework for new technologies and it will be tested with the specific case of charger-sharing platforms. The purpose is not to provide concrete recommendations which pertain to political choice, but rather a tool for improving public policy with respect to new technologies.

Key Characteristics
Electric vehicles · Renewable energy production · Technical platform

Panagiotis Fafoutellis, Emmanouil Kampitakis, Eleni Mantouka
National Technical University of Athens

Category: **Road**	Country: **Greece**
Research Area 8: **Planning, Modelling and System Design**	Idea Number: **14**

PARKONOMOUS - an intelligent parking management system for autonomous vehicles

In recent years, a certain vision of autonomous vehicles has emerged. Autonomous cars are expected to be technically sufficient for common usage by the end of the next decade and will be equipped with numerous sensors in order to identify their surroundings and navigate, using advanced Machine Learning and Computer Vision techniques. We suggest the development of a Control System that will assist autonomous vehicles to locate free parking slots. Each autonomous car would use data gathered from its embedded sensors to identify free parking spaces en route and provide this information to the system, which would transmit it to other autonomous cars searching for a free parking space. Thus, the role of every autonomous vehicle involved will be twofold during different time periods, the "provider" and the "requester". The proposed system would be able to support communication between the users by transmitting information properly. More specifically, when a "requester" is seeking for a parking slot, the system would book for them one already identified by a "provider" for a reasonable time period, in a way to optimize cost, fuel efficiency and walking distance, taking into account priority of all other "requesters" as well. Furthermore, during this time period, the specific parking slot will be flagged as unavailable to any other user randomly passing by. The proposed system is expected to minimize parking searching time as well as traffic congestion and harming emissions caused by it, leading to a more sustainable urban transportation system.
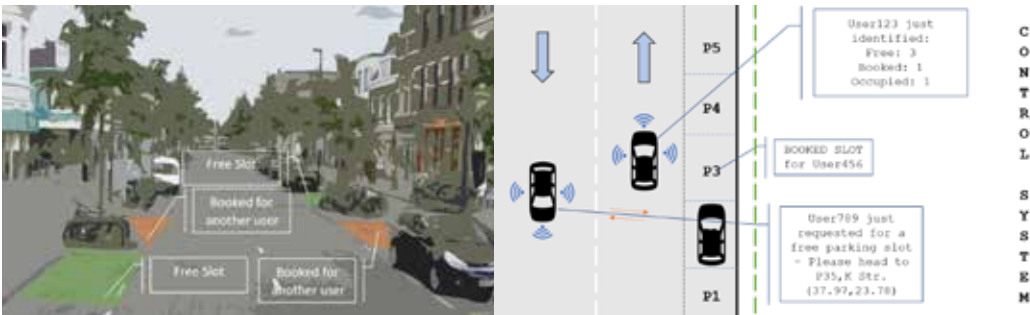
Key Characteristics
Autonomous cars · Machine Learning · Parking management system

Philippe Sohouenou
**University of Nottingham**

Category: **Road**

Country: **United Kingdom**

Research Area 1: **Climate Change, Mitigation and Resilience**

Idea Number: **124**

ResilRoad- resilience indicators for road networks

Extreme weather events and human-made hazards could damage road infrastructures resulting in casualties, service disruptions and significant economic losses. The ability of these infrastructures to sustain, resist and recover from shocks (i.e. resilience) is thus essential for society. To manage the resilience of road networks, stakeholders need metrics; as these provide an effective tool to assess the current resilience of road networks, compare the different strategies for resilience enhancement and measure progress. The research project ResilRoad (Resilience indicators for road networks) addresses this need. ResilRoad seeks to deepen the understanding of the impact of extreme events (for example floods, road accidents and bridge collapse) on road networks usability and accordingly develop a resilience assessment and enhancement framework to support decision makers in predicting, assessing and reducing the impact of disruptive events on road networks. This framework will provide an accurate mean for quantifying road network resilience and effectively compare several resilience assessment possibilities. A literature survey is proposed and used to explore technology gaps that need to be addressed to improve current resilience assessment and enhancement methods. On this basis, the road network resilience assessment and enhancement framework developed in this research project is presented. This report shows that this framework provides a more accurate mean for quantifying road network resilience and effectively compare several resilience assessment possibilities. ResilRoad is connected with two of the priority research areas of the TRA 2020: "Climate Change, Mitigation and Resilience" (RA1) and "Planning, Modelling and System Design" (RA8).
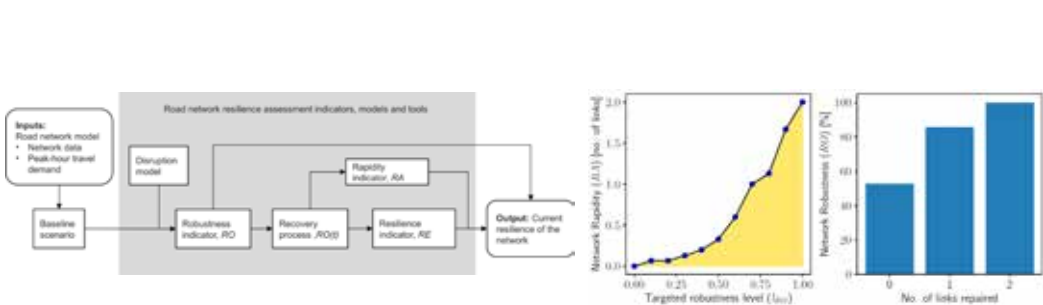
Key Characteristics
Extreme events · Resilience assessment

Jishnu Narayan
Delft University of Technology

Category: **Road**

Country: **The Nederlands**

Research Area 3: **Automation and Robotisation**

Idea Number: **48**

Potential of autonomous vehicles replacing car trips in Amsterdam

The increasing urbanization around the world caused by rapid economic growth has produced an ever increasing need for efficient mobility systems for users in urban areas. The recent advancements in various ICT platforms have facilitated the emergence of autonomous vehicles (AVs). Such services could effectively operate as on-demand service (door-to-door or stop-to-stop, individual or shared). In addition to providing flexible services to passengers, such services could effectively absorb the demand for private cars thereby reducing network congestion and demand for parking. In this context it is timely to assess the impact of such a service on the mobility of users and its potential to replace privately owned car trips. This study investigates the potential of a fleet of autonomous vehicles to replace the demand for private cars for the city of Amsterdam. We developed an agent-based simulation model with day-to-day learning of users for Amsterdam. Results indicated that the fleet of AVs could effectively replace the trips performed by private cars while achieving considerable reduction in the total number of cars used in the network. This could substantially reduce the high levels of on-street parking, thus freeing up public spaces. While AVs operating as taxi-like service produce a marginal increase in the total vehicle-km travelled, use of shared AVs substantially reduce the number of vehicle-km travelled. This could reduce the environmental impact from vehicle emissions in the city.
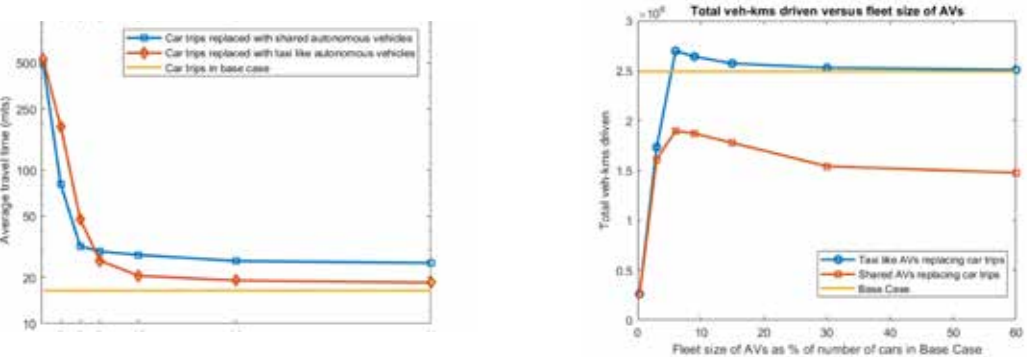
Key Characteristics
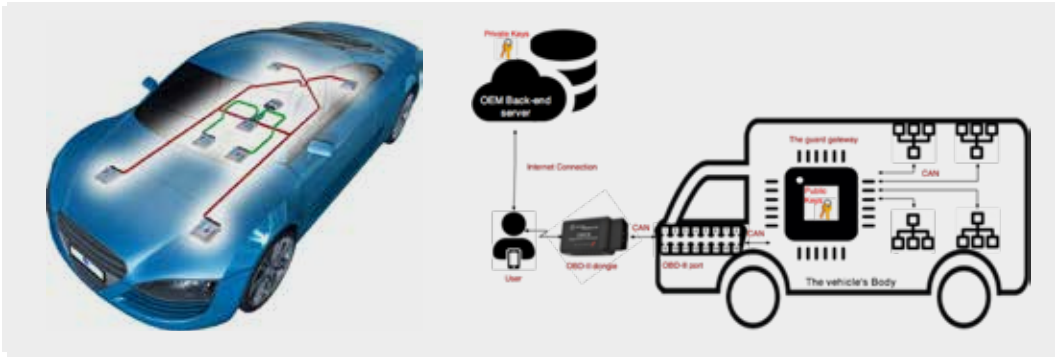Autonomous vehicles · On-demand service · Door-to-door · Stop-to-stop

Mahmoud Ammar
KU Leuven

Category: **Road**   Country: **Belgium**

Research Area 2: **Digitalisation, Digital Safety and Security**   Idea Number: **37**

Securing the OBD-II port in vehicles

Modern vehicles integrate Internet-of-Things components to bring value-added services to drivers and passengers. These components communicate with the external world through different types of interfaces including the on-board diagnostics port (OBD-II), a mandatory interface in all vehicles in the U.S. and Europe. In the current standard, the OBD-II port allows direct access to the vehicle internal network and also software installation on the Electronic Control Units (ECUs). While this historically required physical access to the port using a dedicated tool, today many vehicles support remote access. Because connectivity and security are not pivotal in the design of vehicles, the OBD-II port opens the door to a wide variety of cyber-attacks. We propose a novel, scalable, and lightweight solution to the lack of security in OBD-II ports. Our solution consists in an end-to-end, role-based access-control mechanism based on public-key cryptography able to prevent unauthorized access to any of the vehicle functionality. This solution is AUTOSAR-compliant and architecture-independent, and guarantees a high level of reliability and trustworthiness. Also, because it is purely software-based, it does not require hardware modifications and thus is directly applicable to currently on-road vehicles. Furthermore, any physical attack to a vehicle implementing our solution is not scalable and only limited to that vehicle. We provide a proof-of-concept implementation and evaluation of the proposed solution, showing its robustness and efficiency.

Key Characteristics
On-board diagnostics port • Electronic Control Units • Cryptography

Oyster 2.0
Can lessoned learned from the evolving car-sharing industry in London help shape how journeys are made in the future?

Alex Henderson
University of Westminster

United Kingdom

Road / RA5

Congestion effect on bicycle route choices in Copenhagen

Andrés Fernández Palao
Technical University of Denmark

Denmark

Road / RA8

Poly-functional fibres containing recycling materials for eco-friendly and resilient road paving applications

Shahin Eskandarsefat
University of Bologna

Italy

Road / RA7

Fidere: Introducing users to and building trust in autonomous vehicles through the incremental implementation of an autonomous public transport system.

Robin Severs
Coventry University

United Kingdom

Road / RA3

Transition to Autonomous Mobility: a study with 5,446 hours of simulation

Amin Rezaei
Trinity College Dublin

Ireland

Road / RA3

Troll-E: Improving the Mobility and Independency of the Elderly Population

Hilsann Yong
University of Glasgow

United Kingdom

Road / RA7

Steer-by-wire bicycle

Georgios Dialynas
Delft University of Technology

Netherlands

Road / RA3

Optimal point to induced healing in roads

Daniel Grossegger
University of Nottingham

United Kingdom

Road / RA7

An expedient method For measuring glass beads resistance to scratching

Kevin Wenzel
Hochschule Esslingen

Germany

Road / RA7

TRANSPORT MODE
RAIL

1

Saad Ahmed Khan
Luleå University of Technology

Category: **Rail**

Country: **Sweden**

Research Area 7: **Technology and Engineering**

Idea Number: **1**

Effects of friction modifiers on the friction, wear and cracks of rails

Rolling contact fatigue and wear are two processes that decrease the life of the rails. To increase the lifetime of the rails without decreasing the axle load and speed, a third body with anti-wear and anti-crack properties can be introduced that reduces the wear and rolling contact fatigue (RCF) without reducing the traction coefficient below the safety limit. This research investigated the effects of top-of-rail friction modifiers (TOR-FMs) using computer-based simulations, laboratory tests and field tests, and subsequently life-cycle costs are calculated. The simulation results showed that by reducing the friction, the RCF is also reduced. This effect is more pronounced on narrow curves than on larger curves because the friction force decreases with an increase in the curve radius, and curves with a radius larger than 1,000 m are not prone to RCF. The field results obtained using a handheld tribometer showed that by using a TOR-FM, both the wear and the friction coefficients can be reduced. The content of the TOR-FM can have a significant effect on the carry distance and, generally, non-drying FMs have a longer carry distance. Excessive use of TOR-FM may cause unacceptably low friction and a high operational cost and result in an insignificant increase in the carry distance. The life-cycle cost calculation showed that the on-board system is an economical alternative to the wayside system, as it has lower operation and maintenance costs.

Fig. 1. Normalising of average friction values of different friction modifiers
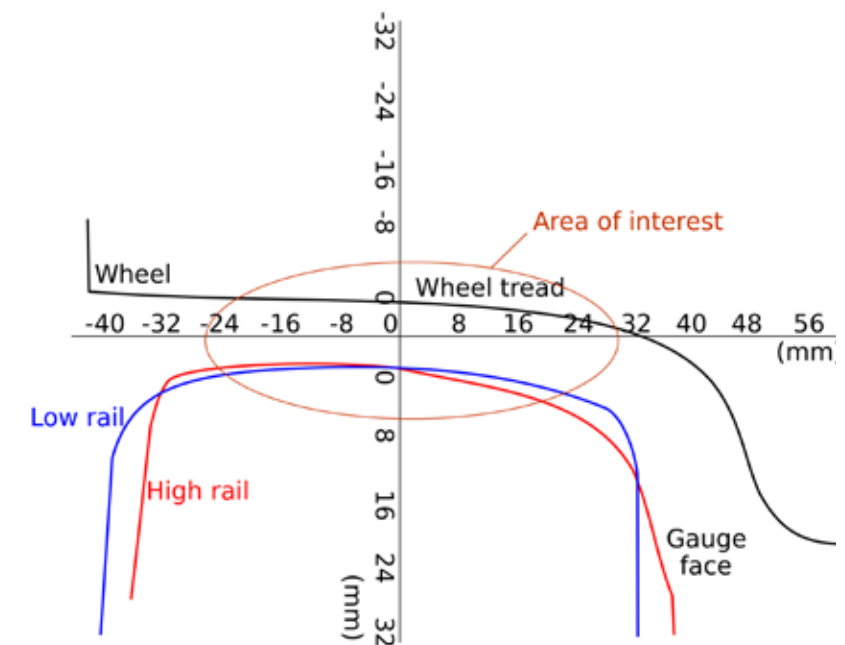
Fig. 2. Worn profiles of wheels and rail (both high and low) used in the simulations

Key Characteristics
Rolling contact fatigue · Wear · Top-of-rail friction modifiers

Visakh V Krishna
KTH Royal Institute of Technology

Category: **Rail**   Country: **Sweden**

Research Area 8: **Planning, Modelling and System Design**   Idea Number: **15**

Track friendliness 4.0

The rail transportation sector across the world in the 21st century is at a unique juncture. On one hand, it is being increasingly acknowledged as the eco-friendliest mode of transportation for its relatively limited emissions. On the other hand, frequent rail-service breakdowns because of aging infrastructure and unsynchronized maintenance planning has led to some questioning its efficiency. However, in the age of the industrial revolution 4.0 there is an opportunity to move over to predictive maintenance strategies considering both the vehicle and the track as a single integrated system. The combination of the relative regularity of the traffic patterns on a railway line for a given period of time, as compared to a highway, with the availability of powerful cloud-computing interfaces opens powerful modelling opportunities. In particular, it is in principle possible to model the integrated vehicle-track interaction over large tonnage and predict maintenance intervals and grade vehicle classes according to the damage they cause to the tracks. This can further encourage innovation in the way we design running gears and maintain our tracks. Moving beyond physical modelling, the research also aims to demonstrate the economic robustness of the method by including an econometric approach guided by engineering principles. The intended outputs of the methodology are to (a) optimize and predict maintenance intervals of railway track sections for the infrastructure managers to help them decide track access charges for different vehicles, (b) guide vehicle builders regarding the dynamic characteristics of vehicle that warrants minimum track damage.

Figure 1: The integrated vehicle-track system approach for better maintenance strategies and innovative running gear solutions. Stakeholders include both the vehicle operators and infrastructure managers
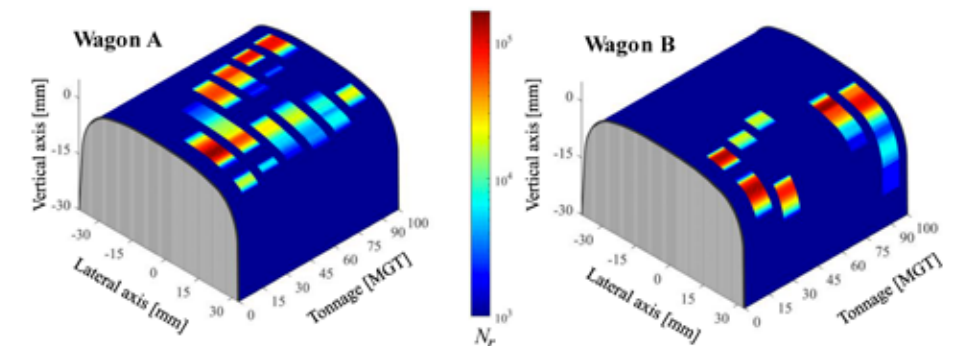
Figure 2. The rail surface damage prediction for two different wagon designs from the simulation module at different periods for a total passage of 100 Million Gross Tonnes (upto 6 years). N_r gives indication to the infrastructure manager on maintenance routines at different points of time. (Model developed by the author)

Key Characteristics
Rail-service breakdowns · Predictive maintenance strategies

3

Matthias Volk, Norman Weik
RWTH Aachen University

|	
Category: **Rail**	Country: **Germany**
Research Area 8: **Planning, Modelling and System Design**	Idea Number: **38**

Reliability analysis of railway station infrastructure based on dynamic fault trees

Infrastructure availability is an essential prerequisite to providing passenger-friendly rail services with minimal delay. At the same time, investments are costly and have long-lasting effects on the operability of railway networks. Hence, detailed a-priori performance analysis is vital to ensure targeted and efficient use of resources. While formal methods have found widespread application in risk analysis and verification of software architectures or interlockings, their use in railway performance analysis remains limited. Even though recently established CENELEC standards call for standardization and formalization of RAMS management, quantitative assessment of infrastructure robustness and resiliency continues to rely on heuristics. Dynamic fault trees (DFT) and stochastic model checking can provide an important contribution to mitigating those shortcomings and providing decision support in infrastructure planning and asset management. In this project, a DFT-based reliability analysis tool has been developed that allows to investigate both the performance of the railway infrastructure as a whole and the criticality of individual components for system operability. As a result, comparative analysis of infrastructure layouts is made possible and focal infrastructure elements can be pinpointed. In a fully automated approach, the infrastructure is read from common exchange formats such as railML and train routes and their required elements are obtained by graph exploration. A fault-tree model is constructed on the train path level that builds on tracks and field elements such as switches, track circuits and signals as base elements. System performance is assessed based on the set of available train routes and performance metrics such as availability or mean-time-to-failure.

