Traficom Research Reports
7/2020

Proceedings of TRA2020, the 8th Transport Research Arena

Rethinking transport – towards clean and inclusive mobility

Toni Lusikka, (ed.)

Hosted and organised by

Co-organised by

Together with

TRAFICOM
Finnish Transport and Communications Agency

Date of publication
28/5/2020

Title of publication Proceedings of TRA2020, the 8th Transport Research Arena: Rethinking transport – towards clean and inclusive mobility	
Author(s) Lusikka Toni (ed.)	
Commissioned by, date Finnish Transport and Communications Agency Traficom	
Publication series and number **Traficom Research Reports 7/2020**	ISSN (online) 2669-8781 ISBN (online) 978-952-311-484-5
Keywords TRA2020, Transport Research Arena, conference	

Abstract

This publication presents the proceedings of TRA2020, the 8th Transport Research Arena, which was planned to be held on 27-30 April 2020 in Helsinki. The physical conference event was cancelled due to the COVID-19 pandemic.

All work presented in this Book of Abstracts was peer-reviewed and accepted for the conference. Authors were encouraged to publish their full paper in a repository of their choice with a mention of TRA2020. Authors were invited to provide a link to the full paper to be included in this Book of Abstracts. If the link is not available, please contact the corresponding author to request the full paper.

Selection of TRA2020 papers were published in Special Issues of following journals: European Transport Research Review (Vol. 11-12) and Utilities Policy (Vol. 62 & 64).

Papers with a TRA VISIONS 2020 senior researcher winner as an author are marked with large yellow stars. Smaller stars stand for papers with an author shortlisted in the TRA VISIONS 2020 competition. The EC has supported the best senior researchers involved in EU projects with the TRA VISIONS awards.

Contact person	Language English	Confidence status	Pages, total 299
Distributed by	Published by Finnish Transport and Communications Agency Traficom		

Liikenne- ja viestintävirasto

Julkaisupäivämäärä
28.5.2020

Julkaisun nimi Proceedings of TRA2020, the 8th Transport Research Arena: Rethinking transport – towards clean and inclusive mobility			
Tekijät Lusikka Toni (ed.)			
Toimeksiantaja ja asettamispäivämäärä Liikenne- ja viestintävirasto Traficom			
Julkaisusarjan nimi ja numero **Traficomin tutkimuksia ja selvityksiä 7/2020**	ISSN(verkkojulkaisu) 2669-8781 ISBN(verkkojulkaisu) 978-952-311-484-5		
Asiasanat TRA2020, Transport Research Arena, konferenssi			

Tiivistelmä

Tässä julkaisussa esitellään abstraktit niistä konferenssipapereista, jotka oli tarkoitus esittää kahdeksannessa Transport Research Arena -konferenssissa TRA2020 Helsingissä 27.–30.4.2020. Konferenssi peruutettiin COVID-19-pandemian vuoksi.

Kaikki tässä abstraktijulkaisussa esitetyt työt on vertaisarvioitu ja hyväksytty konferenssiin. Kirjoittajia on kannustettu julkaisemaan koko paperinsa valitsemassaan tietokannassa ja mainitsemaan siinä yhteydessä TRA2020:n. Kirjoittajilta pyydettiin koko konferenssipaperiin vievä linkki liitettäväksi tähän julkaisuun. Jos linkkiä ei ole käytettävissä, paperia voi pyytää suoraan kirjoittajalta.

Valikoituja TRA2020-konferenssipapereita julkaistiin kahden tieteellisen journaalin erikoisnumeroissa: European Transport Research Review'ssa (Vol. 11-12) ja Utilities Policyssa (Vol. 62 & 64).

Konferenssipaperit, joiden kirjoittajat on palkittu kokeneiden tutkijoiden TRA VISIONS 2020 -kilpailussa, on merkitty suurilla keltaisilla tähdillä. Pienemmillä tähdillä on merkitty paperit, joiden kirjoittajat olivat ehdolla TRA VISIONS 2020 -kilpailussa. Euroopan komissio on tukenut TRA VISIONS -palkinnoilla parhaita kokeneita tutkijoita, jotka ovat mukana EU-hankkeissa.

TRA2020:n järjestäjät ja tämän asiakirjan julkaisija eivät vastaa suoraan tai epäsuorasti tämän asiakirjan sisältämien tietojen oikeellisuudesta eikä niillä ole mahdollisiin virheisiin tai poisjättöihin liittyviä oikeudellisia velvollisuuksia tai vastuita. Asiakirjassa voi olla linkkejä muihin kuin julkaisijan tai järjestäjien palveluihin. Järjestäjät ja julkaisija eivät vastaa tällaisten kolmansina osapuolina olevien palveluntarjoajien sisällöstä, saatavuudesta, oikeellisuudesta tai omistus- tai tekijänoikeuksista.

Yhteyshenkilö	Raportin kieli englanti	Luottamuksellisuus	Kokonaissivumäärä 299
Jakaja	Kustantaja Liikenne- ja viestintävirasto Traficom		

Transport- och kommunikationsverket

Utgivningsdatum
28.5.2020

Publikation Proceedings of TRA2020, the 8th Transport Research Arena: Rethinking transport – towards clean and inclusive mobility	
Författare Toni Lusikka (ed.)	
Tillsatt av och datum Transport- och kommunikationsverket Traficom	
Publikationsseriens namn och nummer **Traficoms forskningsrapporter och utredningar 7/2020**	ISSN (webbpublikation) 2669-8781 ISBN (webbpublikation) 978-952-311-484-5
Ämnesord TRA2020, Transport Research Arena, konferens	

Sammandrag

Denna skrift innehåller publikationerna från den 8:e Transport Research Arena-konferensen TRA2020, som skulle ha ägt rum 27–30 april 2020 i Helsingfors. Konferensen ställdes in på grund av covid-19-pandemin.

Alla texter i skriften har granskats enligt peer review-förfarande och godkänts för konferensen. Författarna har uppmuntrats att publicera sina fullständiga artiklar i valfritt arkiv och där omnämna TRA2020. De har erbjudits att infoga en länk till den fullständiga artikeln i denna skrift. Kontakta författaren för att be om den fullständiga artikeln om det inte finns någon länk.

Ett urval av TRA2020 artiklar har publicerats i specialutgåvor av följande tidskrifter: European Transport Research Review (Vol. 11-12) och Utilities Policy (Vol. 62 & 64)

Artiklar av seniorforskare som vunnit TRA VISIONS 2020 -tävlingen är markerade med stora gula stjärnor. Mindre stjärnor står för artiklar av författare som var kandidater i TRA VISIONS 2020 -tävlingen. Den Europeiska kommissionen har understött de bästa seniorforskarna inom EU projekt genom TRA VISIONS -tävlingen.

Organisatörerna av TRA2020 och utgivaren av denna skrift ger inga uttryckliga eller underförstådda garantier vad gäller riktigheten av informationen i skriften och frånsäger sig allt ansvar för eventuella fel eller utelämnanden. Skriften kan innehålla länkar till andra tjänster än utgivarens och organisatörens. Organisatörerna och utgivaren ansvarar inte för innehåll, tillgänglighet, riktighet, äganderätt eller copyright vad gäller sådana tredjepartstjänster.

Kontaktperson	Språk engelska	Sekretessgrad	Sidoantal 299
Distribution	Förlag Transport- och kommunikationsverket Traficom		

FOREWORD

The main theme of Transport Research Arena 2020 was ***"Rethinking transport - towards clean and inclusive mobility"***. The 2020 conference focused on climate change mitigation and adaptation as well as the development of user-oriented, accessible and sustainable transport and mobility solutions. Based on this, more specific key themes of TRA2020 were also formed.

Transport Research Arena is, as its name suggests, more than a conference. It is a strategic discussion forum for the European transport sector and the relatedresearch, industry and decision-makers. Once every two years, nearly 2,500 researchers and representatives of the public and private sectors meet to exchange experiences and expertise, explore new trends in the industry and consider is the appropriate allocation of the European research and development funding in the coming years. The hosts and main organisers of TRA2020 are the Finnish Transport and Communications Agency Traficom, the Ministry of Transport and Communications, the Finnish Transport Infrastructure Agency, Business Finland, VTT Technical Research Centre of Finland and the European Commission as co-organiser.

TRA2020 was held in exceptional circumstances. The physical conference was to take place in Helsinki on 27-30 April 2020, but the COVID-19 pandemic prevented the organisation of a physical conference event. Therefore, it was considered important to give the conference papers an appropriate forum in a written publication. The TRA2020 Book of Abstracts contains the abstracts of and links to the conference papers approved for presentation (orally or by poster) in the conference. The publication has been approved by all authors.

Many actors and stakeholders contributed to the high-quality scientific content of TRA2020. First of all, we would like to thank the authors of the conference papers. Conference papers were sought for the 12 key themes of the conference, and a large number of quality paper proposals were received. We would also like to thank the volunteer and professional evaluators who invested their time and expertise in the peer review of the conference papers. This was essential in terms of producing high-quality content for TRA2020.

In addition, we would like to thank the members of the TRA2020 Management Committee and Programme Committee for the preparation of the conference programme and for their constructive cooperation. Also, our sincere thanks go to all other active participants, the wide range of stakeholders and colleagues who enabled the set-up of a high-quality programme through their activities. The joint preparation process provided an interesting perspective to the core of European transport research and innovation.

Helsinki, 28 May 2020

Alina Koskela, TRA2020 Management Committee Chair, Finnish Transport and Communications Agency Traficom
Pekka Rajala, TRA2020 Management Committee Vice-Chair, Finnish Transport Infrastructure Agency
Pekka Leviäkangas, TRA2020 Programme Committee Chair, University of Oulu (VTT until 1/2020)
Mikko Räsänen, TRA2020 Programme Committee Vice-Chair, Finnish Transport and Communications Agency Traficom
Ari-Pekka Manninen, TRA2020 Programme Committee Vice-Chair, Finnish Transport Infrastructure Agency
Claudio Roncoli, TRA2020 Programme Committee Vice-Chair, Aalto University

ESIPUHE

Transport Research Arena 2020 pääaiheena oli ***"Rethinking transport - towards clean and inclusive mobility"***. Vuoden 2020 konferenssissa painottui ilmastomuutoksen hillintä ja siihen sopeutuminen sekä käyttäjälähtöisten, saavutettavien ja kestävien liikenne- ja liikkumisratkaisujen kehittäminen. Tämän pohjalta muotoutuivat myös tarkemmat TRA2020-avainteemat.

Transport Research Arena on nimensä mukaisesti enemmän kuin konferenssi. Se on strateginen keskustelufoorumi eurooppalaiselle liikennealalle, sen tutkimukselle, teollisuudelle ja päättäjille. Kerran kahdessa vuodessa lähes 2500 tutkijaa sekä julkisen ja yksityisen sektorin edustajaa kokoontuvat vaihtamaan kokemuksia ja osaamista, tunnustelemaan alan uusia tuulia ja pohtimaan, mihin eurooppalaista tutkimus- ja kehitysrahoitusta on tarkoituksenmukaista suunnata tulevina vuosina. TRA2020-isäntinä ja -pääjärjestäjinä toimivat Liikenne- ja viestintävirasto Traficom, liikenne- ja viestintäministeriö, Väylävirasto, Business Finland, Teknologian tutkimuskeskus VTT sekä kanssajärjestäjänä Euroopan komissio.

Vuoden 2020 TRA oli poikkeuksellinen. TRA2020 oli määrä toteuttaa Helsingissä 27.-30.4.2020, mutta COVID-19 -pandemian vuoksi fyysistä konferenssitapahtumaa ei voitu järjestää. Tämän vuoksi oli tärkeää suoda konferenssipapereille arvoisensa foorumi kirjallisen julkaisun muodossa. TRA2020 Book of Abstracts sisältää abstraktit ja linkit kaikkiin konferenssipaperehin, jotka oli hyväksytty esitettäviksi konferenssissa (suullisesti tai posterilla). Kirjoittajat ovat antaneet luvan julkaisuun.

TRA2020-konferenssin laadukas tieteellinen sisältö syntyi monien toimijoiden ja sidosryhmien yhteistyönä. Ensinnäkin osoitamme kiitoksemme konferenssipapereiden laatijoille. Konferenssipapereita haettiin 12 konferenssin avainteemaan, joihin tuli suuri määrä korkeatasoisia paperiehdotuksia. Haluamme kiittää myös kaikkia vapaaehtoisia ja ammattimaisia arvioitsijoita, jotka panostivat aikaansa ja osaamistaan konferenssipaperien vertaisarviointiin. Tämä oli laadukkaan TRA2020 -sisällön tuottamisessa erittäin keskeistä.

Lisäksi kiitämme TRA2020 -johtoryhmän ja ohjelmakomitean jäseniä konferenssiohjelman valmisteluista ja rakentavasta yhteistyöstä. Vilpittömät kiitoksemme myös kaikille muille aktiivisille toimijoille, laajalle joukolle sidosryhmätoimijoita ja kollegoita, jotka mahdollistivat toiminnallaan korkeatasoisen ohjelman. Yhteinen valmisteluprosessi tarjosi mielenkiintoisen näköalan eurooppalaisen liikennetutkimuksen ja innovaatioiden ytimeen.

Helsingissä 28.5.2020

Alina Koskela, TRA2020 Management Committee -puheenjohtaja, Liikenne- ja viestintävirasto Traficom
Pekka Rajala, TRA2020 Management Committee -varapuheenjohtaja, Väylä
Pekka Leviäkangas, TRA2020 Programme Committee -puheenjohtaja, Oulun yliopisto (VTT 1/2020 asti)
Mikko Räsänen, TRA2020 Programme Committee -varapuheenjohtaja, Liikenne- ja viestintävirasto Traficom
Ari-Pekka Manninen, TRA2020 Programme Committee -varapuheenjohtaja, Väylä
Claudio Roncoli, TRA2020 Programme Committee -varapuheenjohtaja, Aalto-yliopisto

FÖRORD

Huvudtemat för Transport Research Arena 2020 var ***"Rethinking transport - towards clean and inclusive mobility"***. Konferensen 2020 fokuserade på att stävja klimatförändringen och anpassa sig till den samt att utveckla användarorienterade, tillgängliga och hållbara trafik- och transportlösningar. Utifrån detta bildades också mer specifika teman för TRA2020.

Transport Research Arena är, som namnet säger, mer än en konferens. Det är ett strategiskt diskussionsforum för den europeiska transportsektorn, dess forskning, industri och beslutsfattare. En gång vartannat år samlas nästan 2 500 forskare och representanter för den offentliga och privata sektorn för att utbyta erfarenheter och kompetens, känna på branschens nya vindar och fundera på vart det är ändamålsenligt att rikta den europeiska forsknings- och utvecklingsfinansieringen under de kommande åren. Värdar och huvudarrangörer för TRA2020 är Transport- och kommunikationsverket Traficom, kommunikationsministeriet, Trafikledsverket, Business Finland, Teknologiska forskningscentralen VTT och medarrangör är Europeiska kommissionen.

År 2020 var TRA exceptionellt. Den fysiska konferensen var inplanerad den 27–30 april 2020 i Helsingfors men det fysiska konferensevenemanget kunde inte genomföras på grund av pandemin COVID-19. Därför är det viktigt att de konferenspapper som godkändes för TRA2020 får ett värdigt forum i en skriftligt publikation. TRA2020 Book of Abstracts innehåller abstrakten och länkar till de konferenspapper som godkänts för presentation (muntligt eller med poster) i konferensen som skribenten har gett publiceringstillstånd för.

Det högklassiga vetenskapliga innehållet av TRA2020 tillkom genom samarbete mellan många aktörer och intressegrupper. För det första vill vi uttrycka vårt tack till dem som utarbetat konferenspappren. Vi sökte konferenspapper för tolv av konferensens nyckelteman och vi fick ett stort antal bra pappersförslag.

Vi vill också tacka alla frivilliga och professionella bedömare som gav sin tid och sitt kunnande för den kollegiala granskningen av konferenspapper. Detta var mycket viktigt för att skapa ett högklassigt TRA2020 -innehåll.

Vi tackar också medlemmarna i ledningsgruppen för TRA2020 och programkommittén för förberedelserna och det konstruktiva samarbetet kring konferensprogrammet. Vi vill även rikta vårt uppriktiga tack till alla andra aktiva aktörer, de många intressentgruppsaktörerna och kollegerna som genom sin verksamhet möjliggjorde ett högklassigt program. Den gemensamma beredningsprocessen erbjöd ett intressant perspektiv på kärnan i den europeiska trafikforskningen och innovationerna.

Helsingfors den 28 maj 2020

Alina Koskela, ordförande för TRA2020 Management Committee, Transport- och kommunikationsverket Traficom
Pekka Rajala, viceordförande för TRA2020 Management Committee, Trafikledsverket
Pekka Leviäkangas, ordförande för TRA2020 Programme Committee, Uleåborgs universitet (VTT fram till 1/2020)
Mikko Räsänen, viceordförande för TRA2020 Programme Committee, Transport- och kommunikationsverket Traficom
Ari-Pekka Manninen, viceordförande för TRA2020 Programme Committee, Trafikledsverket
Claudio Roncoli, viceordförande för TRA2020 Programme Committee, Aalto-universitetet

Table of Contents

1 Scientific and technical sessions

1.1 Scientific and technical session 1: The institutional and user responses to climate challenge

105 Determination of navigation conditions by inland waterway vessels: outcomes of the H2020 EU project PROMINENT

Schweighofer Juha[a]*, Orlovius Andreas[b], Abma Dick[c], Blagoci Sergiu[d]

a via donau – Österreichische Wasserstraßen-Gesellschaft mbH, Donau-City-Straße 1,Vienna 1220, Austria
b Bundesanstalt für Wasserbau, Kußmaulstraße 17, Karlsruhe 76187, Germany
c TNO, Van Mourik Broekmanweg 6, Delft 2628 XE, The Netherlands
d C.N.F.R. NAVROM S.A., Portului Str. No. 34, Galati 800025, Romania
** juha.schweighofer@viadonau.org*

Abstract

The determination of proper knowledge on navigation conditions comprising water depths and flow velocities allows for detection of unfavourable locations and improved maintenance of the waterway, serving the efficient navigation of vessels sailing in the respective areas, as well as the establishment of more reliable transport services. In addition, safety margins with respect to the loading of a vessel can be reduced, allowing for more cargo to be transported. Finally, the knowledge on navigation conditions is also one precondition for energy-efficient ship operation and development of ship performance tools e.g. relating to voyage planning. In the Horizon 2020 EU project PROMINENT, two different systems were developed for the determination of navigation conditions by shipborne measurements performed on board commercial vessels. The first one was applied in three vessels sailing on the Rhine, the second one was applied in ten different pushed convoys sailing on the Middle and Lower Danube.

Keywords: shipborne measurement, water depth, flow velocity, Rhine, Danube, cargo vessel, passenger vessel

Full paper:
https://www.researchgate.net/publication/339882548_Determination_of_navigation_conditions_by_inland_waterway_vessels_outcomes_of_the_H2020_EU_project_PROMINENT

405 Towards a European Standard of Sustainable Urban Mobility Indicators – Lessons learned from the SUMI project

Ralf Brand[a]*, Stephanie Keßler[b]

a Rupprecht Consult Forschung und Beratung GmbH, Clever Str. 13-15, 50668 Köln, Germany
b Freelance consultant and researcher, Emilienstraße 74, 20259 Hamburg, Germany
** r.brand@rupprecht-consult.eu*

Abstract

Indicators play a vital role in a city's efforts to develop a more sustainable mobility system. To support cities in this important activity, the European Commission (DG MOVE) funded the SUMI project to review and "Europeanised" the existing indicator set SMP2.0 of the World Business Council for Sustainable Development. The SUMI consortium worked with nearly 50 urban areas in almost all EU Member States to apply this resulting indicator set and thus to test, validate and improve it. The overall goal is a methodologically rigorous, yet practical tool with concrete benefits for cities and with the potential to become the European standard of sustainable urban mobility indicators. The added EU benefit will be a feature for cross-city

comparison and benchmarking. This paper presents the lessons learned from the SUMI project in terms of complementarity with SUMP, likely long-term commitment of cities, data availability, benchmarking possibilities and methodological rigour and practicality.

Keywords: Sustainability; Cities; Europe; Mobility; Indicators; Benchmarking

467 Mobility styles and car sharing use in Europe: Attitudes, behaviours, motives and sustainability

Érika Martins Silva Ramos[a]*, Cecilia Jakobsson Bergstad[a], Andrea Chicco[b], Marco Diana[b]

a University of Gothenburg, Department of Psychology, Box 500, SE-405 30 Göteborg, Sweden
b Politecnico di Torino, Department of Environment, Land and Infrastructure Engineering, Corso Duca degli Abruzzi 24, 10129 Turin, Italy
** erika.ramos@psy.gu.se*

Abstract

What are the profiles of both users and non-users of car sharing in European cities regarding their travel patterns and psychological aspects? Two subsamples (1519 users and 3695 non-users of car sharing) participated in a survey, translated into seven languages, with thirty-six questions regarding attitudes towards car sharing, the environment, political orientation, personal norms, frequency of use of different transport modes and transport mode choice for different travel purposes. Through a hierarchical cluster analysis, five distinct mobility styles were identified, with no a priori restriction of the number of clusters. The mobility styles were further characterised by sociodemographic variables and by the motives for making use of car sharing. This paper discusses the implications of research based decision-making and urban planning in a way that guarantees long-term human and environmental security.

Keywords: Car sharing; Transport behaviour; Motives; Attitudes

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

569 Paving Climate Friendly Pavement with Low Rolling Resistance: Perspectives of Extensive Measurements Results

Christian Axelsen[a]*, Matteo Pettinari[a]

a The Danish Road Diretorate, Guldalderen 12, DK-2640 Hedehusene, Denmark
** cax@vd.dk*

Abstract

The Danish Road Directorate has, in collaboration with universities and the Danish pavement industry, been involved in several R&D projects on developing a pavement with a low rolling resistance alongside a high durability, equal to or more than pavement types conventionally chosen for major Danish roads, predominately an SMA11. This pavement is termed the climate friendly pavement. In a political landscape where initiatives of climate change mitigation are increasingly requested, the development and subsequent implementation of the climate friendly pavement has gained great interest. As a result, ear-marked state resources were allocated to the Danish Road Directorate in 2017 and 2018 specifically for further research and analyses through assigning resources for paving additional stretches as a large-scale demonstration project. The results and subsequent analyses of all

measurements that will lead to the comprehensive documentation of the climate friendly pavement will be finalized in 2019 and fully presented at the TRA2020.

Keywords: Pavement, Climate, CO2, Rolling Resistance, Socioeconomic analyses

590 Contribution of Pavements to decreasing the Urban Heat Island effect

Arsel Isel Inestroza Mercado[a]*, Rainer Hess[a]

a Durth Roos Consulting GmbH, Siegfriedstrasse 28, 53619 Rheinbreitbach, Germany
** arsel.inestroza@durth-roos.de*

Abstract

The raising of temperatures nowadays has become a critical issue, especially in urban areas due to the phenomenon of the Urban Heat Island effect (UHI). Asphalt pavement temperatures increase due to the solar radiation, which contributes towards this effect. The concept of cooling the pavement surface is possible by means of a temperature controlled asphalt pavement. This concept will lead to a reduction of the surface temperature and subsequently a decrease of the temperatures in the surrounding urban areas during warm seasons. Thus, it will relieve the Urban Heat Island effect. For this paper the concept of temperature controlled asphalt pavement has been proposed. Theoretical consideration has been made and a numerical modelling is presented.

Keywords: temperature controlled; asphalt; thermal properties; urban heat island effect

Full paper: https://durth-roos.de/images/download/TRA2020_0311019_Inestroza.pdf

647 Climate change adaptation by National Road Administrations Implementation of tools developed under CEDR transnational research programmes in Ireland, the Netherlands and Norway

Billy O'Keeffe[a], Vincent O'Malley[a]*, Kees van Muiswinkel[b], Gordana Petkovic[c]

a Transport Infrastructure Ireland, Dublin, Ireland
b Rijkswaterstaat Water Traffic and Environment, Rijswijk, the Netherlands
c Norwegian Public Roads Administration, Oslo, Norway
** vincent.omalley@tii.ie*

Abstract

Climate change presents National Road Administrations (NRAs) with the following significant challenges:

- To reduce greenhouse gas (GHG) emissions from their activities and that of their supply chain
- To maintain the resilience of their national road network in the face of a changing climate

The Conference of European Directors of Roads (CEDR) commissioned a number of projects over the past 10 years through its transnational research programme to support NRAs with these challenges. All of these projects have produced valuable knowledge and tools for NRAs. The challenge now facing NRAs is to ensure that such tools are implemented and become an integral part of the procedures for designing, building and maintaining road infrastructure. The consensus is that there are now enough tools and knowledge for NRAs to adapt their infrastructure to the impacts of climate change. The next challenge facing NRAs is to implement

adaptation procedures with constrained budgets and the uncertainty around climate change impacts, as well as the uncertainties surrounding the economy and developments in transport mobility.

Keywords: risk, climate change, flooding, resilience, greenhouse gas

664 On route to clean bus services

Nils-Olof Nylund[a]*, Petri Söderena[a], Reijo Mäkinen[b], Tero Anttila[b]

a VTT Technical Research Centre of Finland Ltd, P.O.Box 1000, Espoo, FI-02044 VTT, Finland
b Helsinki Region Transport, P.O.Box 100, Helsinki, FI-00077 HSL, Finland
** nils-olof.nylund@vtt.fi*

Abstract

PTAs have the possibility to act as trendsetters for sustainable mobility. Helsinki Region Transport (HSL) already has managed to cut both local and greenhouse gas emissions of buses significantly. The goals are quite ambitious; by 2025 HSL wants to achieve a reduction of 90 % or more for emissions of carbon dioxide and pollutants, compared to the year 2010. Within the partnership with HSL, VTT has tested more than 200 buses, and conducted several field tests. The technologies and fuels covered include diesel, renewable diesel, ethanol, methane (natural gas, biogas), hybrids and battery electric vehicles, creating a comprehensive database. This paper discusses the progress in the performance of buses with conventional powertrains. Furthermore, it presents the actions taken by HSL to introduce advanced biofuels as well as electric buses in Metropolitan Helsinki. Finally, it presents HSL's fleet strategy going towards 2030.