Key Characteristics
Railway performance analysis · RAMS management · Standardization · Dynamic fault trees
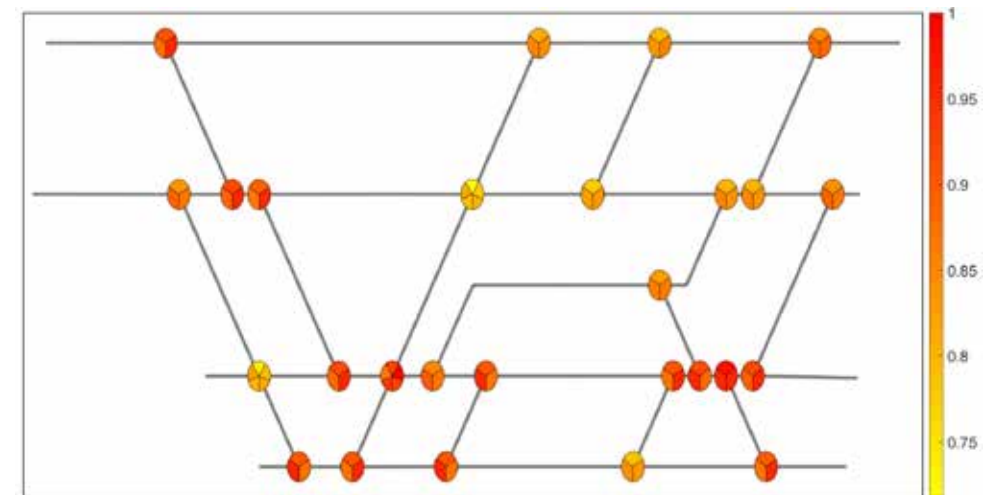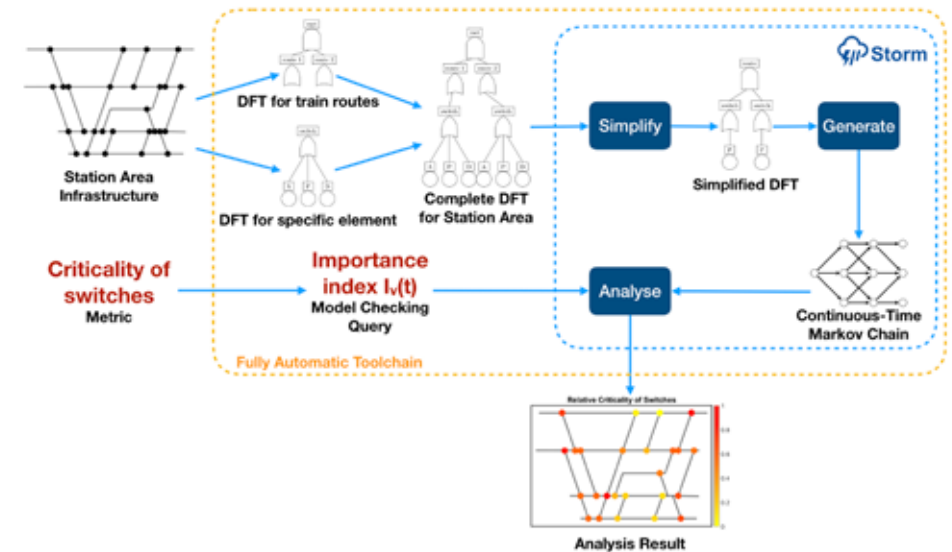
M.R. Mahendrini, Fernando Ariyachandra
University of Cambridge

Category: **Rail**   Country: **United Kingdom**

Research Area 3: **Automation and Robotisation**   Idea Number: **20**

Digitally twinning the geometry of catenary masts in existing rail infrastructure

The time required for generating an object-oriented, geometric railway model of an existing railway from point cloud data is roughly ten times greater than laser scanning. Therefore, the cost and effort of modelling existing rail infrastructure from point clouds often outweighs the perceived benefits of the resulting model. This cost and effort can be reduced by automating the process of creating such models. To achieve such automation, the first challenge is detecting masts from air-borne LiDAR data, as their position and function is critical to the subsequent detection of other elements. This project presents a method that tackles this challenge by leveraging the highly regulated and standardised nature of railways. Railway infrastructure geometric relations remain roughly unchanged over long distances within established regions. Our method initially cleans the point cloud data and roughly detects its positioning and orientation. The resulting datasets are then processed to restrict the search for masts relative to the distance from the track centraline. Subsequently, the method verifies the masts' presence with the use of the RANSAC algorithm. The method also determines the coordinates of the identified masts and finally delivers detected point clusters of the masts as 3D models in IFC format. We implemented the method in a prototype and tested it on three railway point cloud datasets with a cumulative length of 18km. The results indicated that the method achieves an overall detection rate of 94%. This is the first method that automatically detects masts from air-borne LiDAR data.
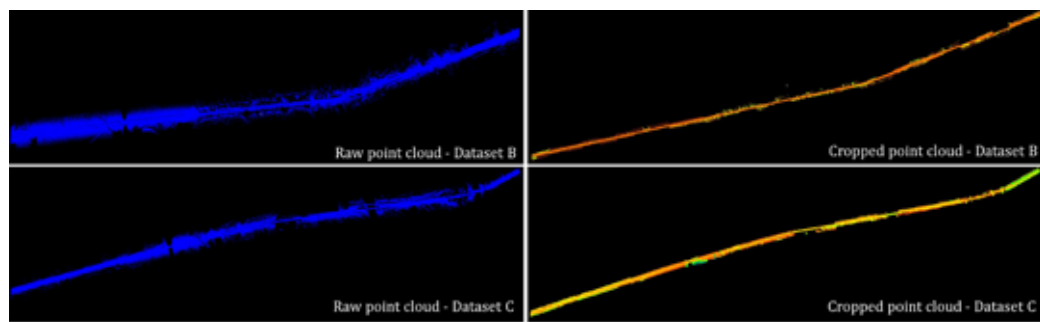
Key Characteristics
Geometric railway model · Point clouds · Masts detection · LiDAR data

Marilisa Botte
Federico II University of Naples

Category: **Rail**   Country: **Italy**

Research Area 3: **Automation and Robotisation**   Idea Number: **7**

An optimisation framework for implementing energy-saving strategies in a passenger-oriented perspective

The proposed research aims at providing a Decision Support System (DSS) for optimising railway dispatching activities, both at planning and operational stage. Specifically, the maximisation of railway energy efficiency is pursued. However, the operational perspective is combined with a passenger-centric evaluation, thus providing an exhaustive analysis. For this purpose, an accurate modelling of railway service and related interactions with travel demand and energy domain is required. In particular, the adoption of energy-efficient speed profiles, while reducing the consumption of energy, also provides an increase in train running times. This has two consequences: i) the increased running times need to be compensated by specific time aliquots properly scheduled and allocated in the timetable, to avoid compromising rail operation stability; ii) the passenger travel times also increase, and therefore an accurate evaluation of the trade-off between the reduction in energy consumption and the increase in passengers' discomfort is required. In addition, given the high vulnerability of railway operations to system failure, the proposed research also focuses on rescheduling strategies which are aimed at re-establishing ordinary service conditions as soon as possible, minimising side effects both on operations and users' satisfaction. A comprehensive methodological structure has been developed to implement the proposed DSS on a practical basis. This methodological framework combines ad-hoc simulation techniques and optimisation tools specifically developed to determine the best trade-off between railway energy efficiency and operational stability, and passengers' comfort.
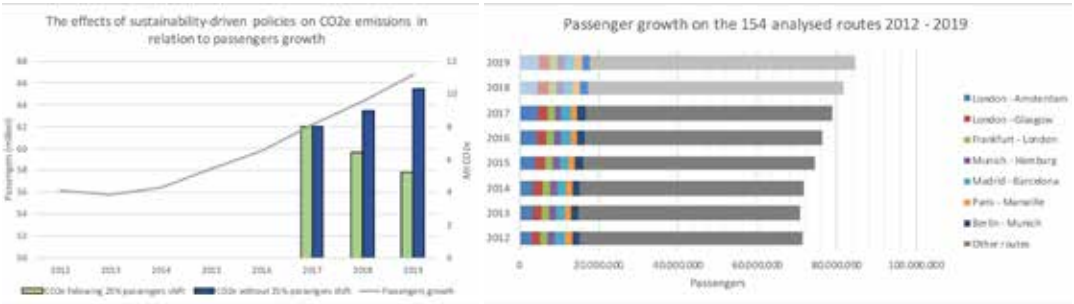

Key Characteristics
Decision Support System · Railway service modelling

Alessio Tardivo
University of Potsdam

Category: **Rail**   Country: **Germany**

Research Area 1: **Climate Change, Mitigation and Resilience**   Idea Number: **122**

Can railway reduce greenhouse gas emissions from the transport sector?

This study analyses CO_2 emissions resulting from short-distance air passenger transport within the EU which could be cut in case of transfer to high-speed rail (HSR). Sustained by empirical data and current literature, this study calculated the $CO_2$2 equivalent production resulting from air transport of about 79 million passengers between 49 European cities along 154 routes. The resulting CO_2 production of 7,98 mt accounted for more than 0,17% of the entire European transport sector emissions and 4,89% of the CO_2 equivalent production from all European airports. Subsequently, the possible scenario in terms of CO_2 production following adequate sustainability-driven policies has been estimated. Limited investments in the rail sector on 25 of these 154 routes would allow HSR to be competitive with air transport, thus cutting CO_{2s} emission. An expected passenger increment of 3,5% and a 25% shift from air to rail transport on these routes will save up to 1,59 Mt CO_2. Furthermore, investments in the current rail network would expand the passengers' possibility for shifting transport mode even on routes longer than the ones here analysed. For instance, if only four routes between the five major EU cities were considered within the same scenario, investments could decrease the total transport sector emission by an additional 0,02%. An enhancement of the rail network, a change of mindset in the passengers regarding air transportation and sustainability-driven policies could start a ripple effect with positive outcomes for the entire transport sector.

Key Characteristics
High-speed rail · Rail network

Mehmet Sirin Artan
Yildiz Technical University

Category: **Rail**   Country: **Turkey**

Research Area 8: **Planning, Modelling and System Design**   Idea Number: **60**

Investigation of train delay prediction with homogeneous and non-homogeneous Markov Chains

Passenger trains in The Netherlands are an important transport mode with millions of passenger traveling every day. A detailed planning of the railway operations is vital to ensure comfortable and on-time trips to the passengers and an efficient exploitation of the railway network. Because railway systems are complex and competition amongst various transportation systems is high, the need for efficient capacity utilization due to economic reasons increases the importance of planning function. However, train movements are subject to disturbances and disruptions, which may cause late departures and/or late arrivals at stations with respect to their pre-determined times. Train delay prediction has been a popular problem amongst the researchers and multiple approaches have been proposed, from econometric models to stochastic models based on Bayesian networks. In this work, we start from the consideration that, because of the many possible causes of disturbances and disruption, individual train movements and train traffic are exposed to randomness. This perspective calls for adopting stochastic modeling approaches for train delay prediction. Markov chains is a widely used analysis and modeling tool for systems with stochastic processes. In this study, two homogeneous and one non-homogeneous Markov chain models are developed and used to predict delays and delay probability distributions of trains at their subsequent activities by using Dutch railways data. The results show that non-homogeneous Markov chain model can make better predictions than homogeneous Markov chain models.
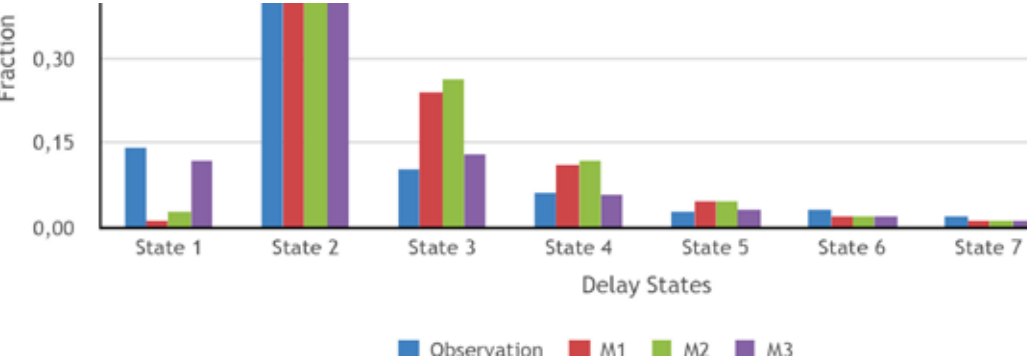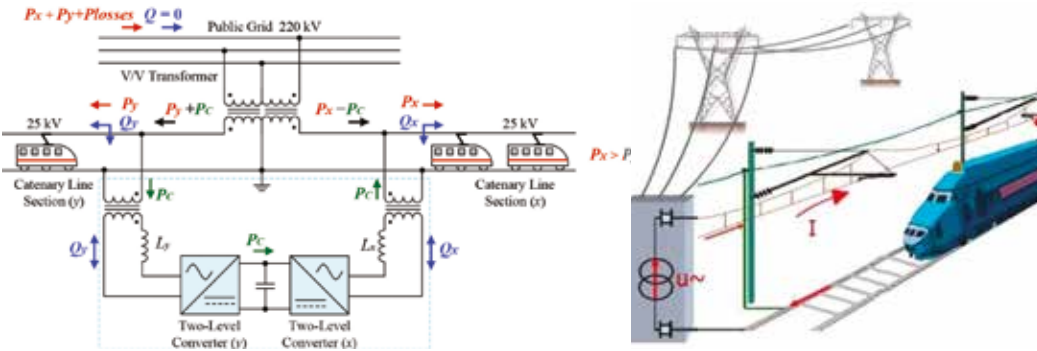

Key Characteristics
Railway operation · Markov chain models

Mohamed Tanta
University of Minho

Category: **Rail**	Country: **Portugal**
Research Area 4: **Electrification, Energy and Power Alternatives**	Idea Number: **11**

Power quality improvement in electrified railway using a rail power conditioner based on modular multilevel converter

Nowadays, most of the high-speed electric locomotives use the AC power system for long-distance electrification. The AC traction power system is normally a single-phase system connected through power transformers to the three-phase public power system. These high-speed trains usually cause significant perturbations in the electrical system around or nearby, thus impacting the power quality of the system as a whole. Despite this problem, the improvement of power quality on the single-phase traction power system has not been historically investigated in detail because the electrical traction load has a poor power quality by nature. This is because of the single-phase non-linear load characteristics that causes three-phase voltages and currents imbalance. Consequently, most of the power quality improvement studies in railway electrification are focusing on the power quality improvement of the three-phase public power system. The typical power quality problems in high-speed electrified railway systems are: current imbalance, voltage and current harmonics, reactive power, and low-frequency voltage fluctuations. Furthermore, the non-linear and the dynamic nature of the high-speed electric locomotives make the improvement of such power quality problems a rather difficult work. In this context, the idea of this project is to use a power compensator-based power electronics technology known as "rail power conditioner" to balance active power and compensate reactive power.

Key Characteristics
AC traction power system · High-speed trains

Behzad Farahani
Faculty of Engineering of the University of Porto

Category: **Rail**	Country: **Portugal**
Research Area 3: **Automation and Robotisation**	Idea Number: **17**

Innovative methodology for railway tunnel inspection

Railway tunnels deteriorate due to ageing, environmental factors, damage, inadequate maintenance and deferred repairs. The increased perception of those problems, led by advances in analysis techniques, further stresses the necessity to deploy fully automated systems for inspection and condition assessment. The latest developments in automation and laser technology support the development of innovative tunnel inspection systems and increasingly point towards automation of these systems in comparison with formerly human operated systems. The significance of commensurate inspection methodologies to address potential problems is at the forefront of monitoring systems for problems that may affect tunnels' integrity. Detecting and characterizing geometrical changes and defects is decisive for effective inspection, investigating tunnel state, and scheduling maintenance operations. This work introduces a methodology design following an image-based technique and a demonstrator relying on 3D Laser Scanning System, which was built and tested. The system consists of a laser and a camera mounted on train's front and back to perform image acquisition of projected laser lines as train passes through tunnels. Acquired data is processed and compared to the original shape to identify geometrical changes. At a second stage, once a substantial geometrical change is located, a non-destructive inspection tool based on Digital Image Correlation (DIC) was developed to characterize existing defects that led to diverge from the original geometry. The main advantage and novelty of the deployed system is a novel technological design, contributing to examine structural integrity of railway tunnel components by acquiring tunnel geometry over time combined with DIC.
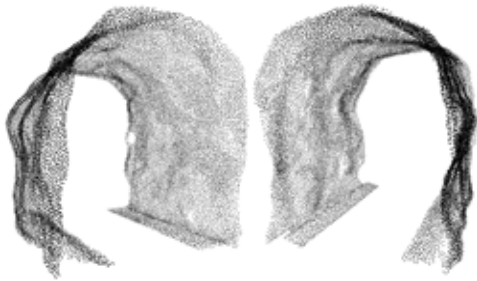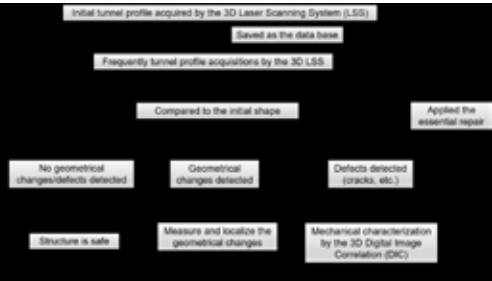
Key Characteristics
Railway tunnels · Digital Image Correlation

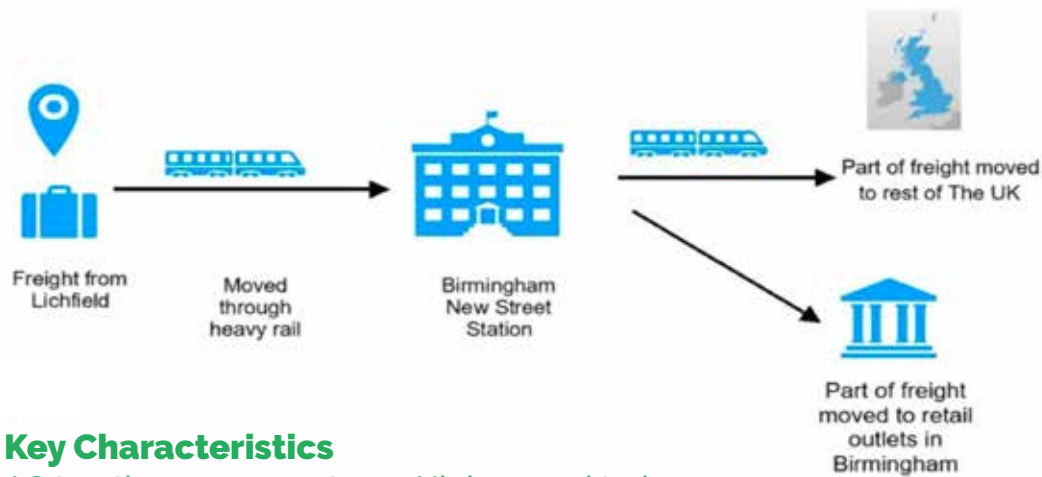## Praful Potti
Aston University

Category: **Rail**   Country: **United Kingdom**

Research Area 8: **Planning, Modelling and System Design**   Idea Number: **121**

A simulation study on the potential of moving urban freight by a cross-city railway line

This study analyses the scope for moving urban freight through the existing rail network. This is achieved by first evaluating the utilisation levels of the Cross-City line in The United Kingdom (UK), running between Lichfield Trent Valley and Birmingham New Street. A simulation model of the current railway system is implemented using the SIMUL8 computer software. The results from the simulation model suggest that the Cross-City railway line is being under-utilised, and thus new services could be introduced that exploit the existing infrastructure and improve the utilisation levels of the railway line. This paper presents three scenarios that have the potential to carry urban freight by rail on the above-mentioned line. These scenarios not only enhance the current utilisation levels of the line, but also reduce the amount of Green House Gases emitted by Heavy Goods Vehicles (HGVs) on the motorways and highways. The total number of services operated on the line is varied among different scenarios. In our best-performing scenario, the number of train services running in a day increases by 108, corresponding to a raise in utilisation levels by 341.71% compared to that of actual system. In the proposed scenario, 5400 HGVs per day are removed from the road, with a consequent reduction in Carbon Dioxide emissions by approximately 5.4%. All the scenarios presented in the study assures a sustainable way to move urban freight by rail, which can potentially reduce congestion and emission on roads in the West Midlands region.