Keywords: bus services; greenhouse gas emissions; pollutant emissions; fuel alternatives

Full paper:
https://cris.vtt.fi/ws/portalfiles/portal/27710314/On_route_to_clean.pdf

723 Road weather model RoadSurf driven by a regional climate model: evaluation and present-day road weather climatologies over Finland

Erika Toivonen[a]*, Marjo Hippi[a], Hannele Korhonen[a], Ari Laaksonen[a], Markku Kangas[a], Joni-Pekka Pietikäinen[b]

a Finnish Meteorological Institute, Erik Palménin aukio 1, 00560 Helsinki, Finland
b Climate Service Center Germany (GERICS), Fischertwiete 1, 20095 Hamburg, Germany
** erika.toivonen@fmi.fi*

Abstract

Anthropogenic climate change affects road weather conditions in the northern high latitudes. The expected warmer and wetter future climate implies new challenges for the road transportation sector. Therefore, it is essential to estimate the impacts of climate change on road weather in the Nordic countries. For this purpose, we have set up a road weather model RoadSurf that utilizes meteorological data from a high-resolution regional climate model HARMONIE-Climate. As a first step, we investigated the skill of the road weather model to reproduce present-day road weather conditions in Finland. Simulated road surface temperatures were compared to observations between 2002 and 2014 at 25 road weather stations. RoadSurf accurately captured the characteristics of observed road weather implying this approach can be used to construct the present-day road weather climatologies as

well as to study the impacts of climate change on road weather conditions in the study area.

Keywords: Road weather model; Road conditions; Regional climate; Climate change

762 High Capacity Transport vehicles increase efficiency, reduce energy and CO2 emissions and road wear – Example of Finland

Jussi Sauna-aho*[a], Olavi H. Koskinen[b], Pasi Sauna-aho[c], Tapio Rivanti[d]

a Vemosim Ltd, Patotie 6 A 15, Vantaa, FI01600, Finland
b Private cosultant, Purjetie 2 C 115, Helsinki, FI00960, Finland
c Vemosim Ltd, Karhuniityntie 9 D, Vantaa, FI01690, Finland
d Globnet Ltd, Pellavakaskentie 10 B, Espoo, FI02340, Finland
** jussi.sauna-aho@vemosim.com*

Abstract

Legislation of road vehicle weights (mass) and dimensions was changed in Finland in 2013 and again in 2019. The 2013 legislation change allowed the transport enterprises to get test licenses for specified time periods for vehicles, which exceed the limits on lengths and masses of the standard, "normal" vehicle combinations. The test vehicles (= HCT vehicles) are mainly combinations with semi-trailers or trailers. The 2019 legislation increased the maximum length of vehicle combinations from 25.25 to 34.5 m but left the maximum combination for the gross mass of 76 tons unchanged. Vemosim Ltd studied the effects of the new legislation in 2016 – 2018. The conclusions are that the HCT vehicles are suitable on roads which are built according to the extant road and bridge design standards without tight road junctions. The HCT vehicles increase transport efficiency, reduce the number of round trips, energy use, CO2 emissions, and road wear compared to the normal vehicles.

Keywords: HCT (High Capacity Transport) vehicles; standard or normal vehicles; energy efficiency; CO2 emissions; road wear impacts

828 Climate extremes impact modelling in the transport sector

Pregnolato Maria[a]*, Jaroszweski David[b], Ford Alistair[c], Dawson Richard J.[c]

a Dep. of Civil Engineering, University of Bristol, Bristol, UK
b School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham, UK
c School of Engineering, Newcastle University, Newcastle, UK
** maria.pregnolato@bristol.ac.uk*

Abstract

Cities are increasingly vulnerable to damage and disruption from adverse weather events, due to their high concentration of people and assets. Improved engineering and planning decisions for complex urban systems require novel analytical tools and methodologies, particularly in terms of impact modelling for extreme events. This paper describes how the nature of the transport system, including its multifaceted vulnerabilities, complexity and spatially heterogeneous network criticality, places unique demands on the impacts community. It highlights a case study of extreme flooding impacting roads which underlines the necessity of systems approaches to tackle the challenges brought by urban complexity. It is demonstrated that combining flood modelling and transport networks into the impact analysis improves engineering decision-making and enables the prioritisation of adaptation investments in urban areas. The findings and the

methodology are of interest to academics, planners, economists and engineers, as well as communities affected by disruptive events.

Keywords: transport, flooding, climate change, impact, resilience

879 Global Climate Change & Maritime Logistics

Rainer Müller[a]*, Matthias Dreyer[b], Esther Hoffmann[c], Patrick Schöpflin[c], Nils Meyer-Larsen[b]

a ISL Institute of Shipping Economics and Logistics, Universitätsallee 11-13, 28359 Bremen, Germany
b ISL Institute of Shipping Economics and Logistics, Barkhausenstrasse 2, 27568 Bremerhaven, Germany
c IÖW Institute for Ecological Economy Research, Potsdamer Str. 105, 10785 Berlin, Germany
** rmueller@isl.org*

Abstract

The global climate change already has adverse effects on maritime intermodal door-2-door supply chains. Extreme weather events, like heavy rainfall, inland river floods and heatwaves already have direct effects on the maritime industry in the Federal State of Bremen in Germany. Besides these direct effects, an event, which happens upstream in the global supply chain, can lead to indirect consequences for Bremen. Besides these extreme weather events, which already occur, also the long-term effects of global climate change – such as sea-level rise, temperature rise, changes in precipitation patterns, and the increase in the frequency and intensity of these extreme weather events – have to be analysed for a proper supply chain risk management. This paper gives insight into the current situation on supply chain risks caused by global climate change. These results were retrieved from interviews and one workshop with participants in the maritime logistics domain.

Keywords: Supply chain risk management, maritime logistics, global climate change, extreme weather events

1078 Modelling Global Transport Pathways to meet the Paris Climate Agreement Goals

Özcan Deniz[a]*, Johannes Pagenkopf[b], Bent van den Adel[a]

a German Aerospace Center (DLR), Pfaffenwaldring 38-40, Stuttgart 70569, Germany
b German Aerospace Center (DLR), Rutherfordstraße 2, Berlin 12489, Germany
** oezcan.deniz@dlr.de*

Abstract

Energy-related carbon dioxide emissions of global transport have risen rapidly in recent decades. But according to the Paris Climate Agreement, advanced decarbonisation pathways have to be followed so that progressing global warming is halted. We developed global transport transition pathways until 2050 that are in line with limiting global warming to +1.5°C and +2.0°C against pre-industrial temperature levels. Our modelling uses CO2 budgets for transport developed within the One Earth Climate Model. We model final energy demands considering potential transport performance and technological developments in a business-as-usual, a +2°C- and a +1.5°C-scenario until 2050. The results show that the final energy demand in the +2.0°C would need to be 66% lower in 2050 (-74% in 1.5°C-scenario) compared to the energy demand in 2050 in the business-as-usual scenario. This means that reaching the 2.0°C and 1.5°C pathways require drastic reductions in global transport energy demand and a decarbonisation of energy carriers.

Keywords: Global transport; transport energy demand; Paris Climate Agreement; decarbonisation pathways; scenario modelling; energy efficiency

1165 Iceland's strides towards carbon neutrality in 2040 – The role of ecofriendly fuels for transport

Anna Margrét Kornelíusdóttir[a]*, Jón Björn Skúlason[b]

a Icelandic New Energy, Grensásvegur 9, 108 Reykjavík, Iceland
b Icelandic New Energy, Grensásvegur 9, 108 Reykjavík, Iceland
** amk@newenergy.is*

Abstract

Iceland has a decades long tradition of energy transition and world leading utilization of renewable energy. The nation has joined the global community to cut emissions, reduce its carbon footprint and set forth means by which to seize the opportunity the impending energy transition brings. An essential factor in reducing fossil fuel consumption, and thus also cutting related emissions, is the firm advancement of clean mobility and implementation of accompanying infrastructure. This paper covers main governmental actions, including incentives and infrastructure support for alternative fuels and describes key initiatives which have impacted the increased uptake of alternative fuels for land and marine transport in Iceland.

Keywords: Energy transition; hydrogen; electrification; transport; policy; carbon neutrality

1.2 Scientific and technical session 2: Zero emission mobility

200 User Centered solutions of electric car-sharing in medium and small size urban centers

Chiara Bresciani[a]*, Francesca Costa[a], Roberta Falsina[a], Alessandro Luè[a]

a Poliedra – Politecnico di Milano, via Giuseppe Colombo 40, Milan, 20133, Italy
** chiara.bresciani@polimi.it*

Abstract

The expansion of car sharing is visibly changing the transportation landscape in urban areas, but today's typical car sharing participants live in urban neighborhoods with medium to high household densities. The objective of the EU co-funded project I-SharE LIFE is to demonstrate innovative solutions of electric car-sharing in medium and small urban centers. The solutions maximize the use of the e-cars during the day by different user types, during the working time by companies and in the free time by citizens or commuters that use the train in combination with e-car-sharing. The paper focuses the User Research and Co-design activities of service models with different users (commuters, Public Administration, private companies), with the aim to create a service designed around the real needs of the customer and to improve the user interactions (i.e. touchpoints). In particular, the activities (re)define the integrated technology platform through the user experience analysis.

Keywords: e-car sharing, e-mobility, user research, co-design, demonstration project

252 Road pavement energy harvesting: experimental validation of an electromechanical system

Francisco Duarte[a], Adelino Ferreira[a]*, Paulo Fael[b]

a CITTA, Department of Civil Engineering, University of Coimbra, Rua Luís Reis Santos, 3030-788 Coimbra, Portugal
b Department of Electromechanical Engineering, University of Beira Interior, Calçada Fonte do Lameiro, 6200-001 Covilhã, Portugal
** adelino@dec.uc.pt*

Abstract

The growing need for more sustainable energy sources has led to the increase of research in the field of energy harvesting in recent years. The potential to harvest the kinetic energy from vehicles in the road pavement has led to a new area of research, known as road pavement energy harvesting, in which some technologies have been developed in recent years. A common problem of such technologies has been the inefficiency of energy conversion, especially when tested outside laboratories. After presenting the system modeling and computational simulations of a new electromechanical system in a previous work, this paper deals with the experimental validation of a road pavement energy harvesting device based on an electromechanical system. The main goal is to quantify the energy harvesting and conversion efficiency of the system and compare it with the existing systems and previous simulations. Conclusions about the system's efficiency and the energy production are presented.

Keywords: road pavement; energy harvesting; electromechanical system; experimental validation; cleantech; sustainability

264 i-HeCoBatt: Intelligent Heating and Cooling solution for enhanced range EV Battery packs

Aitor Makibar[a]*, Alois Sonnleitner[b], Xavier Faure[c], Iosu Erauskin[d], Laura Larrivière[e], Gerhard Engelbrecht[f], Pierre Woltmann[g]

a CIDETEC Energy Storage, Parque Científico y Tecnológico de Gipuzkoa · Pº Miramón 196, 20014 Donostia-San Sebastián, Spain
b Miba AG, Dr. Mitterbauer-Straße 3, 4663 Laakirchen, Austria
c CEA, 5 rue de l'Halbrane, F-44 340 Bouguenais, France
d Datik, Paseo Mikeletegi 56, 20009 Donostia-San Sebastián, Spain
e Vertech Group, 11, rue Defly, 06000 Nice
f EPI GmbH, Leopoldauer Straße 173 - 181, 1210 Wien, Austria
g AUDI AG, D-85045 Ingolstadt, Germany
** amakibar@cidetec.es*

Abstract

The envisaged European CO2 fleet emission limits for 2025-2030 require a massive market introduction of electric-vehicles (EVs), but their high cost, slow charging, limited range or perceived lack of added value hinder the user acceptance. In order to contribute to solve the technical issues, the H2020 project "i-HeCoBatt" aims at achieving a smart, cost bursting industrial battery heating and cooling system to minimize the impact on EVs range in extreme conditions. The project will develop an innovative heat exchanger to enhance the efficiency, as well as an advanced instrumentation system to feed the battery management system and a cloud-based monitoring system. Finally, the solution will be industrialised to enhance the cost reduction and to introduce the product in OEMs value chain in a maximum period of 2 years after the closure of the project. This paper presents i-HeCoBatt project and the main contributions expected from it.

Keywords: e-mobility, lithium batteries, heating and cooling system, product design, manufacturing, vehicle industry

272 EVC1000 – Integrated corner solution for innovative electric vehicles

Eric Armengaud[a]*, Torsten Nager[a], Sebastian Gramstat[b], Stefan Heimann[b], Daniele Gaglione[c], Matteo Mazzoni[d], Gorazd Lampic[e], Jože Buh[e], Riccardo Groppo[f], Claudio Romano[f], Miguel Dhaens[g], Sven Rzepka[h], Valentin Ivanov[i], Aldo Sorniotti[j]

a AVL List GmbH, Hans List Platz 1, Graz 8020, Austria
b AUDI AG, Ingolstadt 85045, Germany
c JAC Italy Design Center S.r.l., Via Torino 21b, Pianezza 10044, Italy
d Freni Brembo Spa, via Brembo 25, Curno 24035, Italy
e Elaphe Propulsion Technologies, Teslova Ulica 30, Ljubljana 1000, Slovenia
f Ideas&Motion S.r.l., via Santa Margherita 8, Alba 12051, Italy
g Tenneco Automotive Europe BVBA, Industriezone Schurhovenveld 1037, Sint Truiden 3800, Belgium
h Fraunhofer ENAS, Technologie-Campus 3, 09127 Chemnitz, Germany
i Technical University of Ilmenau, Ehrenbergstrasse 29, Ilmenau 98693, Germany
j University of Surrey, Stag Hill, Guildford GU2 7XH, United Kingdom
** eric.armengaud@avl.com*

Abstract

E-mobility is a major automotive trend. With falling prices and recent technological advances, the second generation of electric vehicles (EVs) that is now in production makes electromobility an affordable and viable option for more and more people. To maintain this EV momentum, the latest edition of ERTRAC's European Roadmap for Electrification of Road Transport defines four big initiatives outlining the research and development needs. The EVC1000 project targets the "user-friendly affordable EV passenger car + infrastructure" initiative and focus on in-wheel drivetrain layouts, as well as a wheel-centric integrated propulsion system and EV manager. Contribution of this paper is the introduction of the proposed integrated corner solution featuring in-wheel motor, distributed brake-by-wire and active suspensions, and presentation of the results achieved at project mid-time, especially in terms of performance and driveability.

Keywords: automotive; electric vehicle; e-mobility; in-wheel motor

310 Dead-lock in the introduction of ERS-technology for heavy vehicles – a case of true uncertainty

Björn Hasselgren[a]*, Fredrik Widegren[b]

a Swedish Transport Administration, Solna Strandväg 98, 171 54 Solna, SWEDEN
b Swedisch Transport Administration, Solna Strandväg 98, 171 54 Solna, SWEDEN
** bjorn.hasselgren@trafikverket.se*

Abstract

As a major contributor to reaching the goals of de-carbonization of the transport sector, the introduction of ERS-systems for heavy vehicles is a prioritized action, with Sweden as an example. Even if de-carbonization is asked for by policymakers, and part of the medium to long term strategy for many transport market players, it is very difficult to get the transition to take off. Hindrances related to current roles on the market, regulation and the ability to find new ways to finance and foster new business models can be observed. This resembles a 'true uncertainty'-situation. The result might be a dead-lock where the introduction of ERS-systems is delayed. It is argued here that platforms and frameworks for testing new systems, where "regimes" supporting shared risk mitigation, faster innovation, and deployment of ERS-technology could be supported. We discuss possible ways for establishing such platforms and crucial policy content for these.

Keywords: Electric road systems; heavy vehicles; true uncertainty; radical change

Full paper: http://www.diva-portal.org/smash/record.jsf?dswid=-1878&pid=diva2%3A1395060&c=29&searchType=SIMPLE&language=sv&query=bj%C3%B6rn+hasselgren&af=%5B%5D&aq=%5B%5B%5D%5D&aq2=%5B%5B%5D%5D&aqe=%5B%5D&noOfRows=50&sortOrder=author_sort_asc&sortOrder2=title_sort_asc&onlyFullText=false&sf=all

345 Hydrogen as a Transport Fuel: Energy efficiency, CO2 emissions and financial implications

Molly J. Haugen[a], Leonardo Paoli[a], Jonathan Cullens[a], David Cebon[a], Adam M. Boies[a]*

a Department of Engineering, University of Cambridge, Trumpington St, Cambridge CB2 1PZ, United Kingdom
** amb233@cam.ac.uk*

Abstract

Hydrogen as a transportation fuel requires an efficient energy carrier pathway relative to other vectors, such as electric batteries. This study compares the energy efficiency, CO2 intensity, and costs associated with fuel-cell electric vehicles (FCEVs) and battery electric vehicles (BEVs) for current commercial technologies. Providing electricity directly to BEVs is 1.8 – 3.9 times more efficient than converting energy to hydrogen for a FCEV. CO2 emissions are dependent on the energy source and the pathway's efficiency. On average a fully electric pathway has 55% lower CO2 emissions per km driven than a pathway using electrolysis for hydrogen production. Along with increased energy efficiency and reduced CO2 contributions, there are also significantly fewer costs associated with implementing BEVs than FCEVs.

Keywords: Hydrogen, Fuel-cell Vehicles, Electric Vehicles, Transportation

826 Comparison of main energy efficiency strategies implemented in a communication based train control system

Süleyman Açikbaş[a], Mehmet Turan Söylemez[b]*

a HI-SIM Technology & Engineering, Istanbul Technical University Technopolis, Maslak, Istanbul, Turkey
b Istanbul Technical University, Control and Automation Engineering Department Maslak, Istanbul, Turkey
** soylemezm@itu.edu.tr*

Abstract

Nowadays, most of the new metro systems deploy Communication Based Train Control system with grade of automation level 2 or above in which signaling system is driving the trains as per pre-defined speed profiles based on a set of performance parameters. IEEE Std. 1474 standard specifically names train acceleration, train coasting, and train braking that a CBTC system may have as energy optimization algorithms. This paper examines the effects of different combinations of above mentioned parameters on the travel time and energy saving potential against all-out performance. A rail systems simulation software, which can simulate both train performance and traction system at the same time taking the regenerative braking into account, is used to test different combinations of performance parameters against the coasting strategy, and provide a comparison between them. The tests cover from 'station to station' runs with single train to complete line runs with multiple trains.

Keywords: load flow simulation; energy efficiency; coasting; rail system; traction simulation; signalling

Full paper: https://web.itu.edu.tr/soylemezm/tra2020/acikbas_soylemez.pdf

1058 Electrifying freight transport in Europe

Harm Weken[a]*, Rob Kroon[b], Floris Jousma[b]

a Fier Automotive & Mobility, Automotive Campus 30, Helmond, The Netherlands
b Fier Automotive & Mobility, Automotive Campus 30, Helmond, The Netherlands
** harmweken@fier.net*

Abstract

In this paper we focus on application areas for electric freight transport in different segments, and have included example use cases. This is followed-up by a more in-dept description of an implementation project about realising seven battery-electric 44-ton electric trucks with (ultra-fast) charging infrastructure, on which the first insights can be shared. Additionally, an analyses of the current availability of electric trucks and charging infrastructure is shown, including a forecast of suppliers, technologies and developments with regards to the future of electric freight transport.

Keywords: BEV, Heavy Duty, Freight Transport, Truck, Fast Charge

1098 Touchpoints for e-mobility: Understanding the vehicle purchase process to promote EV sales in Switzerland

Jana Plananska[a]*

a Institute for Economy and the Environment, University of St.Gallen, Rosenbergstrase 51, 9000 St.Gallen, Switzerland
** jana.plananska@unisg.ch*

Abstract

Electric vehicles (EV) are critical to fulfil climate goals. Despite societal and technological benefits, Swiss EV market share was only 1.8% in 2018. To understand the reasons for the limited EV sales and propose measures how to increase them, vehicle purchase process has to be analysed. For that, a mixed method research combining narrative literature review and an online survey of 553 Swiss car drivers was conducted. The conclusions firstly deliver a novel, conceptual framework of the vehicle purchase process. It consists of five stages both prior and after the purchase that are underlined by differentiated decision-making strategies. Secondly, key influences in the process have been identified. Based on these findings, touchpoints in individual stages of the purchase process to more effectively promote EV sales in Switzerland have been recommended, namely fostering consultation of a plurality of information sources, car dealer EV training programs and EV use-based incentives.

Keywords: Electric vehicles; Vehicle purchase process; Touchpoints; EV sales; Car dealers; Policy recommendations

1116 Developing roaming protocols for EV charging: Insights from the field

Mart van der Kam[a]*, Roland Ferwerda[b], Rudi Bekkers[a]

a Eindhoven University of Technology, School of Innovation Sciences, PO Box 513, 5600 MB Eindhoven, the Netherlands
b NKL - The Netherlands Knowledge Platform for Public Charging Infrastructure, Vondellaan 162 3521 GH Utrecht, the Netherlands
** m.j.kam@tue.nl*

Abstract

As electric vehicles (EVs) become more mainstream, roaming will become an increasingly important topic; more and more EV drivers want to connect to available charging networks. Roaming is enabled via communication protocols, which also allow for services such as information on availability and tariffs of charge points. Currently, there are several roaming protocols in use within Europe. With multiple roaming protocols gateway technologies are necessary to achieve full interoperability of charge points, which has disadvantages such as extra costs and limited functionality. Whether multiple protocols will be continued to used or one protocol becomes dominant in the future does not only depend on technical performance of the protocols, but also on attitudes of stakeholders towards them. To investigate these attitudes, we have interviewed roaming experts across Europe. Our results address current issues in roaming and point to trade-offs in how to proceed in achieving full interoperability for charging infrastructure.

Keywords: Electric vehicles; charging infrastructure; roaming; protocols; interoperability; harmonization

Full paper:
https://www.researchgate.net/publication/339900323_Developing_roaming_protocols_for_EV_charging_Insights_from_the_field

1.3 Scientific and technical session 3: Clean mobility policies

184 Electric mobility for building up Smart Sustainable Districts

Francesca Costa[a], Giuliana Gemini[a], Alessandro Luè[a]*, Irene Vegetti[a], Clara Callegaris[b], Roberto Nocerino[b], Andrea Canevazzi[c], Valentino Sevino[c]

a Poliedra – Politecnico di Milano, via G. Colombo 40, 20133 Milano, Italy
b Comune di Milano, Direzione Economia Urbana e Lavoro – Smart City Unit, Via Dogana 4, 20123 Milano, Italy
c Agenzia Mobilità Ambiente Territorio, Via Tommaso Pini 1, 20134 Milano, Italy
** alessandro.lue@polimi.it*

Abstract

The development of Smart Sustainable Districts can contribute to reduce the environmental impact of cities and improve their social inclusiveness. The paper describes the contribution of electric mobility in building-up Smart Sustainable Districts, through the experience gained within two European funded projects, Sharing Cities and Merezzate+. Sharing Cities (H2020) concerns an existing district, renovating, optimizing and better organizing what is already in place (Smart Retrofitted District approach). Electric mobility increases the connectivity of the district with the rest of the city, providing more sustainable options to the traditional private mobility. Merezzate+ (Climate-KIC), instead, works in creating from scratch a new residential smart district studying and including tailored services for the residents (Smart Greenfield District approach). The new real estate does not provide just living and community features but is able to orient the buyers in their personal mobility behaviors, offering added-value mobility services.

Keywords: Electric mobility; Shared mobility; Smart Sustainable District; Community Engagement; Behavioral Change

312 What is a fair share? The impact of different emission allowance allocation methods in the citizens' personal carbon trading system for urban mobility

E. Uusitalo[a]*, A. Kuokkanen[a], V. Uusitalo[a], T. von Wright[a], A. Huttunen[b]

a LUT University, Mukkulankatu 19, Lahti 15210, Finland
b City of Lahti, Askonkatu 5, Lahti 15100, Finland
** elisa.uusitalo@lut.fi*

Abstract

Personal carbon budget and trading (PCT) is an innovative downstream policy, which locates rights and responsibilities for the emissions at the individual level. Herein, we present a PCT model for urban mobility in the city of Lahti, which is one of the first pilots of its kind. The aim of this paper is to present results of the citizens' baseline emission profiles data, collected through mobile app tracking. Secondly, the objective is to analyze different carbon allowance allocation methods and their impact on income levels. Results show that greenhouse gas emissions from mobility are higher for people with higher income. Therefore, when emission allocation rights are distributed evenly, people with lower income are more likely to benefit financially, whereas higher income citizens must pay for surplus emissions. Financial benefits and payments depend on the carbon cap, carbon floor price, and whether the system is designed more incentivizing or punitive.

Keywords: personal carbon trade; urban mobility; transport; emission allowance allocation; digitalization

434 EU transport sector decarbonisation: simulating the impacts of electric vehicles diffusion with the ASTRA SD model

Angelo Martino[a]*, Francesca Fermi[a], Davide Fiorello[a], Marco Gatto[a], Stephanie Heitel[b]

a TRT Trasporti e Territorio, Via Rutilia 10/8, Milano 20141, Italy
b ISI Fraunhofer, Breslauer Strasse 48, 76139 Karlsruhe, Germany
** martino@trt.it*

Abstract

Elaborating on the European economy decarbonisation targets, this paper analyse the impact of large-scale diffusion of e-vehicles and other transport policies in the context of a future high share of renewable energy and less carbon-intensive transport activities. Different scenarios of future EU28 greenhouse gas emission are explored based on simulations from REFLEX, a H2020 research project where the System Dynamics model ASTRA is used in combination with other models in a comprehensive Energy Modelling System. Results show that the climate impacts of transport are largely influenced by the trend of electricity price as well as by a set of coherent transport policies. The paper demonstrates that although the diffusion of e-vehicles generates a consistent reduction of GHG emissions, the ambitious transport decarbonisation target can only be achieved with the contribution of complementary policies acting on fuel efficiency of conventional drivetrains, demand management and deployment of low-emission alternative fuels.

Keywords: decarbonisation; greenhouse gas emissions; e-mobility; transport policies; energy

622 Sustainable mobility in the smart city: Will lessons from GrowSmarter help Europe grow smarter?

Paul Fenton[a]*, Maria Xylia[b]

a City of Stockholm, Environment & Health Administration, Fleminggatan 4, Stockholm, SE-11226, Sweden
b Sweco Energy AB, Gjörwellsgatan 22, Stockholm, SE-10026, Sweden
** paul.fenton@stockholm.se*

Abstract

This paper presents lessons learnt and policy recommendations following demonstration of 14 measures addressing sustainable urban mobility in the EU-funded project GrowSmarter and its three "Lighthouse Cities" of Barcelona, Cologne and Stockholm. General conclusions are described by topic with reference to practical examples from the project illustrating potential barriers or opportunities to implementation. More creative use of public space is recommended, through e.g. establishment of regulated spaces in which sustainable mobility is prioritised and a wide range of new services can emerge and flourish. Such spaces could address single topics – such as consolidated delivery services using sustainable last-mile providers – or address more comprehensive travel concepts such as mobility stations. To achieve this, cities should be empowered with new regulatory powers and resources to ensure Europe's sustainable urban mobility transition.