Freight from Lichfield → Moved through heavy rail → Birmingham New Street Station → Part of freight moved to rest of The UK / Part of freight moved to retail outlets in Birmingham

Key Characteristics
AC traction power system · High-speed trains

**TramTrainer
A new approach in digital tram Driver Training**

Lena Scharbert
Hochschule München

Germany

Rail / RA12

Electric Cargo

Armin Kahrom
Politecnico di Milano

Italy

Road / RA7

Towards a European mobility with railways as backbone

Jacqueline Kommers
Technische Universität Berlin

Germany

Road / RA9

An efficient public-private partnership model for High-Speed Railway transport

Mario González-Medrano
Universidad Camilo José Cela

Spain

Road / RA11

TRANSPORT MODE
WATERBORNE

1

Thiago Pessôa
Technical University of Denmark

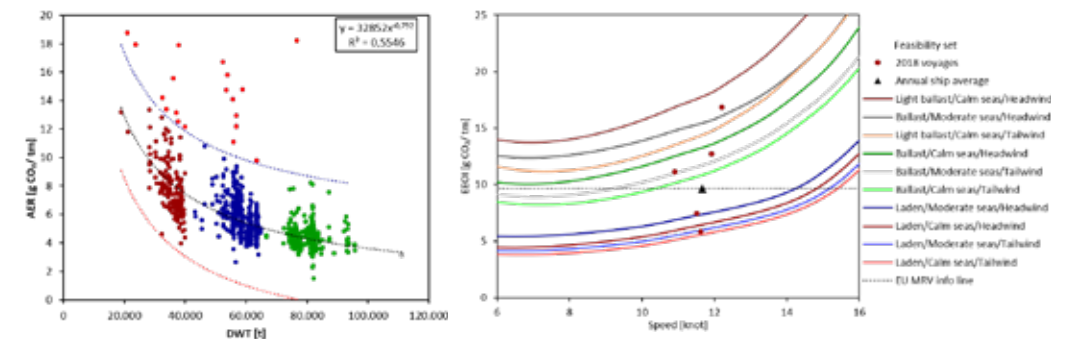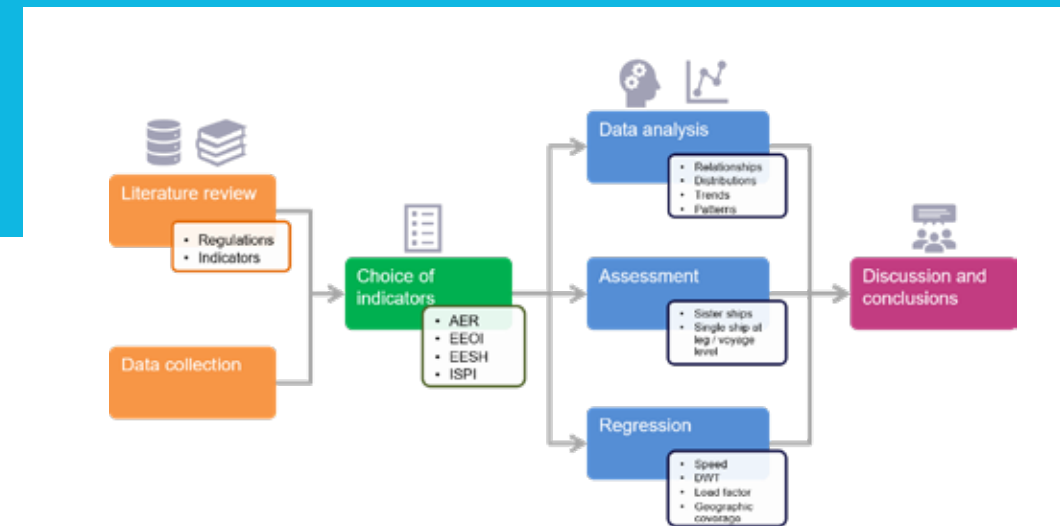| Category: **Waterborne**	Country: **Denmark**
Research Area 9: **Technology and Engineering**	Idea Number: **58**

Monitoring, reporting, and verification of CO2 emissions in shipping: identification and comparison of available methods

Although maritime shipping is by far the most carbon-efficient transport mode, the industry has recently announced its ambitious strategy on reduced carbon emissions. The monitoring of CO2 emissions is the first step in pursuing this strategy. Two major initiatives have been launched in this respect: The Monitoring Reporting and Verification scheme of the EU, and the Data Collection System of the IMO. Despite sharing the ultimate aim of improving the sector's carbon footprint, the two initiatives differ in the adopted approach and tools. A number of additional metrics have also been proposed for monitoring the fuel efficiency of ships. In the framework of the MASSHIP research project, funded by the Orients Fund of Denmark, the present thesis uses data on fuel consumption and CO2 emissions from leading Danish companies to compare the EU and IMO approaches, assess the effectiveness of the proposed performance indices and draw policy and R&D recommendations. Data on the voyages performed in 2018 by a fleet of 1,332 ships in total consisting of dry bulk carriers, tankers, containerships and Ro-Ro ships are analyzed. The role of factors such as speed and capacity utilization on variations among sister ships or even among the voyages of a single ship is investigated. The results show that none of the indicators examined is robust enough to provide reliable information on the fuel efficiency of ships, while the geographic restrictions of the EU scheme introduce additional exogenous bias.

Key Characteristics
Monitoring, reporting and verification scheme · Data collection system

Alexandros Lampoglu, Christos Mantolas
Newcastle University

Category: **Waterborne**	Country: **United Kingdom**
Research Area 8: **Planning, Modelling and System Design**	Idea Number: **35**

Automated fuel oil management unit

International shipping has been identified as a large and rising source of emissions of pollutants globally. The International Maritime Organization adopted strict regulations (2020) for emission levels, especially for ships operating in Emission Control Areas (ECA). The 2020 regulation will enforce a global sulphur oxide (SOx) emission limit of 0.5% while the limit in the ECA zones is 0.1% since 2015. The ship owners will be forced to reduce the environmental impact of their activities. Switching to a lower sulphur fuel is the simplest and cheapest method to comply. However, special attention is required in the changeover procedure, that is switching from one fuel to another, because the plurality of ship operators which proceeds to manual changeover can negatively affect the components in the fuel oil system (pumps, injectors, purifiers etc.). The aim of the project is the development, optimization and simulation of a cost-effective automated fuel oil management unit to execute safely the changeover procedure. The project consists of a retrofit feasibility study and report on a modern oil tanker including the 3D model of the unit and detailed mathematical modelling of the system to optimize the changeover procedure. A physical model was developed to emulate the system with real-time input measurements (i.e. temperature sensor), a programmable logic controller (PLC) and a touch panel, where the process is presented. The system is programmed to operate safely according to the manufacturer's needs and redundant under emergency situations to avoid wear in the engine components.

Key Characteristics
Ship environmental impact · Automated fuel oil management unit

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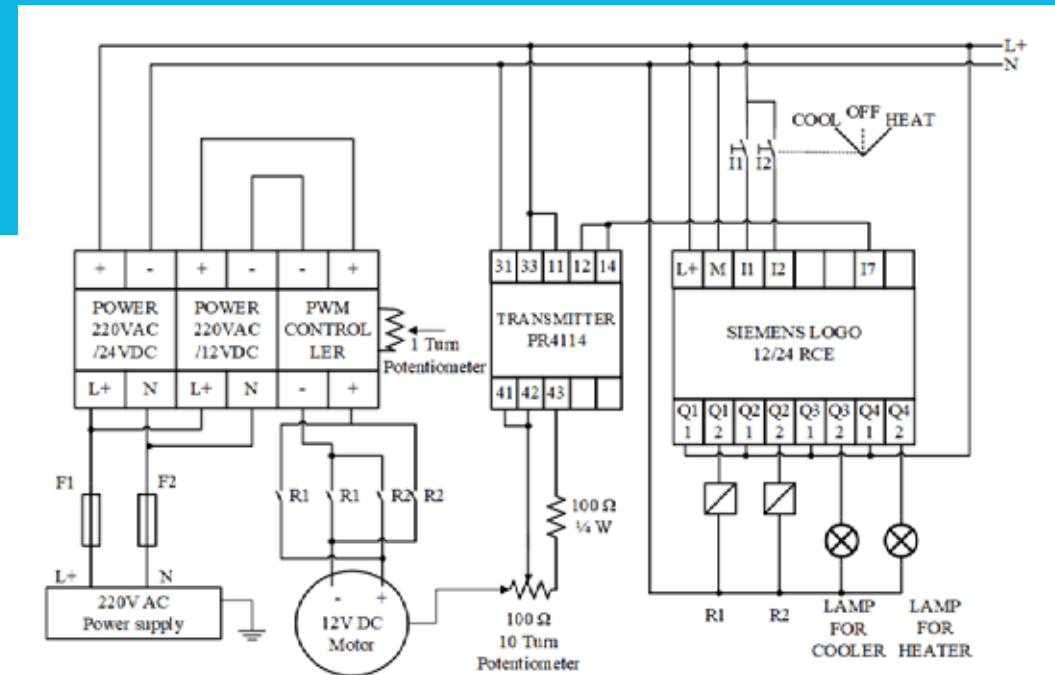
Victor Bolbot
University of Strathclyde

Category: **Waterborne**

Country: **United Kingdom**

Research Area 10: **Transport Safety and Security**

Idea Number: **45**

Dynamic blackout probability monitoring system for cruise ship power plant

The continuous research and initiative projects developments have resulted in new types of systems, with increased components number and implementing new functionalities, such as those on autonomous ships. The increased complexity introduces new hazards since it obscures the human operator on ships or in shore control centre in case of autonomous ships, as she/he has to comprehend an increased number of system parameters, often in limited time during critical operations. In addition, the human operator may not be aware of critical situation arising in the system due to component failure, which may lead to accident. The aim of this research thus is to enhance the safety of maritime complex systems operations by integrating the existing safety models with system information available from sensors. For this purpose, a previously developed Fault Tree model of Blackout in a cruise ship is employed and suitably adjusted. Then, the safety related parameters and information that can be already monitored are integrated with the Blackout Fault Tree to estimate the Blackout Probability in time, accounting for the new available information. The suggested concept is validated within the Matlab/Simulink Environment. The benefit of this approach is that it integrates a number of sensor measurements and alarms in one metric and applies dynamic components criticality assessment, reducing operator cognitive load, allowing the human operator to react faster to arising hazardous situations and preventing them from developing further in accidents.
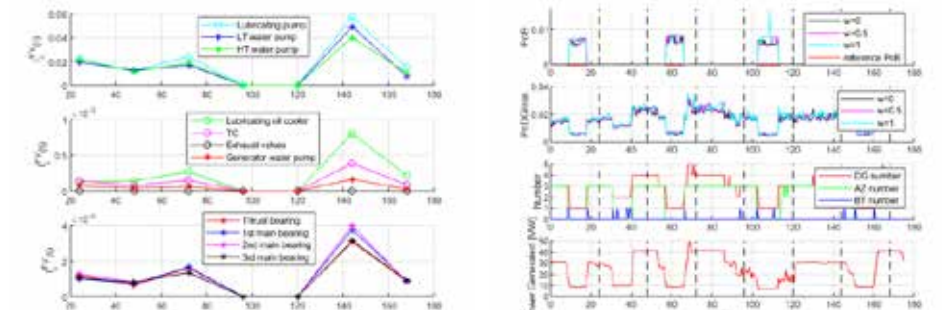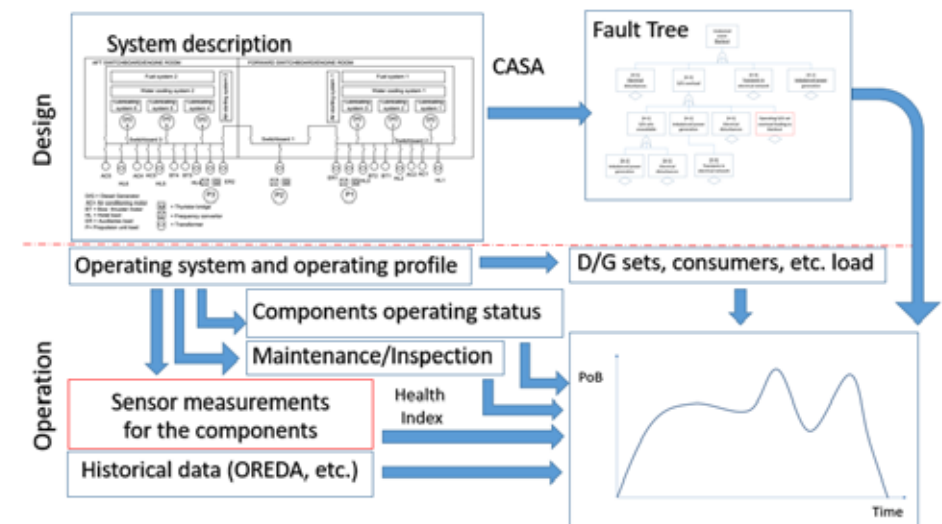
Key Characteristics
Safety · Maritime complex system operations · Fault tree model of blackout

Luca Donatini, Thibaut Van Zwijnsvoorde
Ghent University

Category: **Waterborne**   Country: **Belgium**

Research Area 7: **Technology and Engineering**   Idea Number: **47**

A new solution for turning an inland navigation ship on a very narrow waterway

When inland navigation ships leave or arrive at their berth, they often need to turn around to change direction. In narrow canals and rivers a wider area, called turning basin, allows for this swinging manoeuvre. The diameter of this basin, recommended by international guidelines, is often larger than physically possible, due to environmental and geotechnical restrictions. Real-time ship maneuvering simulations should be used for specific fairway designs, with afore-mentioned constraints, defining the strict minimum dimensions for safely completing this ma-neuver. The dimensions of the turning basin can be further reduced by using a fixed point in the form of a dolphin to which the ship attaches (at bow or stern) with a mooring line. The ship turns around this fixed point. However, this maneuver is unusual and the manipulation of the mooring ropes by the crew is dangerous. A fixed connection using an automatic rigid vacuum or magne-tic pad, replacing a mooring rope, would greatly optimise this technique, eliminating the risk and further reducing the needed turning area. The study focuses on investigating the technical feasibility of this system as well as dimensioning the system. A comparison between the three approaches (without fixation, fixation with mooring lines, and fixation with rigid connection) will be part of the project. Such a solution will lead to an optimal use and increased capacity of the waterway network, which is also beneficial for decreasing greenhouse gases as inland navigation is the most environmentally friendly way of transporting goods.
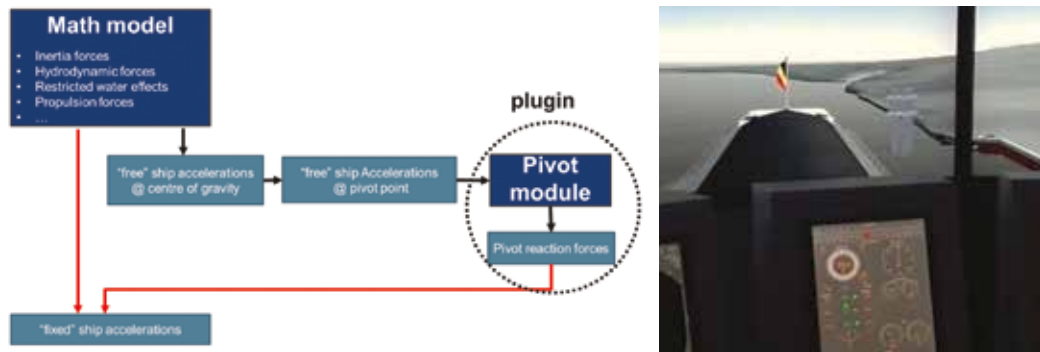
Key Characteristics
Inland navigation ships · Real-time ship maneuvering simulations

Pooran Chand Meena
World Maritime University

Category: **Waterborne**   Country: **Sweden**

Research Area 9: **Policy and Regulation, Market Efficiency, Competitiveness**   Idea Number: **106**

The protection of the marine environment within the territorial seas and continental zone of India as part of salvage interventions

This paper is a study of the salvage laws applicable and enforced in India for protecting the mari-ne environment as part of salvage interventions and the practical solutions to genuine problems of salvage and ways for parties to resolve disputes. The study includes the correlation between Indian and international laws on protecting the marine environment through special attention to salvage under the International Salvage Convention, 1989. A review of salvage contracts and role of insurance in different contracts for various types of salvage operations to protect the ma-rine environment and the rights of coastal State and ships in territorial and contiguous zone is undertaken. It includes a discussion on the use of special equipment in such operations, the preparedness of salvors to deal with challenging situations in hostile weather conditions, and other new developments in salvage. The respective roles of bodies and organisations involved in salvage operations such as salvage companies, the International Salvage Union [ISU], Indemnity Clubs, Machinery underwriters, Ship Owners, Maritime Administration, etc.. are addressed as well. Further, the review of two cases related to marine environment in Indian waters has been analy-sed. The range of salvorial skills available for any salvage operation is examined based on number of successful salvage operations in marine environment protection. The trade-off skills required for ship owners to negotiate with salvage companies or operators for quick action are examined.
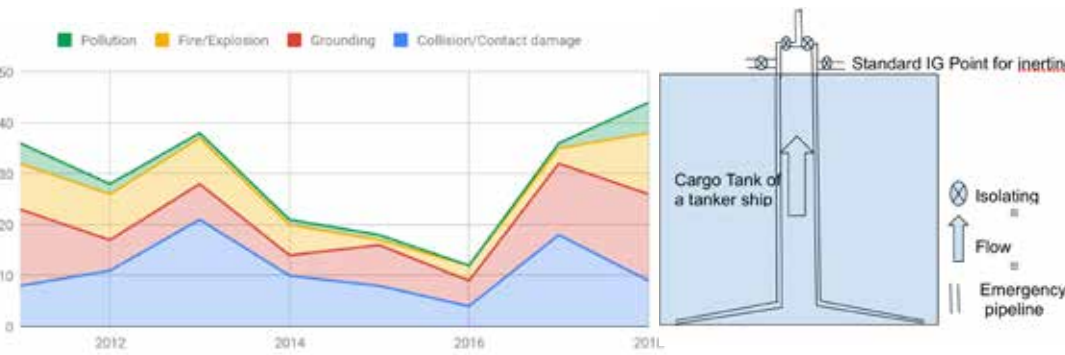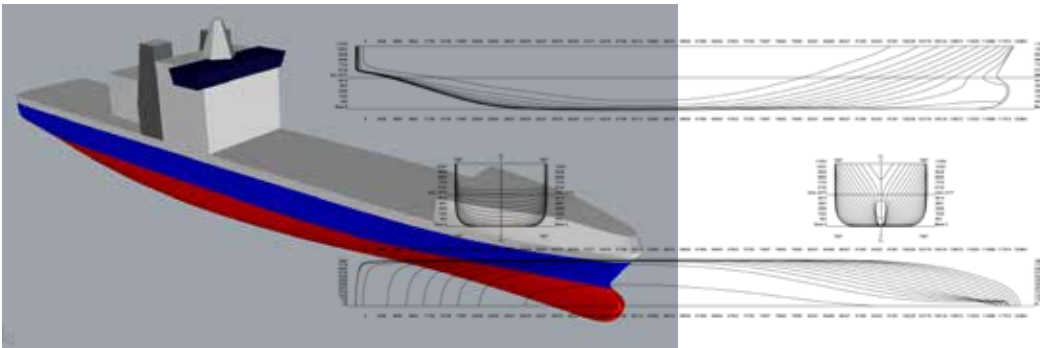

Key Characteristics
Salvage interventions

Joao Santos
University College London

Category: **Waterborne**   Country: **United Kingdom**

Research Area 1: **Climate Change, Mitigation and Resilience**   Idea Number: **116**

Disaster response vessel

On disaster response situations, waterborne intervention might be the best way to supply aid to the distressed population. However, vessels specifically designed to this task are scarce because of their rare utilization per year. To reduce the ownership costs and increase vessel efficiency, we designed a vessel that operates as a commercial RORO (roll-on/roll-off) but is readily converted to operate as disaster response vessel. With this concept of operations, the ship will be owned by the disaster response stakeholder (governmental or NGO) and the operations will be shared by a commercial operator via a charter contract. A 120-meter-long vessel was designed with 7685 tons of displacement, able to run RORO commercial operations and accommodate 'functional' containers with plug-in points. These containers convert the ship from a RORO vessel to a disaster relief vessel. With this solution, the re-role requires only a few hours by design. The containers devised for installation provide the following capabilities: 22 hospital beds, 52 accommodation beds, fresh-water generation with capacity to produce 1500 m3/day, refrigerated cargo containers for 84 tonnes, dry cargo containers for 504 tonnes and two GENSET containers with capacity for 3200 kW. These containers will be supported by the ship auxiliary systems and from their integrated systems. The ship is equipped with 4 Diesel Generators with 9980 kWe total capacity and propelled by two directional pods with maximum speed of 18 knots. The estimated cost for one ship is 105 million GBP.

Key Characteristics
Disaster response · Waterborne intervention

Konstantinos Bartzis, Aristotelis Betsis, Anastasios Pavlidis, Stefanos Xenikakis
University of Strathclyde

Category: **Waterborne**   Country: **United Kingdom**

Research Area 1: **Climate Change, Mitigation and Resilience**   Idea Number: **120**

Ocean cleaning environmentally friendly vessel

Plastic pollution of the oceans is an ever-growing issue, that is unfortunately neglected by most of the governing entities, as no incisive action is taken to reduce the pollution rate or remove the plastic contaminating the sea environment. Million tons of plastic end up in the oceans annually, which does not only destroy the natural landscape, but most importantly endangers the marine environment fauna and the overall food chain. The largest garbage concentration is observed in the five Great Garbage Patches, also referred as "Garbage Islands". To tackle this issue, the Blue Sea Project proposes a novel idea, which aims to reduce the amount of floating plastic in the ocean, by designing an environmental-friendly garbage-collecting vessel, aimed at removing the garbage from the Great Pacific Garbage Patch (1st phase). The designed vessel collects the floating plastic (and other garbage) with an innovative reverse-operation technique. An onboard garbage management plant, treats, separates and stores the garbage, until they are unloaded in inland recycling facilities. The vessel is powered by the gate rudder, an innovative propulsion system whose superior performance and energy efficiency is perfectly fit to the vessel's multidimensional operation. The use of Energy Saving Devices (ESD), such as Flettner rotors and solar panels, and batteries reduce the vessel's emissions and provides a significant level of carbon-free autonomy. To summarise, the Blue Sea Project proposes a viable plan, of the design and operation of an eco-friendly ocean-cleaning vessel.

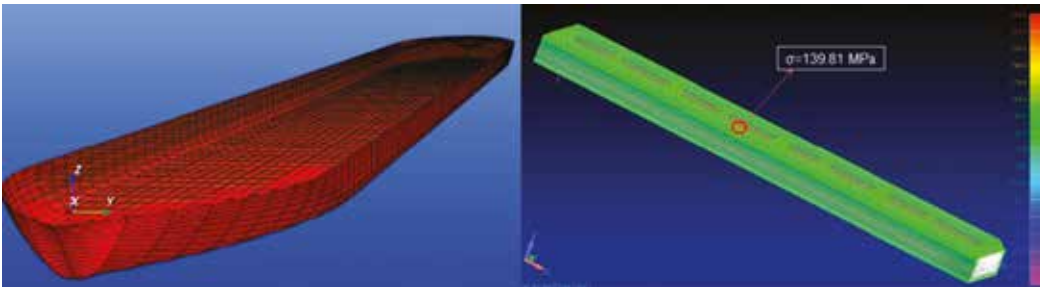## Key Characteristics
Ocean pollution · Ocean-cleaning vessel

Sohanur Rahman
University of Liege

Category: **Waterborne**	Country: **Belgium**
Research Area 8: **Planning, Modelling and System Design**	Idea Number: **3**

Investigation of hull strength of river sea container vessel

River sea vessels are ships for inland navigation and suitable for restricted navigation at sea in regions where wave height does not exceed two meters. In a container vessel structure, almost the entire deck space is occupied by hatches, leaving a narrow strip of deck plating outboard. This calls for a topside structure of heavy plating or a double hull to provide material in tension, stiffness against lateral and torsional loads, and resistance to buckling in compression when the vessel is in sagging condition. For sea going open deck vessels, torsional loading plays a predominant part to the hull girder strength and for inland navigation open deck vessels; the effect of torsion is rather negligible. Keeping this scenario in mind, the aim of this project is to investigate the hull strength of a river sea container vessel under combined bending and torsional loading to study the effect of torsion on river sea open deck vessel. To perform the strength analysis, a finite element model of the investigated vessel is calculated which also determines still water and wave loads. Subsequently, such a model is verified with classical beam theory and thin wall girder theory. The effect of various loading conditions on structural response is also investigated. The structural responses of different hull configurations are scrutinized under combined bending and torsional loading. Finally, some recommendations are proposed for structural response of river sea container vessel subjected to combined bending and torsional loading.

Key Characteristics
River sea vessels · Restricted navigation

Shahroz Khan
University of Strathclyde

Category: **Waterborne**	Country: **United Kingdom**
Research Area 8: **Planning, Modelling and System Design**	Idea Number: **102**

I-SHIP: an intelligent interactive design system for greener and customer-centered ship design

The maritime industry is structured on one of the world's most complex engineering systems such as container ships, tankers, super-yachts and cruise ships. Design of these systems is a critical task and improving their efficiency is crucial as it not only impacts the world's economy but also reduces the carbon footprint of this industry. Due to the complexity and massive physical form of these systems, engineers heavily rely on the computational design platforms as building the full-scale prototypes in time-consuming and uneconomical. Usually, computer-aided design systems are used to build and test their performance. However, the non-intuitive nature of these systems hinders the designers in creating optimal designs. We aim to develop a new intelligent interactive design system for the rapid creation of optimal and user-centered designs. The new system will involve generative and interactive design approaches, which will enable designers to interactively induce their preference for designs into the design space exploration and to create a variety of optimal and user-centered of design alternatives. Among them, a user will select a preliminary design with desirable characteristics based on its physical appearance and performance. Lastly, when building products it is essential to incorporate the customer psychological preferences. Therefore, along with the physical evaluation, an important element of shape exploration should be the integration of visual perception of the users. To achieve this, the users' stylistic perception will be interactively integrated with performance metric during the design exploration.
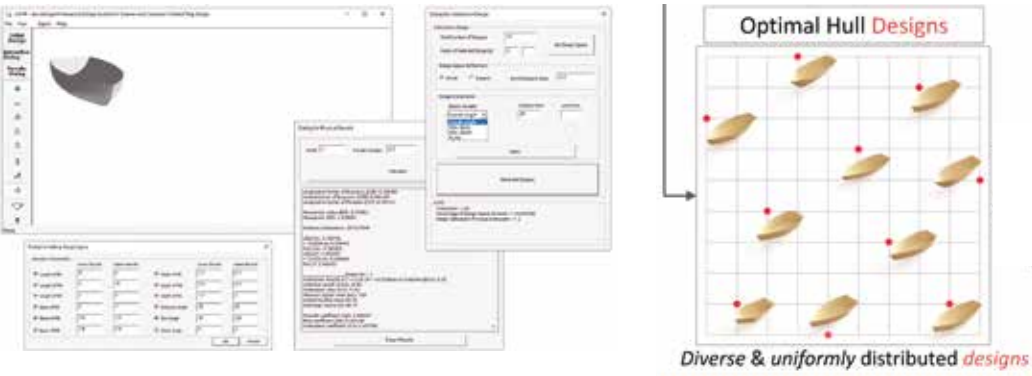
Key Characteristics
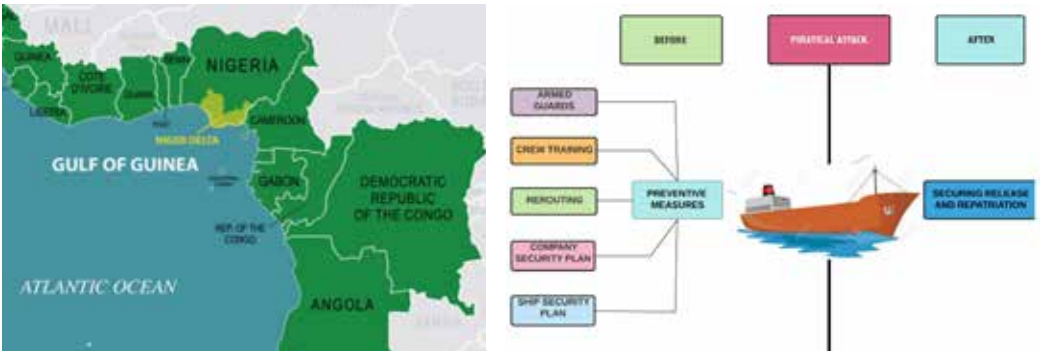Interactive design system · User-centered design

Rajinder Kumar
World Maritime University

Category: **Waterborne**   Country: **Sweden**

Research Area 10: **Transport Safety and Security**   Idea Number: **96**

Strengthening seafarers' rights for securing release and repatriation: piracy in the Gulf of Guinea

From internal waters to high seas, the Gulf of Guinea has recently become a piracy hotspot and transiting ships are at high risk of hijack. There has been much discussion on policies and preventive actions to stop pirate attacks, but the rights of the affected seafarers have been largely ignored. This dissertation focuses on ways to strengthen the rights of seafarers and securing their early release. This dissertation focuses on the role of the shipowner and their contractual agreement with the seafarer. In this regard, the Maritime Labour Convention (MLC 2006) laid down guidelines stressing the role of shipowners in repatriating their seafaring crew. The liability of the shipowner for failing to fulfil the duty of care was examined, and an attempt was made to find a legal remedy for seafarer under "tort of negligence". The analysis of various cases of piracy suggests that securing release by paying a ransom is the most viable solution. Various options for paying the ransom amount were explored: General Average, P&I clubs and Ransom insurance. In addition to covering the ransom costs, ransom insurance also provides for related expenses such as the cost of professional negotiators, liaising with government agencies, the logistics costs of ransom payments and repatriation, and the treatment of injuries (physical and psychological). It is vital that payment of ransom and other expenses are covered in the contract between the seafarer and shipowner so that the former can claim legal remedy if the shipowner fails to fulfil their liabilities.

Key Characteristics
Liability • Piracy

RRS Essi - Future Polar Research and Re-Supply Vessel

Joakim Heinolainen, Alexander Jerne, Juho Särkkä, Vesa-Matti Tala
Aalto University

Finland

Waterborne / RA7

Concept of modular floating parking lot

Ewelina Cioch, Katarzyna Szkaradek
Gdansk University of Technology

Poland

Waterborne / RA8

Exploration of implementation and reporting of hours of work and hours of rest onboard ships

Bikram Singh Bhatia
World Maritime University

Sweden

Waterborne / RA6

Optimisation model of hybrid energy system for ships

Mphatso Nyanya
World Maritime University

Sweden

Waterborne / RA4

Future of cruise shipping in Baltic Sea Region (BSR) Nexus Analysis on Circular Economy

Fhaysal Khan Jadoon
World Maritime University

Sweden

Waterborne / RA1

Energy Pontoon

Manne Stroobants
World Maritime University

Belgium

Waterborne / RA4

Mapping future skills for the kenyan seafarer

Talib Mohammed
World Maritime University

Sweden

Waterborne / RA12

AMBER: a submarine with renewable energy for touristic/personal usage with a touristic catamaran and a removable pontoon for touristic/personal usage with a touristic catamaran and a removable pontoon

Arda Can Akbas
Istanbul Teknik Üniversitesi

Turkey

Waterborne / RA7

Improving Tribocorrosion Resistance of Marine Equipment and Components

Sabri Alkan
Bartin University

Turkey

Waterborne / RA7

TRANSPORT MODE
AIRBORNE

①

Matteo Marchionni
Brunel University London

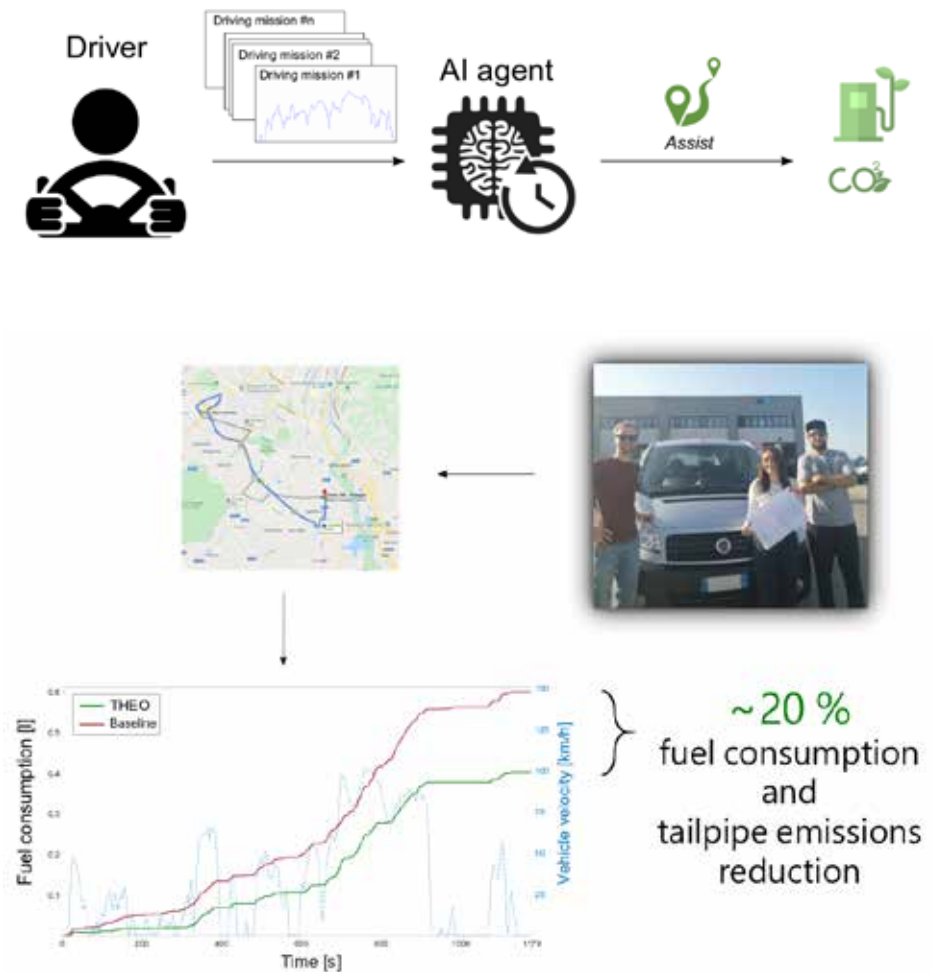| Category: **Airborne**	Country: **United Kingdom**
Research Area 4: **Electrification, Energy and Power Alternatives**	Idea Number: **112**

A novel concept for a zero-emission aircraft turbo-fan engine using CO2 in the supercritical phase as primary working fluid

Increasingly stringent regulations are driving the aviation industry to innovate to reduce aircraft engine emissions. Commonly-pursued approaches, such as the turbo-gas performance increase and the reduction of the wasted thermal energy expelled with the engine exhausts, limit the emissions only up to a certain extent. More promising would be the electrification of aircrafts, which however poses strong technological challenges regarding energy storage, electric machine design and flight autonomy. In this context, this project proposes a more feasible concept for a zero-emission turbo-fan aircraft engine. A closed-loop Brayton cycle using carbon dioxide in supercritical phase (sCO_2) as working fluid is used to drive the Low-Pressure air Compressor (LCP) and the Fan (FAN) and replace the gas engine typical of conventional aircrafts (HPC plus HPT and LPT). The thermal energy to heat up the CO_2 and thus to power the engine is provided by hydrogen oxidation, which also cuts emissions because only water steam is produced by the combustion reaction. The steam is subsequently separated from the CO_2 and injected in the air flow supplied by the LCP and the FAN to increase the engine thrust. Further advantages are: reduced engine weight and dimensions, since the sCO_2 is 10 times denser than air and allows to downsize some engine components; higher propulsive efficiency, thanks to the greater performance of sCO_2 power cycles; and the downsizing of the air compressor (because air is no longer used to power the engine).

Key Characteristics
Aircraft engine emissions · Zero-emission turbo-fan aircraft engine · Carbon dioxide in supercritical phase

Roberto Merino-Martinez
Delft University of Technology

Category: **Airborne**   Country: **The Netherlands**

Research Area 6: **Social Change and Quality of Life**   Idea Number: **6**

Seeing with sound, towards silent aviation

The World Health Organization (WHO) highlighted in their report from 2018 that noise pollution is now Europe's second largest environmental health threat after air pollution. Aircraft noise is one of the main contributors and it causes high annoyance and health issues to the population living near airports. Despite the fact that the noise levels from individual aircraft have considerably decreased in the last decades due to noise-reduction technologies, the ever-increasing demand for flights causes the volume of air traffic to approximately double every 15 years, considerably worsening this situation. This report proposes a novel idea for evaluating and reducing the environmental impact of aviation: the "Aircraft Environmental Impact Monitoring Station" (AEIMS). This station consists of a microphone array capable of performing acoustic imaging (i.e., visualising sound) and an integrated processing unit that provides the noise levels, psycho-acoustic metrics, engine settings and acoustic source maps of aircraft flyovers. These acoustic source maps show the location and the strength of the noise sources on board of an aircraft, and represent the first step towards a sustainable aviation by optimising noise reduction approaches. AEIMS also provide valuable input and databases for developing and updating aircraft noise prediction models. The results obtained by this system are automatically uploaded to a cloud storage service, where they can be accessed publicly. This high-quality device has an approximate prototype cost of 300,000 euro, which could be reduced by using cheaper components or by employing mass-production of this device.