Keywords: smart cities; sustainable cities; urban mobility; transport; emissions; governance

Full paper:
https://www.researchgate.net/publication/339618179_Sustainable_mobility_in_the_smart_city_Will_lessons_from_GrowSmarter_help_Europe_grow_smarter

898 A proposal for a novel urban mobility policy: personal carbon trade experiment in Lahti city

Anna Kuokkanen[a]*, Markus Sihvonen[b], Ville Uusitalo[a], Anna Huttunen[c], Tuuli Ronkainen[a]

a Lappeenranta-Lahti University of Technology, Saimaankatu 14, Lahti and 15140, Finland
b Lahti School of Applied Sciences, Mukkulankatu 19, Lahti and 15210, Finland
c City of Lahti, Askonkatu 2, Lahti and 15100, Finland
** anna.kuokkanen@lut.fi*

Abstract

Climate policies targeting change of everyday practices have been weak or non-existent. Mobility sector is a good example. Despite the development of less polluting engines, biofuels and electric vehicles, the overall emission levels have grown, and are expected to grow further. Personal carbon trade has been suggested as market-based means to cap the overall climate impact and to internalize polluter-pays-principle, thus engaging individuals to climate action and creating an impetus for social change. Despite some interest in the late 2000s, there have been only few practical applications and experiments. Digitalization offers entirely new possibilities that were neither explored nor exploited before. Therefore, the aim of the paper is to propose personal carbon trade as a way to introduce overall carbon budget for a citizen-led urban transformation. Consequently, we present how digitalization can enable new models of personal carbon trade and present a practical case application from the city of Lahti.

Keywords: personal carbon trade; citizen carbon budget; digitalization; urban mobility; sustainability transition; policy innovation

This paper is a part of the Utilities Policy Special Issue:
https://www.sciencedirect.com/journal/utilities-policy/special-issue/10D8V459F11

900 The possible effects of automated vehicles on the modal share of private cars and public transport

Timo Liljamo[a]*, Heikki Liimatainen[b], Markus Pöllänen[c]

a Tampere University, P.O. Box 600, Tampere FI-33014, Finland
b Tampere University, P.O. Box 600, Tampere FI-33014, Finland
c Tampere University, P.O. Box 600, Tampere FI-33014, Finland
** timo.liljamo@tuni.fi*

Abstract

There have been some studies into the effects of automated vehicles (AV) on modal shares, but their results seem to conflict. The purpose of this study is to increase understanding about the possible impacts of AVs on future modal shares. The study presents results from an extensive citizen survey (N=2,036), which was conducted using stated preference method. Based on the results, it can be expected that AVs will impact the modal split in varying ways in different areas. The modal share of public transport is likely to increase along strong trunk routes, while elsewhere the share of passenger cars is expected to grow. The results also suggest that AVs could bring about significant demand for shared taxis and on-demand public transport. Some differences were also found between different user groups in terms of response distribution and the interest in using various modes of transport.

Keywords: automated vehicle; autonomous vehicle; survey; modal share; modal split

975 Taxation or Subsidization? Explaining Norway's Record Fast Market Uptake of Electric Cars

Lasse Fridstrøm[a]*

a Institute of Transport Economics (TØI), Gaustadalléen 21, 0349 Oslo, Norway
** lef@toi.no*

Abstract

Electrification of the vehicle fleet is widely seen as a key element in national governments' endeavor to bring down greenhouse gas emissions from transport. Policies vary considerably between countries, some resorting to subsidization, others relying on taxation, and many national and supranational authorities – such as the EU – emphasizing emissions regulation with or without fiscal penalties. In no other country is the market uptake of electric vehicles as vigorous as in Norway. The unprecedented speed at which Norwegian automobile buyers have embraced battery electric technology has taken observers, policy makers, stakeholders and even protagonists by surprise. We examine the government incentives in force in Norway and discuss whether they can be generalized to other jurisdictions.

Keywords: battery electric vehicles; fiscal incentives; greenhouse gas emissions; stock-flow model

976 The innovative CIVITAS mobility solutions in European cities

Dirk Engels[a]*

a Transport&Mobility Leuven, Diesesteenweg 57, Leuven 3010, Belgium
** dirk.engels@tmleuven.be*

Abstract

CIVITAS is a network of cities for cities dedicated to cleaner, better transport in Europe and beyond. Since it was launched by the European Commission in 2002, the CIVITAS Initiative has tested and implemented over 800 measures and urban transport solutions as part of demonstration projects in more than 80 Living Lab cities Europe-wide. During 2019 a new analysis will be made based on a survey of these cities in the CIVITAS program during the last 15 years about the long-term impact of the CIVITAS approach. This will result in a much stronger understanding of strong strategies for sustainable mobility approaches in Europe illustrated with interesting success stories. The paper will present these findings in a well-structured and attractive way.

Keywords: sustainable mobility, urban environment, traffic management, innovative solutions, technology, behaviour

980 Shared mobility services – a policy package update for Helsinki Metropolitan Area

Jáchym Judl[a]*, Emma Terämä[a], Annika Johansson[a], Marja Salo[a], Laura Saikku[a]

a Finnish Environment Institute (SYKE), Latokartanonkaari 11, 00790 Helsinki, Finland
** jachym.judl@ymparisto.fi*

Abstract

In 2015 a policy package for car sharing and bike sharing was created to highlight policy measures that should be implemented to support greater uptake of the services in Helsinki Metropolitan Area, Finland. It has not been adopted as designed, but many of the proposed policy measures have been at least partially implemented on the municipal level. In this work we present the original policy package and propose its 2019 update. We present which policy measures have been implemented and to what level, and which have not and why, if known. We also link to the City of Helsinki's ambitious carbon neutrality targets, now aiming for a carbon neutral city by 2035 instead of the previous 2050 target, as well as to the new national Government Programme 2019 in terms of its transport and mobility policy.

Keywords: transport policy; carbon neutrality; mobility; car sharing; bike sharing

994 Towards CO2 free mobility

Markus Sihvonen[a]*

a Lahti University of Applied Sciences, Mukkulankatu 19, 15210 Lahti, Finland
** markus.sihvonen@hamk.fi*

Abstract

The personal Carbon Trading (PCT) market place is virtual trading place of personal CO2 mobility emissions for people. Its aim is to promote people's voluntary reduction of CO2 emissions caused by their mobility. The purpose of this paper is to describe first experimental prototype of the system that measures personal mobility related CO2 emissions. There are two main requirements for the system:

It must measure users mobility CO2 emissions and it must support voluntary reduction of CO2 emissions caused by mobility of a user. The prototype proves that mobility related CO2 emissions of a person that uses the system can be measured reliably. This is done by utilizing user's smart phone as a sensor that uploads user's personal mobility data to the PCT platform. The system supports installation of any other possible sensors that complement user's mobility data collected by a smart phone.

Keywords: IoT, CO2 emissions, Personal Carbon Trading, Smart Mobility, Sustainable living

1172 Reducing pollutant emissions from existing passenger car fleet: generic approach to personalised recommendations

René van Gijlswijk[a]*, Norbert Ligterink[a], Armando Indrajuana[a], Claus Matzer[b]

a Netherlands Organisation for Applied Scientific Research TNO, Anna van Buerenplein 1, 2595 DA Den Haag, The Netherlands
b Technische Universität Graz, Institut für Verbrennungskraftmaschinen und Thermodynamik, Inffeldgasse 19, 8010 Graz, Austria
** rene.vangijlswijk@tno.nl*

Abstract

A new approach is proposed to decrease pollutant emissions from the existing passenger car fleet in Europe. First, vehicles are categorised by their engine block, based on fuel, engine size, power output and Euro standard. For each engine block a multi-layer emission map is calculated, using existing measurement data as an input. The engine maps will be available for new cars as well as older cars, and account for aging as well as other factors such as state of maintenance. Using the maps, drivers' trips can be analysed and used for a personalised advice to reduce emissions by changing the way they use the car as well as by changing their driving behaviour. The work described in this paper is performed within the H2020 uCARe project.

Keywords: pollutants, emissions, fleet, passenger car, behaviour

1133 Managing urban growth for a mass transit development Paris Région SNCF Transilien case

Pierre Messulam[a], Françoise Tournassoud[b]*

a Directeur Général Adjoint, SNCF MOBILITÉS-TRANSILIEN, 10 rue Camille Moke- CS 80001-93212 Saint Denis, France
b Responsable Prospective et Grand Paris SNCF Mobilités – Transilien, 10 rue Camille Moke- CS 80001-93212 Saint Denis, France
** francoise.tournassoud@sncf.fr*

Abstract

Mass Transit in Greater Paris, operated by SNCF Transilien, handles 3.4 million daily passengers in 6400 trains. Last ten years, yearly traffic growth has been 2.3%, quite faster than the 0.5% demographic one. Trend should accelerate over the next 15 years due to steady population growth and great business developments triggering more commuter traffic with residential areas. New interconnected lines through (Eole RER line) or around Paris (tram-train then Grand Paris Express) shall increase public transport market share. Handling this growth demands new methods to forecast traffic and manage crowds, and to design future robust infrastructure and systems. Our contribution exposes how we combine public and in house data, with maps and traffic modelling, to anticipate crossed territory and

network effects on traffic, in partnership with urban and City stakeholders, and how we use big data to adjust model and stochastic methods to fine-tune design infrastructures and test robustness of operations plans.

Keywords: Mass transit, urban, data, crowd management, demand management, robustness of operations

Full paper:
https://www.researchgate.net/publication/339882235_Abstract_of_Paper_1133_for_Transport_Research_Arena_TRA_2020_Managing_urban_growth_for_a_mass_transit_development_-Paris_Region_SNCF_Transilien_case

1.4 Scientific and technical session 4: City stories on sustainable and clean mobility

183 Sustainable mobility and transport in Stockholm: Moving from Eccentric to business as usual

Paul Fenton[a]*

a City of Stockholm, Environment & Health Administration, Fleminggatan 4, SE-11226, Sweden
** paul.fenton@stockholm.se*

Abstract

This paper assesses the work of the City of Stockholm in the CIVITAS Eccentric project. Five cities work together in this project to demonstrate fifty measures aiming to increase levels of sustainable mobility and transportation in each city, and to facilitate replication of these approaches to other cities in Europe and beyond. Twelve of these measures are demonstrated in Stockholm, addressing six wider themes. The paper describes the implementation and aims of these measures, informing a discussion about the extent to which Stockholm can mainstream successful practices, and the possibilities for other cities to replicate measures in their own contexts. Replication is found to be a process of adaptation and adoption, in which cities adapt an idea from another context and adopt their own recipe. By facilitating learning and exchange, EU projects such as CIVITAS Eccentric play an important role in facilitating both local demonstration and enabling replication.

Keywords: CIVITAS Eccentric; Stockholm; sustainable mobility; mainstreaming; upscaling; replication

Full paper:
https://www.researchgate.net/publication/339618011_Sustainable_mobility_and_transport_in_Stockholm_Moving_from_Eccentric_to_business_as_usual

235 Assessing future use of autonomous, shared and electric vehicle technologies to meet decarbonisation goals: a case study in Lisbon

Elisabete Arsenio[a]*, Mário Romão[b], Jorge Gomes[b], José Prata[b]

a LNEC, Av. do Brasil 101, 1700-066 Lisboa, Portugal
b ISEG Lisbon School of Economics & Management, Rua do Quelhas nº. 6, 1200-781 Lisboa, Portugal
** earsenio@lnec.pt*

Abstract

Decarbonisation policy goals are expected to drive significant changes in transport and urban mobility markets. However, future city trajectories that could enable multiple societal benefits from low carbon and zero-emissions solutions in a cost-efficient way are still uncertain. To the best of our knowledge, the research reported in this paper represents the first attempt to assess trends in the use of disruptive passenger urban transport solutions in Lisbon, while providing insights on the mechanisms by which stakeholders (public transport operators, new mobility providers such as car-sharing, infrastructure managers, etc.) management activities are open to change, cooperation and can foster strategic innovation towards decarbonizing mobility pathways. The pilot study supported by the Lisbon City Council comprised the former application of the "Benefits Realization Management" approach in the context of urban passenger mobility. Semi-structured surveys were implemented to a multimodal network of stakeholders. Finally, the "Benefits Dependency Roadmap" were derived as a strategic planning tool.

Keywords: Transport decarbonisation; disruptive mobility; benefits management; shared mobility; electric mobility; autonomous vehicles

Full paper: https://perma.cc/KBT9-TMSK

266 Carpooling potential and barriers: results and lessons learned from piloting in Espoo

Juho Kostiainen[a]*, Toni Lusikka[b]

a VTT Technical Research Centre of Finland, Vuorimiehentie 3, Espoo 02150, Finland
b VTT Technical Research Centre of Finland, Kaitoväylä 1, Oulu 90570, Finland
** juho.kostiainen@gmail.com*

Abstract

A carpooling application by Blox Car was piloted in the City of Espoo from Sept 2018 to Jan 2019. This paper presents pilot and survey results for the pilot and experiences of the process. The results find major events and regularly scheduled trips to be the most potential use cases. The biggest barriers for participation include lack of supply (drivers) and demand (riders) as well as the need to commit to pre-determined schedules or those of others. Main challenges for success related to exclusion of financial transactions (i.e. lack of compensation for drivers) and trouble in attracting users. Along with the indicative results of carpooling barriers and potential, a major value of the paper is in the lessons learned. The paper proposes relevant considerations and practical recommendations for piloting and deploying new mobility services based on the experiences, challenges and short-comings of the pilot.