Key Characteristics
Aircraft noise · Aviation environmental impact · Aircraft Environmental · Impact Monitoring Station

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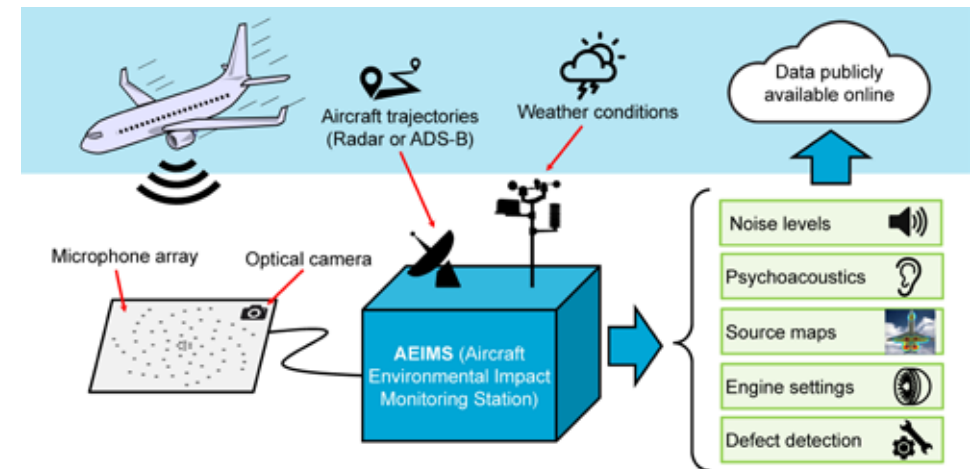
Panagiota Polydoropoulou
University of Patras

Category: **Waterborne** Country: **: Greece**

Research Area 7: **Technology and Engineering** Idea Number: **131**

Increased multifunctionality by filling carbon nanotubes with healing agent

During service of aircraft structures a variety of impact events, such as tool drops, runway debris, ground vehicles and equipment, bird strike, hailstones, maintenance actions, and lightning strikes may occur. As a result, an extensive internal damage may occur with or without visible traces on the impacted area depending on the impact and energy. The incorporation of self-healing Carbon Nanotubes (CNTs) in the aircraft structure is expected to improve the electrical and mechanical performance as well as to increase the service life and the interval times of maintenance leading to appreciably reduced operating costs. A sufficient bonding of CNTs to the surrounding matrix leads to an efficient load transfer. During loading, possible debonding of the CNTs from the matrix requires energy absorb, which is one of the main toughening mechanisms of CNTs. However, by CNTs debonding, a void is formed between the CNTs and the matrix which prevents further load transfer to the CNTs. By filling the CNTs with a healing agent, when debonding occurs the healing agent is released and, assisted by the surrounding catalyst, bonds the crack faces of the void, as described in a similar microencapsulation concept studied by White et al. Hence, further damage development is limited. The combination of CNTs and healing agent into the polymer matrix would increase multifunctionality and would provide sufficiently conductive, light and high-strength materials able to heal debonding, having a wide range of applications in aeronautical structures, as these features are very important for the aircraft.

Capped MWCNTs filled with self-healing agent

Catalysts

Matrix

Key Characteristics
Self-healing carbon nanotubes · Aircraft electrical and mechanical performance
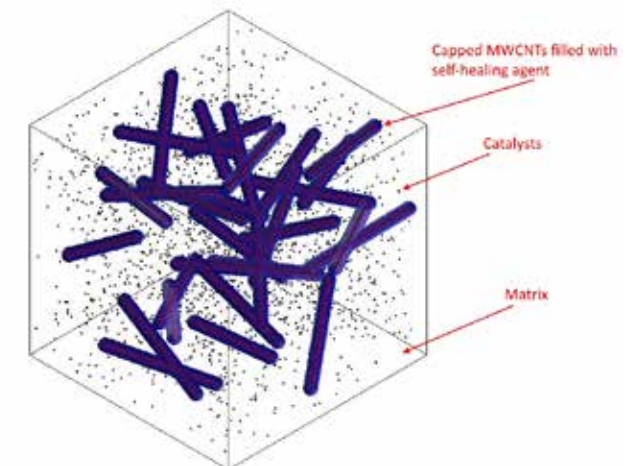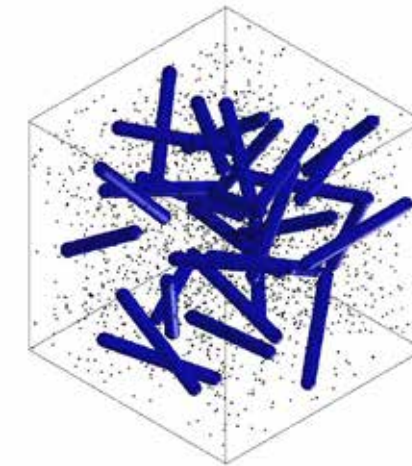
Federico Rovere
University of Glasgow

Category: **Airborne**	Country: **United Kingdom**
Research Area 10: **Transport Safety and Security**	Idea Number: **62**

Safe rotor wakes for better vertical lift

In recent years personal aerial vehicles are becoming an achievable dream, and it is possible that in a few years they will be in everyday city skies. Due to their efficiency, rotors will be used for personal flying machines. New startups and companies begin to offer their services in this emergent field, and focus their efforts to propose the most convenient offer to their costumers. However, the presence of rotors in populated areas, can eventually rise safety risks and problems for people and buildings that have to be resolved. Furthermore, particles on the ground can be uplifted, generating more risks for people in proximity to the vehicle. In this work, computational fluid dynamics is used to evaluate safety considerations for people operating near lifting rotors. The first step is to validate CFD using experimental results for a two-bladed small rotor In Ground Effect conditions, focusing on the evaluation and prediction of the rotor outwash. The simulated flow field is used for safety studies that include outflow forces and tracking of uplifted particles. Three aircraft weights have been studied, evaluating scaling factors to define how weight can affect outflow forces and particle paths, when rotors hover at different heights above ground. Results show how the wake generated by heavier helicopters can lead to stronger forces on ground personnel and push the particles farther away from the rotor.

Key Characteristics
Computational fluid dynamics · Safety · Lifting rotors

Asit Rahman, Andrea Sanchez Mediavilla
University of Glasgow

Category: **Airborne**	Country: **United Kingdom**
Research Area 7: **Technology and Engineering**	Idea Number: **101**

The Hover ambulance

Traffic is one of the biggest challenges for ambulances in the need of reaching their patients promptly, as even a few-minute delay can determine the survival chances of a patient. Thousands of ambulances are delayed each week, some by more than half an hour. The unpredictability of accidents, as well as congestion or construction on roads make it difficult for emergency services to deploy paramedics to their patient, thus reducing the chances of survival. Air ambulances (helicopters) have been used in cases where road access was impossible. However, because of the high operating costs, inability in extreme weather and lack of trained pilots, air ambulances are used only in the most extreme circumstances. In this project we propose a hover ambulance, which enables the operator to access the well-connected city roads as well as fly over the traffic and avoid congestion to reach patients promptly. An arrangement of the propulsion system to generate lift aerostatically is proposed, in the event the vehicle is stuck in between two other vehicles or does not have adequate distance to reach take-off speed. The hover ambulance is designed to maintain a stable flight and move in the air at the same speed as it would on the road. The report illustrates the development of a design that gives the best performing vehicle that meets the criteria of improving ambulance response times, to increase chances of survival, and decreasing costs of long-term health damage.
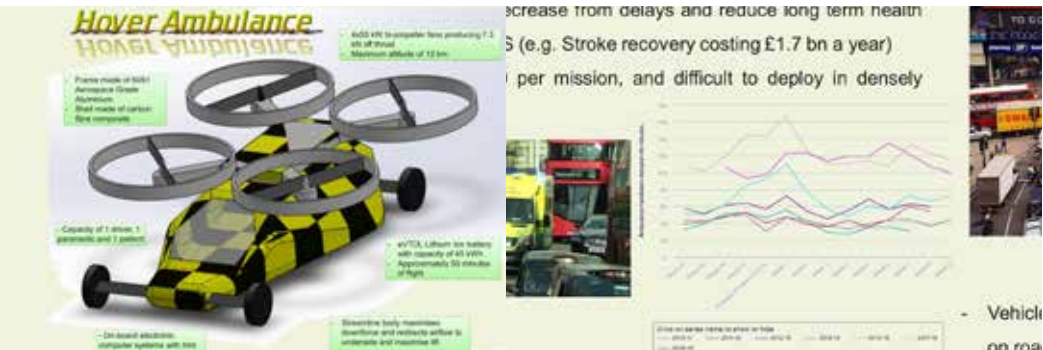
Key Characteristics
Response time · Ambulance · Accidents

Martino Carlo Moruzzi
Politecnico di Torino

Category: **Airborne**   Country: **Italy**

Research Area 7: **Technology and Engineering**   Idea Number: **19**

Windowless concept

In the proposed concept we aim to cut emissions for short-, medium- or long-range aircraft, through a reduction of the structural weight. The reduction of weight is directly linked with reduction of fuel consumption, and consequently there are advantages in terms of operative costs and emissions. This purpose is achieved exploiting a windowless configuration. This configuration consists in removing windows, except those for emergency exits, from the aircraft fuselage. In fact, windows are holes in the structure and they need reinforcements, that add weight. To guarantee the passengers comfort, windows are replaced with monitors connected to external cameras, which allow to the passengers to see outside. A preliminary analysis shows the advantages of this configuration, taking in account both the removed elements (reinforcements and windows panes) and the added elements (monitors, cables and cameras, structural elements as stringers and material to 'refill' the holes). In fact an analytical model was created to study this configuration and it was applied on several aircraft models, showing a not-negligible weight reduction, hence a saving in terms of emissions and operative costs. Furthermore the fuel consumption due to the visual system (monitors and cameras) is calculated. The visual system must be light and efficient. For this reason, organic light emitting diode (OLED) technology has been chosen for monitors, achieving very light displays. Furthermore in a mid-term future the visual system could be improved using eye tracker devices or augmented reality glasses.
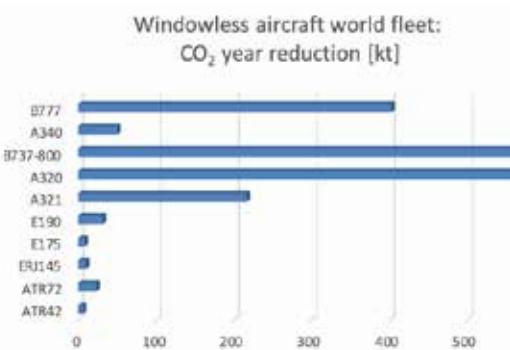
Key Characteristics
Organic light emitting diode (OLED) technology · Aircraft emissions

Romain Barrier
Cranfield University

Category: **Airborne**   Country: **United Kingdom**

Research Area 9: **Policy and Regulation, Market Efficiency, Competitiveness**   Idea Number: **54**

Investigation into the viability of integrated regional air transport based on full electric aircraft

Aviation is presently responsible for 2-3% of global carbon dioxide emissions. However, air traffic growth at current rate could lead to emissions share of 25% by 2050. Consequently, in the last several years, electric aircraft has emerged as an important research topic in academia and industry given the societal aim to significantly reduce industry's carbon footprint. The current technology readiness level does not allow a full-scale implementation of electric aircraft. This could however be feasible in a not so distant future. As a disruptive technology, full electric aircraft is likely to incorporate novel propulsion architectures, airframe configurations, system design and could affect ground infrastructures and operation strategies. Those distinct disciplines need to be dealt with simultaneously to understand the global picture, where the current airline business and operation models could be considerably impacted. Within this context, a novel framework is presented enabling the exploration of potential viability of future aviation. From this, the case of regional air transport has been more specifically studied. To this end, the set-based design methodology has been employed and a roadmap has been established from the juxtaposition of the market analysis with the technical feasibility of concepts. Insights from experts helped assess the integration into the energy and transportation network. Finally, the emphasis has been put on analysing the economic viability and environmental impact as key factors of a future implementation. The established framework allows sensitivity studies to determine external levers that favour the profitability and sustainability of electric aviation.
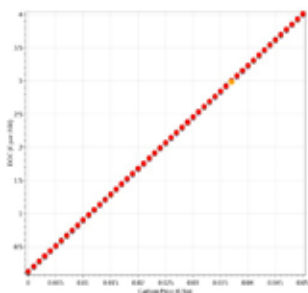

Figure 3(c): Sensitivity study between carbon offset price and fuel price. Changes in carbon offset price are more likely to affect the business model of conventional aircraft than

Key Characteristics
Future aviation · Regional air transport

Chris Gurjao
Università di Bologna

Category: **Airborne**	Country: **Italy**
Research Area 8: **Planning, Modelling and System Design**	Idea Number: **128**

Three-dimensional numerical analysis of delamination growth in composite materials under mixed-mode I/II loading

Composite materials are mainly responsible for the innovation revolution taking place in aerospace manufacturing today. This is because using composites in aircraft results in significant weight savings, increased payload capacity and reduced fuel burn. Thus, airlines using these aircraft may remain profitable in the face of increasing fuel prices. Delamination is an important mechanism of fatigue failure that occurs in composite materials. Composite delamination is often induced by cyclic compression, shear or bending loads. Fatigue failure usually occurs under mixed-mode I/II loading (i.e. a combination of tension and shear loading). Several failure theories are available for evaluating the crack growth in mixed mode I/II crack problems, which form the majority of crack problems. Since the complete stress functions and the contribution of stresses in all directions are considered through the strain energy density function, the Minimum Strain Energy Density (SED) theory provides a more complete physical description of damage in the crack tip zone. The 3-D numerical analysis model created during this project using ABAQUS software is based on a Cohesive Zone Model (CZM) combined with the Extended Finite Element Method (XFEM). This model is validated by comparing its output with the results of mixed-mode crack propagation experiments using carbon-epoxy specimens in order to check if the numerical model reproduces the experimental results with minor discrepancies. In conclusion, the implementation of the numerical model aims at effectively predicting experimentally-observed damage propagation in composite materials.
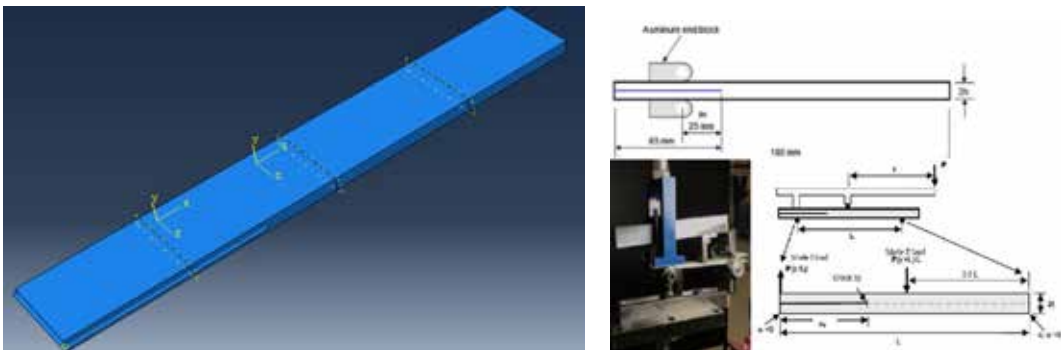
Key Characteristics
Composite materials · Composite delamination · Fatigue failure

Peijian Lv
Delft University of Technology

Category: **Airborne**	Country: **The Netherlands**
Research Area 7: **Technology and Engineering**	Idea Number: **40**

Boundary layer ingestion for transport aircraft

The benefit of wake-filling on power consumption is well known in the field of marine propulsion. Ship propellers are typically installed at the rear of vessel and operated within the current of boundary layer flow. This configuration is known as Boundary Layer Ingestion (BLI) or Wake Ingestion (WI) and it is also applicable to airborne systems. To better understand the physics of BLI applied to aircraft airframe and propulsion systems, this research is divided into two pillars: theoretical and experimental. The theoretical work focuses on conceptual studies to evaluate the performance of the propulsor and its associated vehicle in the configurations of WI and BLI. A power conversion analysis uses the power balance method to elaborate the power-saving mechanism of WI. The body-propulsor interaction occurring in the BLI configuration is qualitatively analysed to clarify its influence on the performance of the integrated vehicle. The experimental study aims at quantifying the power conversion processes. Stereoscopic particle-image velocimetry is employed for the first time to visualise the flow field at the location of interaction between a propeller and an incoming body wake, as well as to provide experimental data to be used for the power balance method. The results suggest that the minimisation of power consumption should be used as a theoretical design criterion for aircraft using BLI. The experiment shows that the utilisation of body-wake energy by the wake-ingesting propeller is the main mechanisms responsible for the efficiency enhancement in the experimental setup.
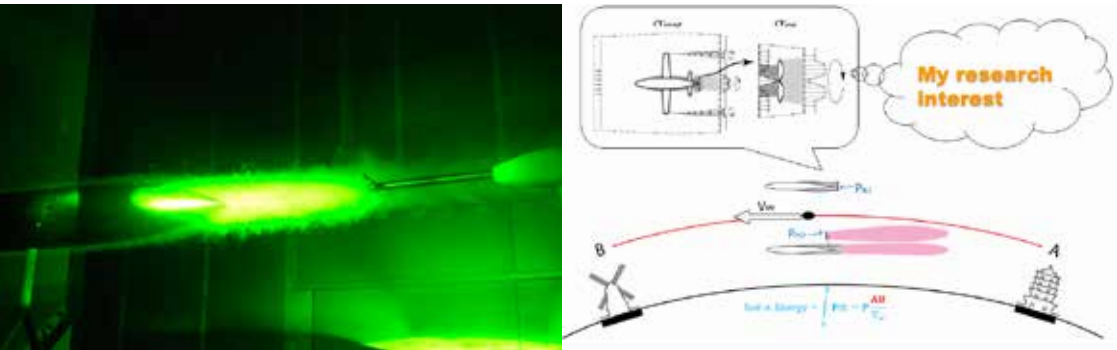
Key Characteristics
Propellers · Boundary Layer Ingestion (BLI) · Wake Ingestion (WI)

Elli Moutsompegka
University of Patras

Category: **Airborne**   Country: **Greece**

Research Area 7: **Technology and Engineering**   Idea Number: **65**

A full methodology for the strength prediction of adhesively bonded composite joints exposed to hygrothermal service conditions

In the last two decades, the use of adhesive bonding has been continually increasing in aircraft structures both for assembling fiber-reinforced structural parts and applying composite patch repairs due to the numerous advantages it provides over conventional structural joining methods, e.g. mechanical fastening where the introduction of holes in composites leads to stress concentrations and can affect the overall load-carrying capacity of the structure. One of the main factors hindering the wider application of adhesive joints is the sensitivity of the bondline integrity to the environmental factors, such as temperature and moisture that adhesively bonded joints are exposed to during service. In order for the designers to meet the aviation certification rules, the limit load capacity of the adhesive composite joint which would result in catastrophic loss of the aircraft must be substantiated. In the present work, the lack of accurate mechanical behavior prediction of adhesively bonded composite joints exposed to hygrothermal environments is addressed and a methodology is proposed to this end. The first step is the prediction of thermal and moisture diffusion in the adhesive joint components, and the effect on their mechanical performance. These data will act as input into a process computational model where the curing of the aged components will be simulated. The final aged joints will then be virtually tested using a modified cohesive zone modelling approach, which derives from the first step, to virtually model the progressive damage and failure of the aged bonded joints.
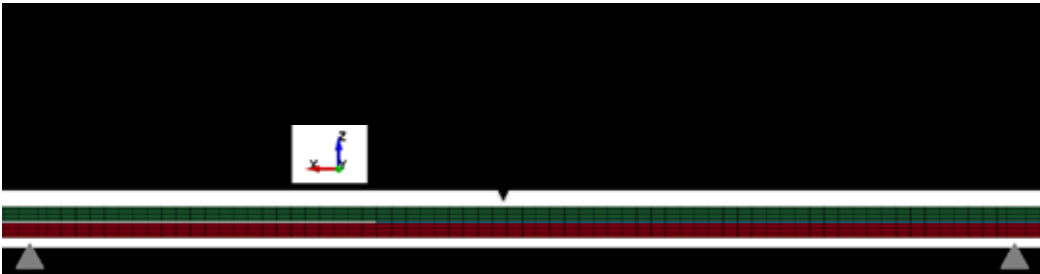
Key Characteristics
Adhesive composite joint · Strength prediction