Keywords: Carpooling; ride sharing; mobility services

623 Institutional Dynamics of Public Transport System: A Case Study of Jaipur City, India

Mohit Dev[a]*, Arindam Biswas[b]

a Research Scholar, Department of Architecture & Planning, Indian Institute of Technology Roorkee, Roorkee-247667, India
b Assistant Professor, Department of Architecture & Planning, Indian Institute of Technology Roorkee, Roorkee-247667, India
** mohidev@gmail.com, mdev@ar.iitr.ac.in.*

Abstract

The objective of this paper is to analyze the existing institutional framework for the public transport system and characteristics of the public bus and private mini-bus service, and the competition between these services in Jaipur. The study is based on the secondary data and primary surveys processed through the interviews of the representatives of Jaipur City Transport Services Ltd. (JCTSL), Regional Trasport Office (RTO) and the private mini-bus operators. Institutional mapping method and the time series analysis methods are used to analyze the existing institutional framework for the public transport system and the financial performance of the JCTSL respectively. The study finds major issues like the absence of a horizontal relationship between JCTSL, RTO, and JMRCL, conflict of administrative powers, competition of public and private mini-bus service. The findings will lead to the use of transport modes in an integrated manner to complement and promote the public transport system.

Keywords: Institutions; institutional mapping, public bus; private mini-bus; competition

742 How do society, industry and authorities benefit from the assessments of the Finnish National Transport System Plan?

Katja Estlander[a]*, Niko-Matti Ronikonmäki[b]

a The Finnish Transport Infrastructure Agency, P.O.Box 33, 00521 Helsinki, Finland
b Ministry of Transport and Communications, PO Box 31, 00023 Government, Finland
** katja.estlander@vayla.fi*

Abstract

In Finland, a new parliamentary procedure for long-term strategic design of the national transport system is developing. The impact assessment of the 12-year plan under construction supports planning throughout the iterative process. The assessment relies on legislation and national policy objectives. A new element is going to be the broader perspective of economic impact assessment. In our paper, we will demonstrate the new comprehensive perspective to national transport system planning and its interactive evaluation. The paper attempts to address the benefits of impact assessment for the strategic transport system planning in the context of the Finnish National Transport System Plan. We will discuss the advantages and disadvantages of this new perspective. However, as the Finnish National Transport System Plan is completed only in the spring of 2021, many details about the planning process are not yet available for this paper, but we will address those in the actual conference presentation.

Keywords: policy, externalities, transport economics

Full paper:
https://vayla.fi/documents/20473/716802/TRA2020_03132020_Estlander.pdf/53acb9d6-3b3d-488e-a1f6-3ba778cbff51

796 Driving sustainability: An analysis of micro-electric vehicle potential and city propensity for their success

Ilona Loustric[a], Melinda Matyas[a]*

a MaaSLab, Energy Institute, University College London, 14 Upper Woburn Place, WC1H 0NN, London, UK
** melinda.matyas@ucl.ac.uk*

Abstract

As a subset of increasing EV growth and micro-mobility technologies trends, micro-electric vehicles (micro-EVs) have the potential to address many transportation system issues. Little research quantifies micro-EV potential, increasing investment risks. This paper builds an index to measure city propensity for micro-EV success by incorporating differentiation, implementation, commercialisation, consumer and manufacturer requirements, and economic stability and viability aspects. The results highlight that micro-EV success is probably influenced by the lock-in of the city's transportation system. Despite inherent difficulties due to lock-in, our index suggests that there could be windows of opportunity for micro-EVs to be successful. Although both cities show a propensity for success, Shanghai scores higher than London, highlighting that these opportunities may exist particularly in developing countries as they experience less lock-in and have more consumer incentives. Implementing micro-EVs in cities with higher propensity could have the domino effect of motivating change in other locations.

Keywords: micro-electric vehicles; innovation success; city propensity; lock-in; transportation

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

850 Building a sustainable transportation model in cities: the example of "Grand Paris-Sud" conurbation

Paul-Eric Dossou[a,b]*, Marion Cailleau[b], Ronan Coueraud[b]

a Université Paris-Est,SPLOTT,AME, IFSTTAR, F77447, Marne-La-Vallée, France
b Icam Paris-Sénart, 34 Points de Vue, 77127, Lieusaint, France
** paul-eric.dossou@icam.fr*

Abstract

Road transportation is continuously increasing in Cities and urban areas. Indeed, this situation creates congestions, citizens anger, increasing of carbon and greenhouse gas (GHG). Despite, local authorities' good decisions for decreasing pollution and improving their citizens quality of life, the problem of customer consumption and company needs, reverse the positive trend. This paper focuses on the definition and validation of alternative solutions to road transportation from European ports to big cities by a direct connection or, through peri-urban platforms. Concepts for elaborating these solutions for a city will be developed. These concepts are based co-creation and co-innovation theories by associating all stakeholders (local authorities, companies, citizens) to the definition of the alternative solution. Then, the architecture of the decision aided tool being developed in Icam (French Engineer High school) supporting the new solution elaboration process will be presented and apply to "Grand Paris Sud" area.

Keywords: sustainable transportation, congestion optimization, carbon and GHG emission reduction, decision aided tool

931 Environmental performance of micromobility solutions in Paris: Preliminary results using Life Cycle Assessment

Anne de Bortoli[a,b]*, Ignacio Sanchez[c], Marcela Alves Lomasso[c], Zoi Christoforou[a,d]

a University of Patras, Department of Civil Engineering, 265 00 Patras, Greece
b University Paris-East, ENPC/IFSTTAR/UPEM, Lab. City Mobility, Transportation, 77420 Champs-sur-Marne, France
c Ecole des Ponts ParisTech,6-8 Avenue Blaise Pascal, 77420 Champs-sur-Marne, France
d IFSTTAR, GRETTIA Lab, 77420 Champs-sur-Marne, France

* *anne.de-bortoli@enpc.fr*

Abstract

Micromobility is booming in Paris. Between June 2018 and June 2019, twelve operators of free-floating electric scooters have appeared on the market, not to mention the rise in personal acquisitions of electric solowheels, nonelectrical scooters and hoverboards. While social and financial aspects of these new mobilities are vigorously questioned, their environmental impacts are often cut short as positive without a proper appraisal. We provide first estimates of environmental impacts of micromobility solutions in Paris, modeled using attributional process-based Life Cycle Assessment, and compare their multicriteria performance to classical urban modes.

Keywords: Electric scooter; free-floating; two-wheeled self-balancing personal transporter; solowheel

Full paper:
https://www.researchgate.net/publication/334710768_Environmental_performance_of_micromobility_modes_in_Paris_preliminary_results_using_Life_Cycle_Assessment

958 Efficiency of electric light vehicles in last mile delivering realization – Szczecin case study

Stanisław Iwan[a]*, Mariusz Nürnberg[a], Mariusz Jedliński[a], Kinga Kijewska[a]

a Maritime University of Szczecin, Faculty of Transport Economics and Engineering, 11 Pobożnego Str., 70-, Szczecin, Poland
** s.iwan@am.szczecin.pl*

Abstract

One of the solutions that help reduce the negative environmental impacts of urban freight transport is making use of vehicles that produce less pollution, such as electric vans. They prove very effective in reducing local emissions of e.g. PM or NOx. However, one of the key limitations is the potential short driving range of such vehicles, which results from the battery capacity. In recent years some analysis related to that issues have been made. Nevertheless, these works have taken to the account the passenger cars only. The paper presents the results of studies aimed at verification of electric vans effectiveness in real-life conditions, i.e. when delivering courier consignments. The electric van used for the purposes of the experiment was Nissan eNV200. It fulfil the important knowledge gap and could be helpful from both theoretical and practical perspective. The research study was carried out under the EUFAL international project, funded under the Electric Mobility Europe programme.

Keywords: city logistics; urban freight transport; electro-mobility; transport management; electric freight vehicles

993 How to halve the greenhouse gas emissions from traffic – Strategic measures in Helsinki region

Heikki Palomäki[a]*

a HSL Helsinki Region Transport, PL 100, 00077 HSL, Finland
** heikki.palomaki@hsl.fi*

Abstract

The Helsinki Region has a long history of regional long-term transport system planning. The Helsinki region land use, housing and transport plan (MAL 2019) is a plan that points out concrete measures how to meet the jointly agreed objectives. The strategic objectives for the MAL 2019 plan are: low-emission, attractive, vital and healthy region. The prioritized binding target is to reduce the region's transport CO2 emissions by 50 % from 2005 by 2030 which proved to be challenging. However, the measures were found. The key proved to be in focusing on reducing travel mileage and emissions per driven kilometer. The most significant measures included heavily growing the portion of EVs, introducing road pricing, making the buses CO2 neutral and supporting low-carbon heavy traffic. Planning was done iteratively. The main tool in evaluation was the regional transport model HELMET. The iterative process is something that every planning process should consider.

Keywords: transport system, transport policy, CO2 emissions, strategic planning

1.5 Scientific and technical session 5: Green shipping and clean ports

201 WATERBORNE: Winning the challenge against emissions

Paolo Guglia[a]*, Alberto Gruden[a], Andrea Castino[a]

a Fincantieri, via Genova 2, I-34151 Trieste, Italy
** paolo.guglia@fincantieri.it*

Abstract

The Waterborne sector in Europe is well-developed, diversified and cross-cultural. The Waterborne community is called to tackle societal needs and adopt emerging technologies, in order to determine the world of tomorrow and the life of future generations. Addressing the Sector's environmental sustainability has become a real cornerstone for the Waterborne stakeholders. In order to pursue such an ambitious changeover, a deep technological development is required, affecting both new-built ships and vessels and existing fleets. The Waterborne community is therefore committed to strongly address a wide range of damaging emissions which currently harm the waterborne ecosystem and make the sector a real pillar of the environmental sustainable economy. This paper will consider the impact of shipping on the environment and present a synthesis of the WATERBORNE TP stakeholders analysis on technologies to reduce harmful environmental emissions, beyond GHG.

Keywords: Waterborne transport, innovation, sustainability, emissions, environment

277 FLAGSHIPS: Deploying two hydrogen vessels in Europe

Antti Pohjoranta[a]*, Victor Laravoire[b], Ivan Østvik[c], Maria Luisa Angrisani[d], Arber Haxhiu[e], Laurence Grand-Clément[f], Alexandre Bellot[g], Marie Launes[h], Pål G Eide[i]

a VTT Technical Research Centre of Finland, Tietotie 4C, Espoo, 02150, Finland
b Compagnie Fluviale de Transport, 11 Rue du Pont V, Le Havre, 76600, France
c Norled, Solheimsgaten 16b, Bergen, 5058, Norway
d Ballard Power Systems Europe, Majsmarken 1, Hobro, DK-9500, Denmark
e ABB, Merenkulkijankatu 1, Helsinki, 00980, Finland
f PersEE, 83 rue Pierre Corneille, Lyon, FR-69003, France
g LMG Marin, 9 rue Saint-Antoine du T, Toulouse, 31000, France
h NCE Maritime CleanTech, Meatjonnesvegen, Stord, N-5412, Norway
I Westcon Power & Automation, Jektevikveien 41, 5582 Ølensvåg, Norway
** antti.pohjoranta@vtt.fi*

Abstract

Hydrogen is conceived as a viable zero-emission fuel for waterborne transport and in particular for vessels operating on known, relatively short routes, with a pre-determined schedule. The FLAGSHIPS project is a European co-operative with the aim to deploy two commercially operated hydrogen-fueled vessels. One vessel is a push-boat operating at and around the Port of Lyon, on the river Rhône in France. The other vessel is a passenger and car ferry, operating as part of the Stavanger area public transport system on the short-sea area in Norway. This paper presents the status of the project and gives a technical overview of the vessels.

Keywords: zero-emission shipping; hydrogen; fuel cells

548 TCO Comparison of Different Road Ferry Architectures

Pekka Rahkola[a]*, Alexander Smirnov[a], Jussi Martio[a], Kai Happonen[a], Mikko Pihlatie[a]

a VTT Technical Reseach Centre of Finland, Address, Espoo FI-02044, Finland
** pekka.rahkola@vtt.fi*

Abstract

To reduce the emission of inland road ferries it is important to understand what is the impact of a particular solution. In the work, powertrain architectures with different portion of electrification are evaluated from the emission and the cost point of view. The work presents a simulation method to define the dimensioning of different powertrain architectures and the energy consumption of road ferries with different transport capacities. Using the simulation method the total cost of ownership for different powertrain architectures are defined. The work is carried out with application to Finnish infrastructure and weather conditions that implies arctic conditions and ice-breaking capabilities for road ferries.