TRANSPORT MODE
CROSSMODALITY

(1)

Nikolaou Paraskevas
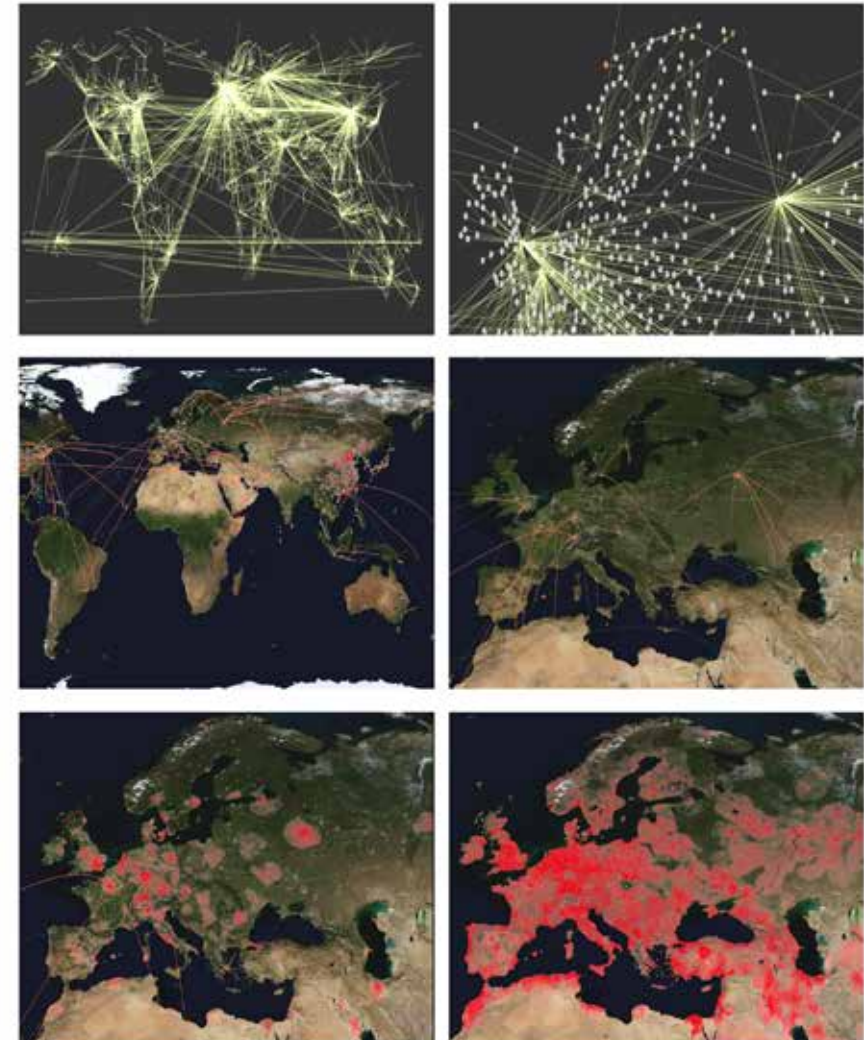**University of Cyprus**

Category: **Crossmodality**   Country: **Cyprus**

Research Area 9: **Policy and Regulation, Market Efficiency, Competitiveness**   Idea Number: **89**

Controlling the possible spread of infectious diseases through the air transportation network: a dynamic network approach

One of the most important and positive global phenomena in recent decades stands for the rapid increment of mobility for both people and goods. Referring to the 2017 report of the European Commission in Mobility and Transport the performance of the modes for passenger transport (roadways and airways) recorded in the first place. The reported improvement in global connectivity though may pose some threats related to the public health that is the possible facilitation of infectious diseases spread through the transportation networks. To face this possible threat, an important element stands for the investigation of the mechanics of infectious diseases spread through mass transportation systems, where people have direct or indirect contact. The air transport network is frequently subject to speculation that may act as a medium for spreading infectious diseases, mainly for importing them from distant areas that may suffer epidemic phenomena. In this project, a thorough investigation focusing in Europe is performed. In particular, a dynamic systems approach is developed, combining the integration of two modes of passenger transport (airway and roadway) with epidemic dynamics. The model development is based on the realistic global air traffic data (network structure and passenger flows), while the land transportation system on real information population densities, resulting in a very detailed model of peoples' mobility. On the other hand, epidemic modeling is based on alternative dynamic epidemic models. The outcome of the project provides a novel approach for identifying specific locations or facilities that are possible spreading of infectious diseases over spatially connected regions (e.g. Europe) and analyzes several scenarios from preventing disease spreads. The advances in this area besides the accurate epidemic forecast that emerges from the epidemic modeling is also the understanding of how the network topology, i.e. the air and road connection between the countries, can affect these dynamical processes.

Key Characteristics

Infectious disease spread · Transportation networks · Mass transportation systems

María J. Alonso González
Delft University of Technology

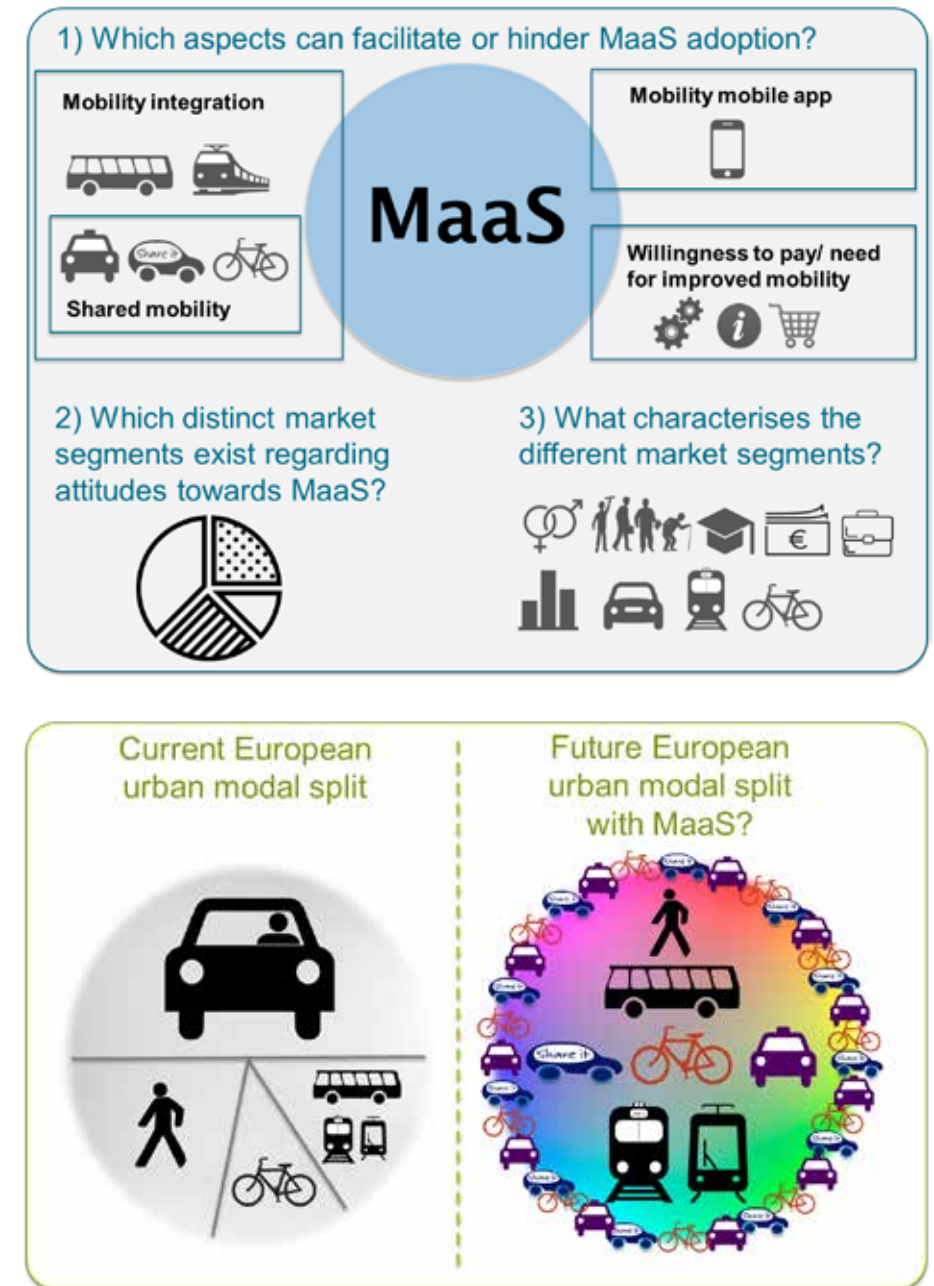| Category: **Crossmodality** | Country: **The Netherlands** |
| Research Area 5: **User-focused Mobility services, Servitisation** | Idea Number: **71** |

Potential uptake of mobility-as-a-service for different market segments

Mobility-as-a-Service (MaaS) aims at improving urban transportation by providing integrated mobility "as a service". MaaS is fuelled by the rainbow of new on-demand transportation services that are emerging in urban areas, and it is expected to become the drive of the upcoming mobility revolution, contributing to a shift away from the current (privately-owned) car-centred model. Initial pilots suggest that MaaS will reduce private car usage and increase public transport usage. This project aims at investigating individuals' inclination to adopt MaaS. It goes beyond the study of early adopters and it identifies drivers and barriers that can play a role in the adoption of MaaS for a large representative sample (>1,000 individuals) of the Dutch urban population. It also investigates whether public transport or rather other on-demand services are likely to become the backbone in MaaS. First, we present respondents with a series of (carefully designed) MaaS-related attitudinal indicators. Second, we perform a latent class cluster analysis (LCCA) on these, to identify distinct market segments. LCCA is a model-based clustering technique, and it allows to group respondents according to an underlying unobserved (latent) variable. And third, we profile the different segments regarding their socioeconomic characteristics and their current mobility patterns. Study results help evaluate future changes in urban mobility as a result of MaaS, and help design targeted strategies tailored to the distinct segments. Additionally, this project provides a framework to investigate differences in MaaS adoption potential among countries.

1) Which aspects can facilitate or hinder MaaS adoption?
Mobility integration — Shared mobility — MaaS — Mobility mobile app — Willingness to pay/ need for improved mobility
2) Which distinct market segments exist regarding attitudes towards MaaS?
3) What characterises the different market segments?

Current European urban modal split — Future European urban modal split with MaaS?

Key Characteristics
Potential uptake of mobility-as-a-service for different market segments

Ioulia Markou
Technical University of Denmark

Category: **Crossmodality**   Country: **Denmark**

Research Area 8: **Planning, Modelling and System Design**   Idea Number: **27**

Prediction of traffic anomalies due to special events

Traffic congestion greatly impact urban areas, as it has significant economic repercussions through deterioration of mobility, safety, and air quality. In 2017, New York drivers spent 91 hours on average sitting in traffic. In Europe, even cities with relatively low congestion levels show excessive network demand during peak hours, which consequently affects the quality of life of their residents. These observations emphasize the need for frameworks that promote better management of city's road network and transport services. While mature research exists for habitual behaviors, such as commuting cycles, and average situations, current traffic management solutions typically fail under non-recurrent circumstances, such as incidents, special events (e.g. concerts), demonstrations, road works, crisis scenarios (e.g. terrorist attacks), inclement weather, etcetera. This project explores machine-learning architectures for combining time series and textual data for mobility-demand predictions in eventful areas, where abnormal patterns are often observed and not easily explained. Our framework focuses on predicting taxi demand. However, the proposed methodology is applicable to problems that go beyond the transportation domain. Our proposed models significantly reduce forecast errors by using cross-modal sources of information, namely publicly-available taxi and weather data from New York, and information about events collected using web-scrapping techniques and Application Programming Interfaces (APIs). The importance of semantic information is highlighted in all presented methods. The results show that abnormal demand peaks can be accurately detected on time, and competent authorities can subsequently take all the necessary measures to deal with them optimally.

Key Characteristics
Traffic congestion · Traffic management · Traffic anomalies
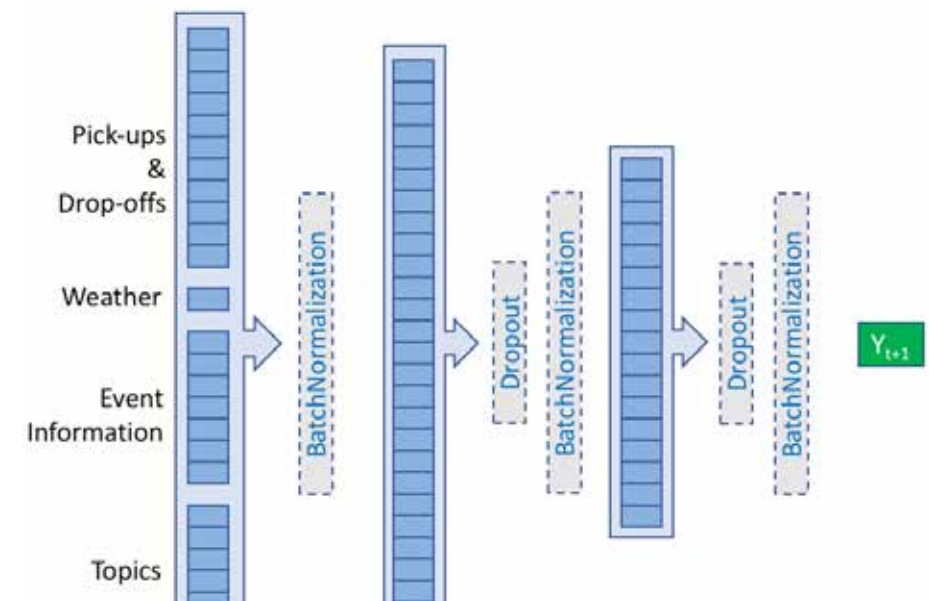
Sergio Piastra
University of Bologna

Category: **Crossmodality**	Country: **Italy**
Research Area 7: **Technology and Engineering**	Idea Number: **84**

Augmented reality for cross-modality

The transportation field is one of the most promising for Augmented Reality (AR) and it can be subdivided into two main macro-areas in which all the related AR applications can be grouped: control and management. The first macro-area deals with the issue of being able to see and know where you are going. It mainly concerns automotive, naval and aviation sectors. The latter is considered the parent of Augmented Reality, as the first AR head-up displays in the aircraft cockpits date back to 1937 and were used for pilot assistance in German aircraft. The automotive sector currently represents the leading field in terms of investments in Augmented Reality: digital overlays can be applied on the car windshield to inform the driver of the car's speed, the position where to turn, the location of lane markings and how close the car ahead is. For what concerns the control and management macro-area, it is usually characterized by the presence of an observer experiencing a panoramic view of the surrounding environment, which has to be managed and controlled. This is the case of the control centers managing airports, ports and container terminals. The use of Augmented Reality in these facilities can produce significant benefits in terms of operators' workload, performances and situation awareness, providing positive impacts on safety and efficiency of the whole system.
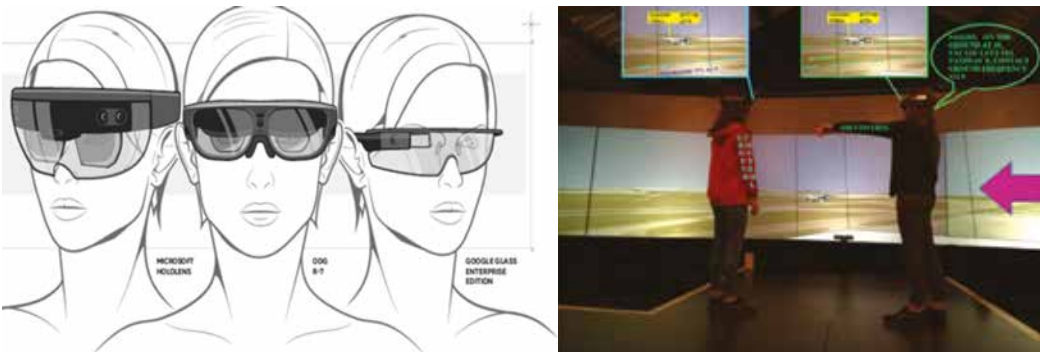
Key Characteristics
Augmented reality · Performance and situation awareness

Abedelkareem Alnajajreh
Polytechnic University of Bari

Category: **Crossmodality**	Country: **Italy**
Research Area 8: **Planning, Modelling and System Design**	Idea Number: **56**

A new mesoscopic simulation model for dynamic network loading and spillback queuing assessment in a multiclass environment based on the vehicular type

Traffic flow modelling is the most significant component undertaken by the static and the dynamic network loading (DNL) models in the traffic assignment. DNL models represent a non-linear relationship between each link flow and its path flow, as they are the fundamental element in estimating the dynamic interaction between demand and supply in oversaturation condition. Moreover, the solution for DNL problems is necessary for generating the dynamic traffic assignment (DTA) models. Dynamic models can be characterised according to the simulation details level: microscopic, macroscopic or mesoscopic models. Many different aspects can be included within the dynamic network loading models such as the multiclass property. This thesis proposes a new dynamic network loading model which simulates traffic dynamics (speeds, densities, flows, queues, etc.) explicitly, through modelling the multiclass traffic flow considering the discrete mesoscopic simulation. The proposed model is capable of using two speed-density relations; Greenshields and the triangular-shaped fundamental diagram to propagate the flow. FIFO holds between the vehicles in the same class and creeping speed is assumed to avoid circulation blockage in the oversaturation conditions. For assessing the real-time queuing spillback, the proposed model is applied to a simple network. Moreover, the proposed model is compared to a commercial traffic simulator to highlight its performance in the oversaturation conditions.
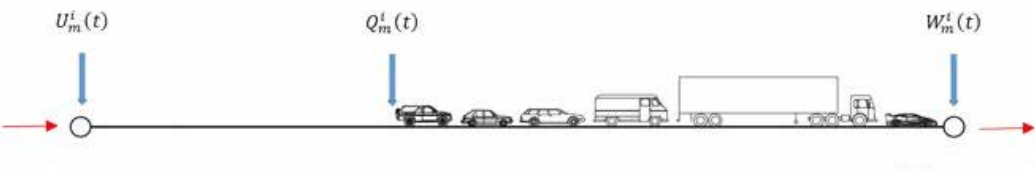
Key Characteristics
Congestion · Flow propagation · Queue spillback · Multiclass mesoscopic simulation

Johannes Weber
Technische Universität Dresden

Category: **Crossmodality**	Country: **Germany**
Research Area 8: **Planning, Modelling and System Design**	Idea Number: **61**

New strategies towards a representative sample: app-based travel survey with non-probability sampling in Dresden

It can be observed that response rates in traditional travel surveys, usually randomly sampled from resident's registers, are declining in Germany and beyond. Consequently, risks of selectivity as well as costs and efforts to achieve high-quality data increase. Apart from traditional surveys commonly conducted by questionnaires and telephone interviews, innovative methods such as smartphone apps open up promising possibilities for data collection via GPS-tracking and allow a wide variety of analyses. This even presents opportunities for new recruitment strategies but entails challenges regarding representativeness and biases as well. The objective of this project is to gain experience in non-probability sample recruitment and data collection with a digital travel survey app developed by the Swedish company Trivector. This will be achieved by planning and conducting an app-based travel survey in Dresden in autumn 2019. It is aimed to reach a representative net sample of at least 1,000 individuals of the city's population and to target all relevant person groups. As the project is embedded in a European collaboration called 'Travelviewer – data for low-carbon sustainable transport systems' financed by EIT Climate-KIC, the survey will be hold with three other sites participating. At first, literature research on survey methodology focusing on non-probability sampling will be done. Then, recruitment strategies will be developed aiming for the defined sample target. This will include questions on the approach, motivation and support of individuals. In conclusion, the survey will be evaluated regarding sample representativeness and recommendations for future application in travel surveys will be given.

Key Characteristics
Travel surveys · Apps

Sigma Dolins
Chalmers University of Technology

Category: **Crossmodality**	Country: **Sweden**
Research Area 5: **User-focused Mobility services, Servitisation**	Idea Number: **98**

Let's all go together: investigations on willingness to share rides in dynamic ridepooling contexts and its significance for future autonomous public transport, using multivariate, hypothesis-driven model

Research indicates that the potential of autonomous vehicles (AVs) can only be fully realised through AVs being deployed as shared, pooled rides, in a format known as dynamic ridepooling. Therefore, to develop strategies for increasing acceptance and adoption of a new mobility behaviour, it is critical to understand what makes consumers more likely to share their rides with strangers. The current study investigates the willingness to share (WTS) in four different countries. The results of a first survey, currently in development, will be used in our multivariate, hypothesis-driven model that includes both latent structures and discrete choice modelling, designed to capture the notion of WTS. As other research has shown social discomfort and value of time as meaningful for WTS, beside considering the normally-used variables of privacy and time-sensitivity, we include the following four latent variables. "Vehicle factor", to test whether the prestige of owning a car or the comfort and luxury of the car affect the WTS, and "Imitating others", "Subjective norm" and "Trust" to account for the effect herd behaviour has on WTS. We also examine the possible impact of country-specific variables (e.g. GDP per capita, regional density, and average age of first car purchase). In addition, we identify the existing research gaps in the services currently available and the research that has already been completed, laying out our roadmap for future work in creating prescriptive measures to address any crucial findings towards WTS.
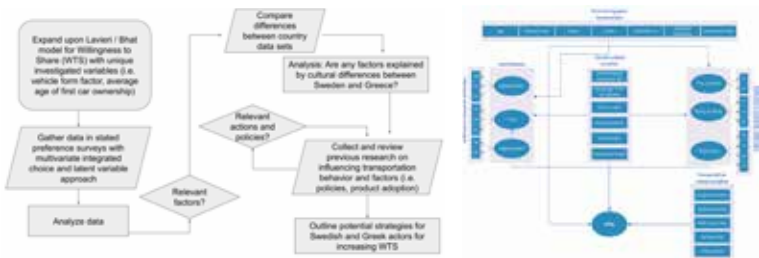
Key Characteristics
Dynamic ridepooling · Willingness to share (WTS)

Diogo Correia
University of Coimbra

Category: **Crossmodality**	Country: **Portugal**
Research Area 1: **Climate Change, Mitigation and Resilience**	Idea Number: **31**

Airport pavement energy harvesting

The ability to connect remote regions and the trip duration make flying an efficient transport mode for long-distance travels. However, this mode of transport, and the whole industry based on it, civil aviation, accounts for 2% of all man-made carbon emissions. The emerging need for sustainability the civil aviation sector has responded to the global challenge of sustainable development with targets to reduce CO2 emissions by using a 4-pillar strategy to assess aviation's environmental impact and, subsequently, to meet the CO2 emission targets. Airports are also part of the civil aviation sector and, besides contributing only with 5% to the sector's CO2 emissions, adopted a set of measures to reduce greenhouse gas emissions. Aware of the recorded climate change, airports have been channeling their efforts searching for renewable energy to create conditions for energy independence, and so, resilience. This is therefore a good opportunity for the entry of new sources of energy production, namely energy harvesting. The main objective of this research is the development of an innovative device that enables the transformation of the kinetic energy directed to the airport pavement into electrical energy. To achieve the uninterrupted power supply needs, and for an airport resilience aid, the energy storage is also addressed so that the electric power can supply essential equipment uninterruptedly for airport's operations.

Key Characteristics
Airport · Resilience

Vasileios Papapaschos
National and Kapodistrian University of Athens

Category: **Crossmodality**	Country: **Greece**
Research Area 3: **Automation and Robotisation**	Idea Number: **18**

HydraX robot: a hybrid 3D printing and milling 3D printed robotic arm

This study aims at enabling the combination of Additive and Subtractive Manufacturing processes carried out by a low cost 3D Printed Robotic Arm through proper control and efficient programming. The 6-axis robotic arm was custom designed and its components were manufactured by a domestic 3D printer with PETG material, so as to serve both functional properties and aesthetics. 3D printing parameters were carefully chosen for optimal robot part stiffness and integrity. Construction was complemented with appropriate off-the-shelf parts and motors for smooth operation. G-Code was selected as the programming language, which facilitates both CNC beginners and experts in its use. The robotic arm has the ability to automatically change its end-effector, whether it is a milling spindle, a 3D printing hot end, a laser engraver, or a gripper via its specially designed Automatic Tool Change system, thus providing the ability of multiple manufacturing processes and part handling on a single platform. The CAM software Post-Processor for G-code extraction was developed in the philosophy of a Finite-State Machine (FSM), which means that the NC output file is automatically adjusted, when input variable values are changed in the CAM software. Custom macros (M-Codes) have also been developed for specialized functions, such as filament extrusion and tool change. Furthermore, as the robotic arm does not require specialized training or working conditions, it can safely and efficiently be utilized in either domestic or industrial environments for low-cost quality production of even high complexity parts.

Key Characteristics
3D Printed Robotic Arm · Manufacturing

Morteza Khashaypoor
Lusofona University

Category: **Crossmodality**   Country: **Portugal**

Research Area 6: **Social Change and Quality of Life**   Idea Number: **86**

The impact of strategic policies changes on urban mobility improvement: the case study of Tehran

The Iranian capital, Tehran, has a complex urban mobility system, which needs to improve in a sustainable perspective to address the challenges posed by the increasing traffic congestion and pollution. The city's road network has developed much faster than public-transport infrastructure and non-motorized modes. Consequently, the city's urban mobility system is car-oriented. Hence, Tehran's urban mobility management policy is facing a drastic increase in private vehicles use, which is affecting the central area and resulting in a permanent congestion on this area of the city. Taking into account the upcoming challenges and problems regarding urban mobility improvement, this study analyses the impact of changes in the usual strategic policies to improve urban mobility in central area of Tehran. Some innovative approaches and strategies were subject to a multi-criteria evaluation. The research focus on: A) a new, human-centred, urban-mobility policy approach based on the human characteristics of transport demand and its needs in urban mobility. B) the presentation of a model-based methodology for assessing the improvement of the urban mobility. C) an innovative method is proposed for data gathering and household travel survey. D) the definition of a set of quantitative criteria to measure urban-mobility characteristics and improvements towards a more sustainable mobility. E) the development of an analytic-network-process model for selecting the best alternative policy, based on quantitative criteria and unique interactions and feedback between the elements that characterise them.

Key Characteristics
Urban mobility system · Mobility management

SENIOR RESEARCHER
COMPETITION

The concept behind the Senior Researchers Competition is to have an award celebrating excellence in transport related research. It is open for leading transport researchers engaged with EU-funded projects who can demonstrate proven impacts in their field.

The competition provides a platform to disseminate knowledge and results from innovation and/or research projects in Transport, promoting future synergies and further development of pioneering ideas, in line with the strategic objectives of the TRA stakeholders.

The Senior Researchers Competition acts as a showcase for some of the best EU-funded innovation and research and encourages the identification of current and future leaders in their field. The competition was promoted through the stakeholders in the consortium, through national contact points and through targeted contact coordinators and participants in EU-funded transport projects. Participants could register for the competition either directly via the TRA VISIONS website or via the TRA 2020 conference entry portal.

The evaluation was a three-stage process. Firstly, all entries were reviewed for content, eligibility and relevance to produce a long list. All entries which were selected for the long list were then invited to submit additional information; an impact statement about their research and a brief CV. These submissions were assessed by at least two independent, subject expert evaluators against the following selection criteria: (i) amount and proportion of EU funding; (ii) impact of research on national, EU and global levels; (iii) relevance to transport and (iv) research track record of entrant. A shortlist of three entrants was produced for each transport mode (Road, Rail, Air, Waterborne and Cross modality). The winners were chosen by an expert panel at a selection workshop held at the European Commission in Brussels on 10th February 2020. The panel consisted of transportation experts and stakeholders as well as representatives from the EC.

STATISTICS
AND OVERALL RESULTS

The TRA VISIONS 2020 Senior Researcher Competition received 81 entries from 20 countries. Only 50 were longlisted. The following charts contains some statistical information regarding all the seniors' entries.

The map besides shows the entries submitted per country and their geographical spread.

ENTRIES **PER COUNTRY**

The table below shows the number of entries submitted from each country. Spain was the largest contributor with a total of 10 eligible submissions, Italy came second with 9 submissions and UK and Germany came third with 8 entries each.

The chart besides shows the number of entries submitted per country.

Country	Entries
AUSTRIA	4
BULGARIA	1
CROATIA	2
CZECH REPUBLIC	2
FINLAND	3
FRANCE	3
GERMANY	8
GREECE	6
HUNGARY	1
ITALY	9
LATVIA	1
NETHERLANDS	4
NORWAY	2
POLAND	2
PORTUGAL	7
SLOVAKIA	2
SPAIN	10
SWEDEN	3
TURKEY	3
UNITED KINGDOM	8

ENTRIES **PER MODE**

A total of 20 road related entries, 7 rail related entries, 6 waterborne related entries, 5 airborne related entries and 12 cross modal related entries were submitted for the senior researcher competition. The charts below show the number of entries submitted per mode in percentage terms.

ROAD	RAIL	WATERBORNE	AIRBORNE	CROSSMODALITY
40%	14%	12%	10%	24%
TOTAL PROJECTS	TOTAL PROJECTS	TOTAL PROJECTS	TOTAL PROJECTS	TOTAL PROJECTS
20	7	6	5	12
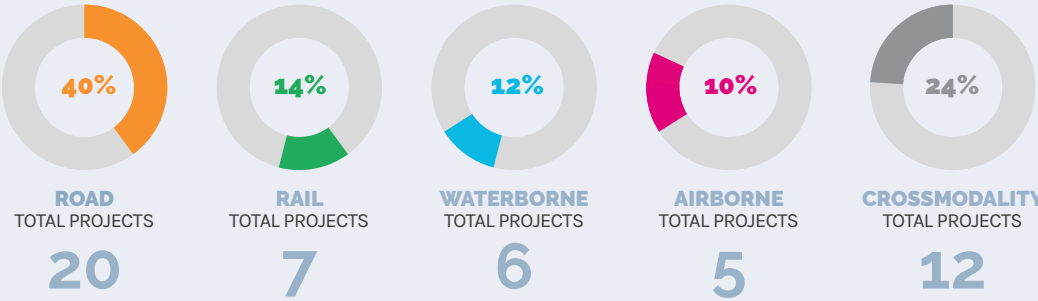
TRANSPORT MODE
ROAD

Zissis Samaras
Aristotle University of Thessaloniki

Category: **Road**   Country: **Greece**

Zissis Samaras is an expert in engine and vehicle emissions testing and modelling, and he has carried out a wide range of projects on modelling emissions from internal combustion engines. He is the Project Coordinator for the EC funded project DownToTen (Measuring automotive exhaust particles down to 10 nanometres, 2016-2019) that aims to develop a methodology for the measurement of exhaust particles down to at least 10nm, under laboratory and real-world operational conditions. The main impact of the project is that the methodology, together with the sampling and measurement system, can be used to demonstrate that low emissions of nanoparticles can be delivered by diesel and petrol vehicles when following the latest Real Driving Emissions (RDE) specifications. Much effort has been devoted to distinguish the particles which are produced by the vehicles and are not artefacts of the sampling system.

DownToTen has collaborated with vehicle prototype developing projects in the same call and provided directions on how RDE levels below limits (with conformity factor 1) can be reached by both diesel and especially direct injection petrol vehicles. Thus, the project will have significant impacts towards developing a super low emission vehicle standard with ultra-low emissions in real operational conditions. First, it delivers a comprehensive measurement protocol that would leave no possibility for a noncompliant vehicle passing the test. Second, it provides a demonstration system with the capacity to sample particle numbers less than 23nm (PN<23nm) under all conditions met on the road, that is a pre-requisite for the verification of an ultra-low emission vehicle. Third, it provides information on the origin and formation of particles for their effective control. Also, special attention has been given to the implications of potentially unregulated particles, such as volatile ones or particles <10nm.

In addition, DownToTen performed a comprehensive characterization of particle emissions for the latest and upcoming vehicle technologies with the aim of improving understanding of the origin, formation, and properties of the remaining particles downstream of state-of-the art emissions control systems, including emission factors to be used in air quality studies. Via its key partners in the US and Japan DownToTen ensures that developments regarding PN emissions in the EU become globally known.

Key research themes
engine and vehicle emissions · super low emission vehicle standard
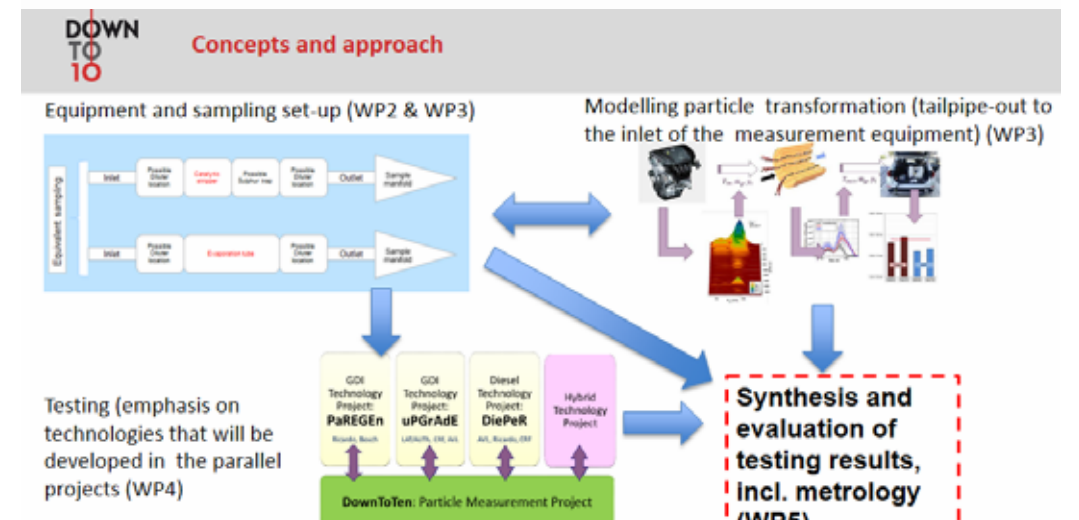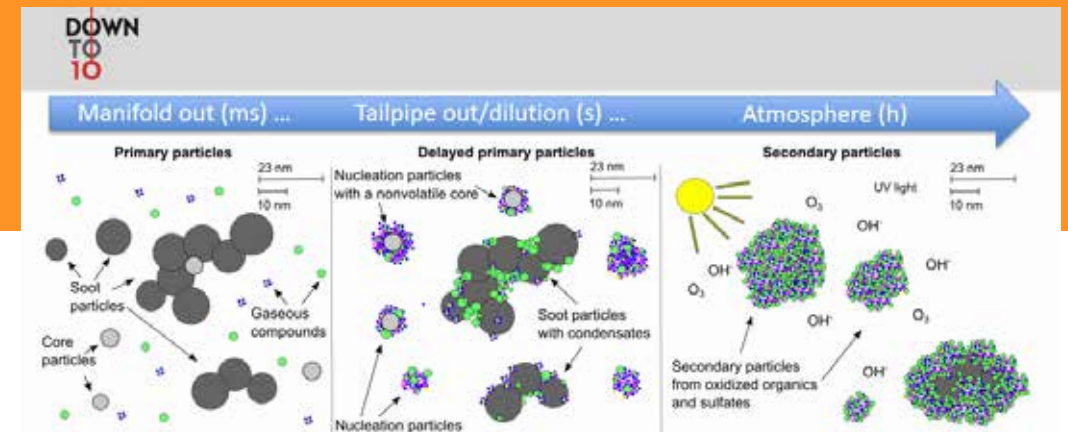
Professor Samaras research work deals with engine and vehicle emissions testing and modelling. He is elected Vice Chairman of ERTRAC and co-led for many years the UN-ECE Topic Group "Mobile Sources". He coordinated a number of large European projects, he provided expert advice to several organisations (such as World Bank, ACEA, Concawe). He co-authored more than 250 publications, he has an author h index 35 and holds four international patents. He is the co-founder of three spin-off companies.

Anna Anund
Swedish National Road and Transport Research Institute

Category: **Road**   Country: **Sweden**

Luca Persia
Sapienza University of Rome

Category: **Road**   Country: **Italy**

Anna Anund is an expert in driver fatigue, leading national and international projects. The focus has been on understanding the reasons behind fatigue, how to describe the development of fatigue and to identify promising countermeasures. She been leading the EC funded project ADAS&ME (Adaptive ADAS [Advanced Driver Assistance Services] to support incapacitated drivers & Mitigate Effectively risks through tailor made HMI under automation, 2016-2020). This project is unique not only for including automation as a part of the HMI (Human Machine Interaction) strategy, but also because it covers passenger cars as well as trucks, motorbikes and city buses.

One of the tasks of special interest in ADAS&ME is the transition between the driver and the system considering driver impairment. The concept prioritises safety. In ADAS&ME the development of the human-machine interaction for automation uses an adaptive driver assistance perspective, where automation is seen on the one hand as the saviour of a fatigued, overloaded, stressed or simply inattentive driver; and on the other hand, as a driving companion providing advanced comfort functions but still keeping the driver in the loop.

In 2016 1.35 million people were killed in traffic, ADAS&ME will contribute to reducing this.

Luca Persia has been studying transport systems for twenty-five years, with a specific focus on urban passenger transport systems and road safety. He was the project coordinator for H2020 project SaferAfrica (Innovating dialogue and problems appraisal for a safer Africa, 2016–2019).
A major result of SaferAfrica is the African Road Safety Observatory, a participative web portal where African stakeholders can find specialized information on road safety. Another important achievement has been the creation of a Dialogue Platform Management Board with 11 prominent international institutions identified among political unions (AU, EU), multilateral development banks (WB, AfDB), other key organizations (UNECA, WHO, IRF, IRU, ITF, FIA, PIARC), able to effectively influence the process towards the African road safety improvement.