Keywords: Battery; electric drive; hybrid; powertrain; road ferry; simulation

630 A framework definition for the carbon footprint of ship production

Lisette Cozijnsen[a], Jeroen F.J. Pruyn[a]*

a Delft Technical University, Mekelweg 2, 2628CD Delft, The Netherlands
** j.f.j.pruyn@tudelft.nl*

Abstract

Worldwide measures are taken in order to lower the emissions of greenhouse gases. Since shipping takes place in international waters the industry was excluded from the Paris Agreement. An IMO agreement was made to cover the emissions from shipping. However, the emissions from shipbuilding still fall under the Paris Agreement. Looking at the total impact is required, yet not covered by one set of regulations. The manner in which the production process can be taken into consideration was studied. In this investigation it was discovered that not only more information is needed about the actual footprint of ship production, but especially there is a need for a standardized approach to the Life Cycle Assessment (LCA). A balanced approach to LCA is therefore proposed, taking into account the elements relevant both for shipping and ship building.

Keywords: Ship production; Shipping; Carbon footprint; Life Cycle Assessment; Greenhouse gases

Full paper:
https://www.researchgate.net/publication/339339428_A_framework_definition_for_the_carbon_footprint_of_ship_production

699 Greening navigation through stakeholder collaboration

Jordi Arjona Aroca[a]*, José Andrés Giménez Maldonado[b], Gabriel Ferrús Clari[b], Nuria Alonso i García[b], Lucia Calabria[b], Jorge Lara[b]

a Instituto Tecnológico de Informática, UPV, Valencia 46022, Spain
b Fundación Valenciaport, Muelle del Turia, Valencia 46024, Spain
** jarjona@iti.es*

Abstract

The shipping industry has grown spectacularly during the last 50 years transporting nowadays, approximately, the 80-90% of the international trade worldwide. However, shipping remains a highly inefficient industry. Only in the last 10-15 years has the industry started studying how to optimize navigation speeds and digitization is just entering ports. Consequently, institutions like the International Maritime Organization (IMO) are pressing towards the adoption of measures that increase the industry efficiency, like Just-In-Time (JIT) operations.

This paper shows why the Sea Traffic Management (STM) concept, based on stakeholder collaboration, is a JIT enabler. To do so, we analyze one year of navigation data of 33 ships, estimating the impact of JIT barriers on shipping and showing the benefits that the adoption of STM, with different maturity levels, could provide to the industry. Our evaluation shows that, only for containerships, STM can help reducing by 15-25% of fuel consumption and GHG emissions.

Keywords: Just-in-time navigation; port call synchronization; PortCDM; Sea Traffic Management

This paper is a part of the European Transport Research Review Special Issue:
https://www.springeropen.com/collections/TRA2020

801 Towards sustainable shipping: Obstacles for cargo coordination in sea freight sector

Henry Schwartz[a]*, Magnus Gustafsson[a], Jonas Spohr[a]

a Åbo Akademi University – Laboratory of Industrial Management, Piispankatu 8, 20500 Turku, Finland
** henry.schwartz@abo.fi*

Abstract

With the aid of digitalization and developed communication tools, the global cargo flows could be steered with more efficient and sustainable way both economically and environmentally. Comparative solutions that have been seen on road transport, such as Uber, have not been utilized to coordinate the existing ship capacity. Our study is to map out the main reasons why the inefficiencies of the shipping industry continue to persist. More specifically, we aim to find out the lock-ins preventing the shipping industry to implement known and more efficient ways to organize cargo flows. Cargo coordination would arguably improve both the shipping industry's profitability and decrease its emissions. We are to answer our research questions by interviewing cargo owners, ship owners, and ship operators. In addition, we are

pointing out the expected investment characteristics such as monetary benefits and expected costs related to utilization of cargo coordination in shipping.

Keywords: cargo coordination; investment decision, shipping; digitalization; emissions; entry barriers

Full paper:
https://www.researchgate.net/publication/339842662_Towards_sustainable_shipping_Obstacles_for_cargo_coordination_in_sea_freight_sector

831 The HyMethShip concept: Overview, concept development and obstacles for concept application in ocean-going vessel

Nicole Wermuth[a]*, Jan Zelenka[a], Paul Moeyaert[b], Abhijit Aul[c], Martin Borgh[d]

a LEC GmbH, Inffeldgasse 21, 8010 Graz, Austria
b EXMAR, De Gerlachekaai 20, 2000 Antwerpen, Belgium
c Lloyd's Register EMEA, Burgess Road, Southampton, SO16 7QF, United Kingdom
d SSPA Sweden AB, Chalmers Tvärgata 10, SE-400 22 Göteborg, Sweden
** nicole.wermuth@lec.tugraz.at*

Abstract

The HyMethShip project (Hydrogen-Methanol Ship propulsion using on-board pre-combustion carbon capture) is a cooperative R&D project funded by the European Union's Horizon 2020 research and innovation program. The project aims to drastically reduce emissions while improving the efficiency of waterborne transport. The HyMethShip system will achieve a reduction in CO2 of up to 97 % and practically eliminate SOx and particulate matter emissions. NOx emissions will fall by over 80 %, safely below the IMO Tier III limit. In this study the HyMethShip concept is introduced and various aspects of the concept development are discussed. Additionally, some issues that might accelerate or hinder the concept application for commercial shipping are presented.

Keywords: hydrogen; methanol; alternative fuels, emissions reduction; ship building, propulsion

Full paper:
https://graz.pure.elsevier.com/files/27259867/Wermuth_et_al_TRA2020.pdf

832 From nature to green shipping: Assessing the economic and environmental potential of AIRCOAT on low-draught ships.

Johannes Oeffner[a]*, Jukka-Pekka Jalkanen[b], Stefan Walheim[c], Thomas Schimmel[c]

a Fraunhofer Center for Maritime Logistics and Services, Am Schwarzenberg-Campus 4, 21073 Hamburg, Germany
b Atmospheric Composition Research, Finnish Meteorological Institute, Erik Palmen's Sqaure 1, 00560 Helsinki, Finland
c Institute of Applied Physics, Institute for Materials Research on Energy Systems (MZE) and Institute of Nanotechnology, Karlsruhe Institute of Technology (KIT), Wolfgang-Gaede-Str. 1, 76131 Karlsruhe, Germany
** johannes.oeffner@cml.fraunhofer.de*

Abstract

Air pollution from ships have been recently shown to contribute to human health effects by over 250 000 premature deaths annually even with the global 0.5% Sulphur cap which enters in force by Jan 1st 2020 (Sofiev et al., 2018). This paper introduces a passive air lubrication application for ship hulls, which has potential to reduce frictional resistance, fuel oil consumption and atmospheric emissions. The

AIRCOAT approach is based on a biomimetic ship hull coating that introduces a permanent layer of air on a surface under water. This avoids direct contact of the ship and water, which reduces drag, corrosion and fouling of the hull and may lead to significant fuel savings at global level. Estimations revealed that applying AIRCOAT on low-draught boats and partly coated high-draught vessels of the global IMO-registered fleet could reduce annual fuel cost by millions of Euros depending on friction reduction performance of AIRCOAT.

Keywords: Air lubrication, Salvinia effect, drag reduction, biomimetics, ship emission modeling, fuel efficiency

Full paper: http://publica.fraunhofer.de/eprints/urn_nbn_de_0011-n-5787772.pdf

857 A new methodology for assessing the significance of environmental aspects of port operations: a use case of four pilot ports

Igor Kegalj[a]*, Ignacio Lacalle[b], Teodora Milošević[a], Stjepan Piličić[a], Željko Linšak[c], Carlos E. Palau[b], Luka Traven[a]

a Department of Environmental Medicine, University of Rijeka, Faculty of Medicine, Braće Branchetta 20, 51000 Rijeka, Croatia
b Universitat Politécnica de València, Communications Department, Camino de Vera, s/n 46023, Valencia, Spain
c Teaching Institute of Public Health of the Primorsko-goranska County, Krešimirova 52a, 51000 Rijeka, Croatia
** igor.kegalj@medri.uniri.hr*

Abstract

The paper describes a methodology for identifying the most impactful aspects of port processes and provides an overview of different methods for evaluating environmental behaviour indices currently used and published in the scientific and expert literature. Afterwards, the work sets the ground for the development of a single quantitative indicator measuring the impact of port operations towards the environment (so-called PEI, Port Environmental Index). Environmental aspects are mapped in our different ports, ranking them according to the criteria of probability of their emergence, as well as the size or severity of their impact on the environment for each port activity. Afterwards, a list of environmental key performance indicators (eKPI) is established for computing PEI from a technological context. The paper also discusses the limitations and possibilities of introducing PEI in small and medium-size ports thanks to the advances of PIXEL project.

Keywords: environmental aspects, port processes, environmental impact, Port Environment Index PEI, Internet of Things

Full paper:
https://www.dropbox.com/s/xputn8isvnm8tfl/TRA2020_06062019_Kegalj%20%28final%29.pdf?dl=0

906 Sustainability of port operations: The European ports' attempts to reduce negative environmental impacts

Ville Hinkka[a]*, Reetta Mäkinen[a], Jenni Eckhardt[b], Toni Lastusilta[a]

a VTT Technical Research Centre of Finland Ltd, Vuorimiehentie 3, FI-02150 Espoo, Finland
b VTT Technical Research Centre of Finland Ltd, Kaitoväylä 1, FI-90571 Oulu, Finland
** ville.hinkka@vtt.fi*

Abstract

The main objectives of the EU transport policy belongs the limitation of the negative environmental impact from ports. Similarly, companies are adopting sustainable supply chain management practices to response the policy makers' and consumers' demands for sustainable operations. This paper aims to discover how the largest European container ports communicate about their efforts to improve the sustainability of their operations to find out how the ports themselves see their position as a part of transition towards more sustainable supply chain operations. Based on the study, different large European container ports consider environmental issues variously. The risk is that some ports may get competitive advantages by slipping in the environmental questions. Alternatively, if the port does not take sustainability questions seriously and it gets a bad reputation, the risk is that the customers and consumers do not accept the behavior of the port and shipping companies start to avoid that port.

Keywords: sustainable supply chain management; port; waterborne transport; environmental impact; EU transport policy

995 Reviewing Scalability, Focus and Methodology in Maritime Emissions Studies

Esa Hämäläinen[a], Tommi Inkinen[b]*

a Brahea Centre, University of Turku, 20014-Turku, Finland
b Brahea Centre, Centre for Maritime Studies, University of Turku, 20014-Turku, Finland
** tommi.inkinen@utu.fi*

Abstract

The Intergovernmental Panel on Climate Change (IPCC) has stated that climate change is a major ongoing process requiring strict restrictive actions on a global level. Shipping and transport vessels and their routes (operational distances) are essential, because all route-related pre-calculations have a significant impact on emission levels, especially in the long term. In particular, container ship routings are heavily linked to the emissions and profit levels of shipping companies. The Sulphur Emission Control Area (SECA) decision has had several positive impacts on local climate conditions, especially in harbour areas. The SECA legislation forces businesses to develop long-lasting, responsible solutions. This paper is a review of selected scientific articles dealing with the topics of maritime transport and scalability. The results indicate that research focuses on modelling and simulations. The paper discusses the obtained results in relation to current maritime emission regulations.

Keywords: Literature Review; Maritime Research; Emission; Regulations; Scalability

1081 Emission Control Measures in Swedish Ports

Peter Sjögren[a]*, Johannes Hüffmeier[a]

a RISE Research Institutes of Sweden, Gibraltargatan 35, Gothenburg 412 79, Sweden
** peter.sjogren@ri.se*

Abstract

In this paper, alternatives to shore power of vessels at quays are evaluated, mainly vessel emission control systems (VECS). The analysis addresses the air quality challenges in ports. Vessels at quay, give rise to emissions which have a negative impact on the local environment. Connecting the vessels to the electricity grid is an existing solution but a measure that in many cases is not feasible. VECS, as an

alternative, is an external exhaust purification system connected to the vessels' funnel when they are at the quay. VECSs prevent emissions of particles, nitrogen oxides and sulfur dioxide. The analysis evaluates the VECS technique together with other alternatives for limiting emissions comparing them to power from shore and includes a cost breakdown of VECS investment and operation. Results show VESC as a viable option to power from shore in the short term. However, investment must be weighed against the fast developments in shore power.

Keywords: Emission control; Shipping and port operation

Full paper:
https://www.researchgate.net/publication/339899602_Emission_Control_Measures_in_Swedish_Ports

1135 INTENS - Integrated energy solutions to smart and green shipping

Zou Guangrong[a]*

a VTT Technical Research Centre of Finland, Visiokatu 4, Tampere FI-33720, Finland
** guangrong.zou@vtt.fi*

Abstract

The major transition to smart and green shipping poses challenges and opportunities to the global marine cluster, which is especially true for Finland since the hi-tech and marine industries are two of the mainstay industries for the country. This paper presents one of the on-going activities to showcase the Finnish marine expertise, practices and efforts towards smart and green shipping, namely the INTENS project. INTENS is a national industry-wide collaborative research, development and innovation action dedicated to advancing and promoting the digital transformation, decarbonization and collaboration in the Finnish marine industries and beyond. It concerns innovative technologies and practical applications of major digital transformation methods, including AI, Big Data, Digital Twins, IIoT and Cloud Computing, specifically to the energy efficiency improvement and emissions reduction of ship energy systems. It highlights the prominent roles of both innovations and collaborations in the digital transformation and decarbonization of global shipping.