The project's impact potential has been developed through the Dialogue Platform, the creation of a community of 231 stakeholders from 42 African countries and the Safety Observatory, consistently interacting to foster the planned actions of awareness and knowledge building for road safety governance. Several initiatives have been set up to continue the work started by SaferAfrica, some purely national, others of a more regional character, these will address many critical issues including those relating to design, data collection, education and policy. The project received the 2019 Prince Michael International Road Safety Award.

Key research themes
driver fatigue · automation · HMI · driver in the loop

Key research themes
transport systems · urban passenger transport systems · safety

TRANSPORT MODE
RAIL

Sakdirat Kaewunruen
University of Birmingham

Category: **Rail**   Country: **United Kingdom**

Sakdirat Kaewunruen has already made a significant contribution to the rail industry through his involvement in research projects including the H2020 funded S-CODE (Switches and Crossing Optimisation, Design and Evaluation and other funded projects, 2016-2019) as well as other projects funded by the European Agency for Regional Development, and nationally funded projects with UK, Japan, Australia and Malaysia.

RISEN provides not only practical engineering solutions and policy guidance but importantly also technical capabilities and resources, trained staff and research network for research synergy. It recognises the strong need for research exchange, skill mobility, talent and capability development in relation to railway engineering in general. Within the rail industry, there have been significant demands globally to fill in the knowledge gap because baby boomers are leaving the workforce. In addition, a strong drive to innovate railway systems for the future cannot be underestimated as it requires highly-developed research skills, which are often trained during postgraduate and doctoral studies. Thus, RISEN has enhanced research and innovation human resources by utilising research mobility and synergy. Integration of systems approach and rail research skills has contributed to each participant's personal development and career perspective, in addition to social network and avenues accessing to future employers, stakeholders, and even prospective customers. RISEN has already supported and sponsored over 50 scholars to establish long lasting research networks through secondments with world-class partners including Universities in USA, Japan, Brazil and Iran and Australia. The RISEN scholars have already contributed to over 250 peer-reviewed open-access scientific articles. Advanced scientific knowledge and capabilities stemming from RISEN will contribute towards rethinking rail transport for cleaner and more inclusive mobility.

Sakdirat Kaewunruen is the coordinator of the H2020 funded project RISEN (Rail Infrastructure Systems Engineering Network, 2016–2020) which has already resulted in significant national, European and international impacts. Initial outcomes were recognised as 'excellent innovations' by the EU Innovation Radar in March 2018.

Key research themes
railway engineering · cleaner and inclusive mobility

Markus Hecht
Technische Universität Berlin

Category: **Rail**   Country: **Germany**

Svenja Hainz
DLR Institute of Transportation Systems

Category: **Rail**   Country: **Germany**

Markus Hecht has extensive railway engineering experience with particular expertise in running gear optimisation, longitudinal dynamics, noise reduction, freight car telematics, energy efficiency and pollution mitigation. He has contributed to many EC funded projects including four under the umbrella of Shift2Rail joint undertaking.

Assets4Rail (Measuring, monitoring and data handling for railway assets; bridges, tunnels, tracks and safety systems, 2018-2021) is a key project for enhancing asset monitoring and maintenance practices. The main objective of the project is to develop a set of cost-efficient and cutting-edge asset-specific measuring and monitoring devices. The TU Berlin effort on RFID application in the investigation of waysides for obstacles and maintenance purposes will be of vital importance to the creation of a dedicated information model. The model will allow to safer and more accurate asset monitoring and maintenance.

The technical solutions that Assets4Rail will produce will be extremely valuable in rethinking rail mobility. Passenger and freight transport fleets will be produced according to higher safety paradigms. Their implementation will allow for a more efficient, clearer and more reliable management of the rail network. Thanks to Assets4Rail, the European railway infrastructure will be stronger and will be ready to cope with the expected increased traffic in the future.

Hainz's main research activities have been carried out under the EC funded project IMPACT-1 (Indicator Monitoring for a new railway PAradigm in seamlessly integrated Cross modal Transport chains – Phase 1, 2016-2018) and its follow-on project IMPACT-2 (Phase 2, 2017-2022). Both are part of the Shift2Rail initiative.

Her key activity within the projects is the evaluation of the impact of innovations on the operation of the railway by common key performance indicators (KPI). She was significantly involved in the development of models to integrate the different aspects of railway systems into one model per KPI. The calculation of the change in those KPIs due to the innovations developed within Shift2Rail was developed by her and an international team of experts from academia, industry and railways.

The KPI activities within Shift2Rail play a notable role for the railway research in Europe as the results are one of the aspects that will be considered when deciding about the funding for future railway research initiatives by the EU. The study of KPIs has a big impact on railway research at national, EU and global level as KPIs are usable as a translation of research results of various scientific fields to decision makers and the public.

Key research themes
European railway infrastructure · asset monitoring · increased traffic

Key research themes
impact of innovations on operations · new railway paradigm

TRANSPORT MODE
WATERBORNE

Pentti Kujala
Aalto University

Category: **Waterborne**   Country: **Finland**

Prof Kujala has an extensive track record of projects aiming to improve the safety of shipping in ice covered waters on the Baltic Sea, Arctic and Antarctic waters funded by European Commission, Lloyd's Register Foundation (LRF) and nationally. The first project, coordinated by him, was FP6 project SAFEICE (Increasing the safety of icebound shipping, 2004-2007) aiming to create a scientific basis for ice class rules (ship hull strength) and for placing requirements on ice classes with partners from Europe, Canada, Russia and Japan. This was continued by coordination of the FP7 project SAFEWIN (Safety of winter navigation in dynamic ice, 2009-2013) aiming to study the influence of the dynamic, moving ice on ships and to develop an operational ice compression prediction system. At present, this research continues as part of H2020 project SEDNA (Safe maritime operations under extreme conditions; the Arctic case).

Other important projects related to the same topic have been the LRF funded Center of Excellence CEARCTIC (Scenario based risk management for arctic shipping and operations, 2013-2018) aiming to develop holistic risk analysis methods for the design of ships for arctic operations and transport. Prof Kujala initiated this centre and managed the activities as its Chair. The work will continue on the new LRF funded Centre of Excellence CEPOLAR (Recommended practise of scenario based risk management for Polar waters). The aim is to prepare recommended practice for the future safe and economic ship design and operations for Polar waters.

Nationally supported projects include funding from TEKES and Academy of Finland to instrument the Finnish built ship Agulhass II for full scale ice load measurements on Antarctica (2012-2018). Also the recent Baltic Sea BONUS projects STORMWINDS and BALTIMARE which included studies of safety of winter navigation on the Baltic Sea.

All these efforts and projects have resulted in a remarkable impact to improve the safety of shipping in ice covered waters. Scientific impact can be measured through about 200 publications during this period, with about 2500 citations and Scopus H-index 30. A most important impact to policy development is the validation of the new IMO created Polar Code risk based approach (POLARIS) using the developed ice load and ship strength analysis methods together with extensive full scale data (7 years) from Arctic and Antarctic.

Pentti Kujala, Professor of Marine Technology and Vice Dean for research at School of Engineering in Aalto University, chairing a CoE for Arctic shipping and operations funded by Lloyd's Register Foundation. He has been active in EU funded research since 1995, being e.g. the coordinator of 3 projects: DISCO, SAFEICE and SAFEWIN.

Key research themes
safety · ice class rules · operational ice compression prediction system

Maria Boile
University of Piraeus

Category: **Waterborne**   Country: **Greece**

Antti Pohjoranta
Neste Oyj

Category: **Waterborne**   Country: **Finland**

Maria Boile has been the project coordinator on numerous European Commission funded research projects in the field of ports and maritime policy. MARPOS (Maritime Policy Support, 2008-2011), assisted the EC in the implementation of the EU Maritime Transport Policy priorities, providing recommendations on future research needs and priorities. FUTRE (Future Prospects on Transport Evolution and Innovation Challenges for the Competitiveness of Europe 2012-2014) highlighted future challenges and demand drivers that can have a considerable impact on the global transport demand patterns and how this may affect the competitiveness of related industries and service providers. EUPORTRAItS (European Port workers Training Scheme, 2013-2016) provided technical support to the European Ports Social Dialogue, which was launched in 2013 and examined health and safety, training and qualification challenges in EU ports. One of the major achievements of the project was the facilitation of Ports Social Dialogue at a national level in seven countries. The project received a Silver Prize at the 2015 Health & Safety Awards.

In addition to the above, Maria Boile has participated as core project partner and leader of specific activities in EU projects GREENBERTH (2012- 2015), MATES (2018-2021), SUPAIR (2018-2019), Cluster-Act (2019-2021) and MarLEM (2019-2022).

These projects have produced a systemic overview of current practices in port and maritime transport with emphasis on training aspects.

Antii Pohjoranta is an expertise in modelling and testing of hydrogen fuel cells. He has been involved in many fuel cell related EC funded projects including FLAGSHIPS (Clean waterborne transport in Europe, 2019-2022) and MARANDA (Marine application of a new fuel cell powertrain validated in demanding arctic conditions, 2017-2021) both of which are taking hydrogen and fuel cells to sea, the latter on the marine research vessel Aranda.

One main impact of this work has been to raise the awareness of regulatory and political bodies, locally as well as at the European level, to the challenges related to implementing hydrogen-powered propulsion for marine vessels. From a technical viewpoint, it has confirmed what is already achievable and helped identify the technical bottlenecks and thus focus future research efforts for using hydrogen powered fuel cells on ships. It has established a solid technical, practical and regulatory competence basis for future research and development work and built confidence with technology providers so that they can activate themselves in this field.

Key research themes
maritime policy · facilitation of ports social dialogue · training

Key research themes
hydrogen fuel cells modelling · hydrogen propulsion for marine vessels

TRANSPORT MODE
AIRBORNE

Vassilis Kostopoulos
University of Patras

Category: **Airborne**   Country: **Greece**

Aviation's environmental impact extends across the entire lifecycle of manufacturing aircraft, their maintenance throughout operational service, and responsible disposal or preferably recycling. One of the possibilities being explored in the project is the use of plant-based materials as an environmentally desirable alternatives to petrochemicals in composites. Following the same direction for greening of composites, is the work to replace glass fibre reinforcement with flax fibres and keep the composite properties almost at the same level and performance as in the case of typical glass fibre reinforced plastics. Using new bio-composites for aircraft interiors as well as for the cabin furnishings, which are lighter as well as ecologically friendly, leads directly to fuel saving during the operational phase of the aircraft as well as at end of life.

In parallel ecoTECH is developing out of autoclave manufacturing methodologies for bio composites as well as low energy curing methods, focusing on microwave curing and near IR LED multiplexing approach. Following this manufacturing route gives at least an 80% energy saving during the manufacturing phase of bio-composites while keeping properties and performance unaffected.

Thus ecoTECH is not only directly addressing the operational phase of an aircraft, but also indirectly through the lighter materials that are being developed, it seriously contributes to the greening of aircraft manufacturing by introducing biomaterials and low energy curing methodologies.

The output of ecoTECH has the potential to impact all the fields of the composite industry from road transport to wind energy and it will find use at national, EU and global levels. The use of bio-composites together with the low energy curing methodologies may transform the full composite industry of EU, thus moving the transport industry in the direction of lighter and environmentally sustainable vehicles.
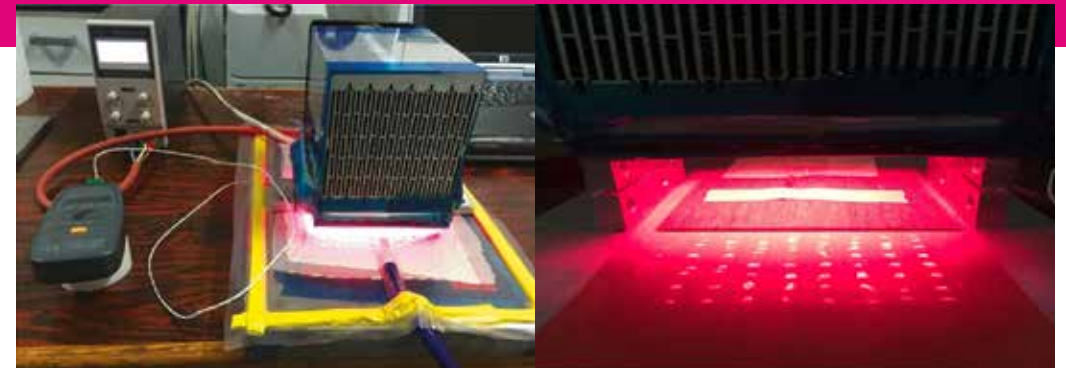
Vassilis Kostopoulos has a long history of research into the design, analysis and optimization of composite structures with involvement in over 50 EU funded projects with a variety of applications. A recent example is his contribution to the project ecoTECH (ECO-friendly airframe, 2016-2023) that has been funded within the framework of the EU Clean Sky 2 Joint Undertaking, ecoTECH is part of Airframe ITD, and is in collaboration with Eco Design Transverse Activity.

Key research themes
maritime policy · facilitation of ports social dialogue · training

Christophe Hurter
École nationale de l'aviation civile

Category: **Airborne**   Country: **France**

Massimiliano Zanin
Universidad Politécnica Madrid

Category: **Airborne**   Country: **Spain**

Christophe Hurter's core research area is Information Visualization, an example of this is the EU funded project the embodied MOTO (reMOte Tower, 2016-2018). MOTO applied an Embodied cognition framework to understand air traffic controllers' perception and actions in a remote control tower setting, to understand what generated the sense of presence and how to make it as real as the reality. This emerging technology operates in immersive and mixed reality environments where users wear a Head Mounted Display. This technology opens new promising opportunities to leverage user ability to support decision making with complex data visualisation.

This project generated many fruitful outcomes for the research community and for aeronautical practitioners with the remote tower concept, including high quality journal publications, two patent submissions and successful demonstrations to the French ministry of transportation and the head of the French civil aviation.

This work is being extended in many directions beyond Air Transportation Management including direct usage with neurosurgeons and brain fibres exploration. In addition, Christophe Hurter will investigate how to use this immersive technology to provide more transparent algorithms going beyond black box processes into the domain of Explainable Artificial Intelligence.

Massimiliano Zanin has an European Research Council starting grant ARCTIC (Air Transport as Information and Computation, 2019 -2024) to study how concepts from neuroscience can be applied in air transport, and specifically to characterize and solve the problem of reactionary delays. This builds on his earlier work on EU funded aviation projects such as SafeClouds.eu (Data-driven research addressing aviation safety intelligence, 2016-2019) and PROSPERO (Proactive Safety Performance for Operations, 2012-2015) and his wider experience in the biomedical and software fields.

His research is an example of the importance of interdisciplinarity and he believes that air transport can (and must) benefit from the advancements witnessed in other fields. An interesting example of this is neuroscience: while two decades ago most of the attention was devoted to the molecular level (e.g. how neurons interacted between them through neurotransmitters), now the focus has shifted to high-level concepts like information and networks. Tools from statistical physics and information theory have then been imported, leading to a better understanding of the overall brain dynamics. For example, interactions between aircraft in an airspace can be mapped into networks, which can then be used to understand which structures are more prone to create safety-related events, e.g. losses of separation.

Key research themes
information visualization · immersive-mixed reality environment

Key research themes
neuroscience · reactionary delays · networks · statistical physics

TRANSPORT MODE
CROSSMODALITY

Cristina Pronello
Politecnico di Torino

Category: **Crossmodality**

Country: **Italy**

Cristina Pronello's research activity is focused on two main topics; the environmental impacts of transport systems and the travel behaviour and Information Technology solutions, crosscut by the common issue of sustainable mobility.

The EC funded project Opticities (Optimise Citizen Mobility and Freight Management in Urban Environments, 2013-2016) studied transport users perception, attitudes and behaviours for three years, to gain an understanding if and how smart mobility technologies could influence travel behaviour, inducing a modal diversion towards more sustainable mobility. The findings resulted in a rethink of the way to collect mobility data. Starting with a framework for an innovative and multisource data collection; followed by developing an app thought as an educational tool to make people aware about the consequences of their mobility.

This allowed Cristina Pronello to establish a living lab in France, now replicated in Italy, and establish the basis to launch a start-up using the technology for social innovation: the more people know and understand, the more they are inclined to provide their data to turn upside down the current paradigm of transport planning.

The current ecological debate, pushed by green activist groups, is increasingly influencing public policy. Thus, the analysis of how technology and related mobility policies can affect people's beliefs and emotional reactions can support policy makers wanting to encourage a more sustainable mobility. The research allowed defining of a simple and effective measure of ecological behaviour suitable to different cultural and geographical contexts, understanding people's attitudes towards environmental issues and how such information can be used to better tailor mobility policies. The second result is the detection of factors driving user decision making, this allows forecast of the mode choice and the individual sustainability index. The third result was the definition of a psycho-social based segmentation of Advanced Traveller Information System (ATIS) user scores on the convenience rather than on the utilitarian transport value.

Cristina Pronello, Full Professor, Politecnico di Torino (Interuniversity Department of Regional and Urban Studies and Planning), and, formerly, Chair holder "Intelligent Transport Systems and Territorial Dynamics", Sorbonne Universités – UTC, coordinates TRIS (Transport Research for Innovation and Sustainability) research group. She is member of the Board of Ferrovie dello Stato Italiane.

Key research themes
transport systems · environmental impact · travel behaviour · mobility data

Elisabete Arsenio
LNEC and ECTRI

Category: **Crossmodality**   Country: **Portugal**

Irina Stipanovic
Infra Plan Consulting

Category: **Crossmodality**   Country: **Croatia**

Elisabete Arsenio is a transport expert specialising in sustainable urban mobility planning, and economics and policies to achieve societal goals. She has contributed to a multitude of EC and nationally funded projects most notably USE-iT (Users, Safety, security and Energy In Transport Infrastructure, 2015-2017). The objective of USE-iT was to gain a better understanding of the common challenges experienced across transport modes and to develop a set of common research objectives. More than 300 technologies, processes and systems were identified that could benefit from a cross-modal approach. A significant number of technologies, materials and approaches were identified which could help reduce transport energy consumption and reduce carbon emissions. It also identified the common challenges facing all modes as they work to reduce transport carbon emissions, and the potential areas of cross-modal research that could help to address these were evaluated and prioritized. This led to her help develop the Portuguese national scientific agenda on the topic of mitigation of climate change effects and low carbon mobility policies plus further collaborative research projects on the topic of sustainable and multimodal mobility plans towards decarbonisation which are a contribution to the rethinking of transport towards an inclusive and clean mobility.

Irina Stipanovic has an established track record of contributing to EC funded infrastructure projects focusing on risk based life cycle management (oVERFLOw, EnDurCrete and SAFE-10-T) and nationally funded projects (Croatia, the Netherlands). The decision support tools developed in several research projects are used by railway and highway agencies (Ireland, Croatia and the Netherlands) and the tools enable better usage of limited resources, resulting in safer and less congested transport networks. The models allow risk to be quantified and safety levels to be improved recognising that the use of finite resources must be quantified and optimised.

The work on improving decision making process related to development of optimal maintenance plans has been applied and validated by infrastructure managers for real-world problems, e.g. by Irish Rail to predict delays, performance and maintenance needs of switches and crossings. In collaboration with experts from Rijkswaterstaat (Dutch Highway agency) advanced machine learning models have been developed, the models use existing data to plan bridge maintenance activities.

Irina Stipanovic is helping the University of Zagreb enhance its research visibility and establish collaborations between Croatian and other European academic institutions (e.g. ETH, TU Delft, University of Twente, TU Berlin, etc.)

Key Characteristics
Organic light emitting diode (OLED) technology · Aircraft emissions

Key Characteristics
Future aviation · Regional air transport

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