Keywords: smart and green shipping; ship energy systems; energy efficiency; emissions, digitalization; collaboration

1.6 Scientific and technical session 6: Air quality, noise and particulate emissions

505 Real world vehicle emissions: Using computer vision in instantaneous vehicle emissions modelling

Anna K Schroeder[a]*, Marc Stettler[b], Adam M Boies[a]

a University of Cambridge, Department of Engineering, Trumpington Street, Cambridge CB2 1PZ, UK
b Imperial College London, Department of Civil and Environmental Engineering, South Kensington Campus, London SW7 2AZ, UK
** aks85@cam.ac.uk*

Abstract

Vehicle related air pollution is a major issue worldwide. As such being able to understand vehicle emissions accurately is crucial. Currently, traffic modelling

software is the main source for vehicle data used in instantaneous vehicle emissions models. However, these modelling tools rarely reflect real-world vehicle behaviour. This paper proposes a different approach by using computer vision to understand real-life vehicle behaviour based on traffic camera video footage. The proposed algorithm using a convolutional neural network counts vehicles with an accuracy of 4% and the average relative speed accuracy at 1 Hz is just below 3%. This paper also demonstrates the spatial and temporal changes in traffic emissions that are obtained as a result of using this algorithm in an instantaneous vehicle emissions model.

Keywords: Vehicle emissions; Computer Vision; Intelligent Transport Systems; vehicle emissions modelling

526 PEMs4Nano: Portable Emissions Measurement systems for nano-particles

M. Rieker[a], P. Kreutziger[a], A. N. Bhave[b], K. Lee, J. Akroyd[cd], M. Kraft[cde], C. Focsa[f], D. Duca[f], J. A. Noble[f], Y. Carpentier[f], C. Pirim[f], T. Tritscher[g], J. Spielvogel[g], A. Pérez[h], S. Paz[h], W. F. van Dorp[i]*

a HORIBA Europe GmbH, Hans-Mess-Str. 6, 61440 Oberursel, Germany
b CMCL Innovations, Castle Park, Cambridge, CB3 0AX, United Kingdom
c Department of Chemical Engineering and Biotechnology, University of Cambridge, United Kingdom
d CARES, Cambridge Centre for Advanced, Research and Education in Singapore, 1 Create Way, CREATE Tower, #05-05, Singapore, 138602
e School of Chemical and Biomedical Engineering, Nanyang Technological University, 62 Nanyang Drive, Singapore, 637459
f Univ. Lille, CNRS, UMR 8523 - PhLAM - Physique des Lasers, Atomes et Molécules, Lille F-59000, France
g TSI GmbH, Neuköllner Str. 4, 52068 Aachen, Germany
h IDIADA Automotive Technology SA, L'Albornar E-43710, Santa Oliva (Tarragona), Spain
i Uniresearch B.V., Elektronicaweg 16c, 2628 XG Delft, Netherlands
** w.vandorp@uniresearch.com*

Abstract

On-road motor vehicles are important sources of ultra-fine particulate matter (PM). Recent advancements in engine technologies have resulted in reduction in the average size of emitted PM. However, there are currently no certified measurement procedures for the smallest particles (below 23 nm) under real driving conditions. The H2020 PEMS4Nano project (www.pems4nano.eu) aims to develop a portable, robust and reliable emission measurement system including sub-23 nm particles, providing a contribution to future regulations on emissions in real driving conditions. To support the development of this measurement system and methodology, the particulate emissions are characterized as a function of their size and composition as they form and evolve through to the tailpipe. In addition to measurements, a Model Guided Application (MGA) combining detailed physico-chemical and advanced statistical algorithms models the particulate emissions and helps understand the particle characteristics, supporting the optimization of the nanoparticle emissions measurement system at the engine- and vehicle-level.

Keywords: Particulate matter, Particle number, Measurement systems and procedures, Particle characterization, Model Guided Application

601 Impacts of connected and automated driving on greenhouse gas emissions in Germany

Michael Krail[a]*

a Fraunhofer Institute for Systems and Innovation Research (ISI), Breslauer Str. 48, 76139 Karlsruhe, Germany
** michael.krail@isi.fraunhofer.de*

Abstract

Will the development of connected and automated driving (CAD) on roads lead to increasing greenhouse gas emissions or can it contribute to making the entire transport system more climate-friendly by 2050? In order to answer this question, the paper presents an assessment of the potential of these technologies. It takes into account technical development, user acceptance and the effects of the technology on travel behavior, both for passenger and freight transport.

Keywords: automated and connected driving; greenhouse gas emissions; transport modelling; transport system impacts

627 Lessons learnt from non-aviation sector noise management best practices: The ANIMA project results

Fabio Galatioto[a]*, James Ferguson-Moore[a], Rui Roosien[b], Stephan Großarth[c], Delia Dimitriu[d], Dirk Schreckenberg[c]

a Connected Places Catapult, 170 Midsummer boulevard, MK9 1BP Milton Keynes, United Kingdom
b NLR - Royal Netherlands Aerospace Centre, Anthony Fokkerweg 2, 1059 CM Amsterdam, The Netherlands
c ZEUS GmbH, Sennbrink 46, D-58093 Hagen, Germany
d Manchester Metropolitan University, Chester Street, Manchester, M1 5GD Manchester, United Kingdom
** fabio.galatioto@cp.catapult.org.uk*

Abstract

Noise affecting citizens and communities is a growing problem, recent figures provided by the European Commission highlight that almost 80 million people are estimated to be exposed to road noise ≥55 dB over the whole day, followed by over 10 million exposed to rail noise. Within the H2020 project ANIMA a specific analysis has been carried out to consider prevailing sources of environmental noise that go beyond the aviation sector and how noise related to non-aviation sectors can affect local communities. The main objective of this exercise is to identify what aviation can learn for strategies of reducing community responses to noise from other sectors. For this, over 10 case studies across the following key specific non-aviation sectors have been reported: 1) Transport, mainly roads and railways; 2) Construction; 3) Wind turbines/parks; and 4) Domestic and leisure activities and lessons learned and potentially some transferable noise mitigation strategies are highlighted.

Keywords: environmental noise annoyance; noise abatement strategies; transferability; communities; aviation; case studies

670 A collaborative appraisal framework to evaluate transport policies for improving air quality in city centres

Javier Tarriño-Ortiz[a]*, Julio A. Soria-Lara[a], José M.Vassallo[a]

a Transport Research Center – TRANSyT—Universidad Politécnica de Madrid, Profesor Aranguren,3, Madrid, 28040, Spain
** javier.tarrino.ortiz@upm.es*

Abstract

Transport policies for improving air quality are increasingly being implemented in city centres across the world. The role that stakeholders engagement can play in

identifying impacts and potential implementation strategies could improve the effectiveness of those policies. The city of Madrid (Spain), where there is a clear intention to restrict traffic in its centre, was taken as case study. Local stakeholders were engaged in a series of semi-structure interviews and a final face-to-face workshop to evaluate the potential impacts, acceptability, and feasibility of eight transport policies. Consensus between groups was hard to achieve for three specific policies: (i) license-plate restrictions; (ii) charges to motor vehicles; and (iii) development of walking and cycling infrastructure. The paper outlines the methodological process, reflects on the usefulness of stakeholder engagement in the policy-making process, and concludes with a discussion on the acceptability of the evaluated transport policies in the local context of Madrid.

Keywords: Stakeholder; Ex-ante evaluation; Participation; Pollutans; Policy

687 First experimentation of a device collecting at source airborne particles issued from rolling stocks brakes systems

Philippe Clement[a]*, Loïc Adamczak[b], Adrien Maistre[b], Vincent Nicot[a]

a Rolling stock engineering, SNCF Mobilités, Le Mans, France
b Tallano Technologie, Boulogne-Billancourt, France
** philippe.clement@sncf.fr*

Abstract

Air quality measurements in underground railway stations shows it is influenced by railways operations as infrastructure wears, particles from mechanical braking, station design and ventilation. The study focuses on a device collecting at source airborne particles issued from trains braking systems. A groove pattern of braking pads has been optimised with finite element analysis, air flow simulations and tests on bench, the mass collection efficiency growing from 21% to 80%. Tests on bench with accurate sensors have been conducted to characterise particles under commercial braking conditions and braking performances under standardised conditions. A reduction of the emissions is noted. The various methods to establish the collection efficiency are under investigations. The grooves realised had an impact on braking performances requiring additional work. The values obtained have been considered acceptable to start the tests in commercial service beginning of 2020 in order to evaluate the reliability and maintenability of the device.

Keywords: railway; underground station; air quality; brake wear; particle matter; collection

740 Mobile monitoring for the spatial and temporal assessment of local air quality in urban areas

Fabio Galatioto[a]*, James Ferguson-Moore[a], Ruth Calderwood[b]

a Connected Places Catapult, 170 Midsummer boulevard, MK9 1BP Milton Keynes, United Kingdom
b City of London Corporation, PO Box 270, Guildhall, London. EC2P 2EJ, United Kingdom
** fabio.galatioto@cp.catapult.org.uk*

Abstract

This paper reports on the analysis and findings of the data collected during a mobile air quality campaign commissioned by the City of London Corporation (CoL). This was using an equipped vehicle capable of taking continuous precision measurements of local air quality while travelling within the City. Several comparative analyses on measured Nitrogen Dioxide (NO2) data have been performed between Smogmobile data and that available from CoL precision

systems as well as with indicative systems, namely Diffusion Tubes, distributed across the City. Key findings highlight that data collected from the Smogmobile, in terms of average concentration of NO2 across the City (62µg/m3), is very similar to that obtained by averaging the values from the 48 indicative systems (59.5µg/m3), with an error of just 4%. Overall, this study demonstrates significant potential and value in using mobile air quality measurements to support assessment of air quality over large areas by Local authorities.

Keywords: Mobile Monitoring; Statistical analysis; Smogmobile; Nitrogen Dioxide; Precision systems; Large areas

820 Modeling of air emissions and discharges from ships to the sea

Jukka-Pekka Jalkanen[a]*, Lasse Johansson[a]

a Atmospheric Composition Research, Finnish Meteorological Institute,Erik Palmen's Square 1, 00560 Helsinki, Finland
** jukka-pekka.jalkanen@fmi.fi*

Abstract

Air emissions and discharges from ships in European sea areas have been studied with a state-of-the-art bottom-up modeling approach. This vessel level description relies on the combination of Automatic Identification System data, IHS Markit world fleet data and Ship Traffic Emission Assessment Model. The results indicate that SOx scrubber discharges from ships sailing the Emission Control Areas contributed 123 million tonnes of wash water which may contain heavy metals and polyaromatic hydrocarbons. This removes an air pollution problem (SOx) and creates a new source of water pollution. The impact of SOx scrubbing should be carefully studied to understand the significance of these discharges to marine life. This paper takes the first step in that direction.

Keywords: Ship emissions; Scrubber; Air pollution; Discharges

830 Relationship between weight of the heavy trucks and traffic noise pollution in the viewpoint of feasibility of fines for exceeded noise – a case study

Bajko Kulauzović[a]*, Tomo Pejanović Nosaka[a], Julijana Jamnik[a]

a Cestel d.o.o., Špruha 32, 1236 Trzin, Slovenia
** bajko.kulauzovic@cestel.si*

Abstract

Noise, as undesirable sound can be annoying and in extremes it may cause physical and psychological damage. Traffic is significant generator of noise, which cannot be avoided. Relation between traffic volume and traffic noise is well known, as well as the fact that heavy vehicles are generating more noise regardless of the speed. This paper discusses relationship between vehicle generated traffic noise and vehicle weight with focus on overloaded vehicles to establish relationship between the two and to determine feasibility of fines for exceeded noise. As systems for measuring traffic noise and portable weigh in motion systems are becoming increasingly available, they can be used to collect freight noise and weight data.

Keywords: Noise pollution; heavy traffic; weigh in motion; fines; exceeded noise

Full paper: https://www.cestel.eu/media/uploads/TRA2020_Kulauzovic.pdf

851 Using benzothiazoles as tracers for tire tread emission

Ninni Helene Bye[a], Jon Petter Johnsen[a], Elisabeth Rødlanda[b]*, Sondre Melanda[b]

a Norwegian University of Life Sciences, Faculty of Environmental Sciences and Natural Resource Management,P.O. Box 5003, NO-1432 Ås, Norway
b Norwegian Institute for Water Research, Gaustadalléen 21, NO-0349 Oslo, Norway
** elisabeth.rodland@niva.no*

Abstract

Tunnel wash water is considered as a hot spot for road related contaminants such as particles, metals and organic micropollutants. Recently, tire wear is emphasized as one of the biggest sources of microplastics to the aquatic environment. The present study aimed to quantify the emission of tire wear particles from a high traffic tunnel in Oslo (Norway) by using benzothiazoles as a marker/tracer. During a tunnel wash, water samples were collected and analyzed for 2-hydroxybenzothiazole (OHBT), 2-mercaptobenzothiazole (MBT), 2-aminobenzothiazole (ABT), Benzothiazole (BT) and 2-methylthiobenzothiazole (MTBT). For the measured concentrations of BTs, the daily TP emission in the tunnel was estimated to be in the range of 1.7-10.4 kg/day depending on the BT used in the estimation. The measured BT concentration in this study shows significantly higher (15 times higher) concentrations of BT than in regular storm water runoff.

Keywords: Microplastic; particles; tire; roads; tunnels; benzothiazoles

891 Black carbon, particulate mass and non-volatile particle number emissions from marine transport in comparison to road transport and consideration of uncertainty

Päivi Aakko-Saksa[a]*, Kati Lehtoranta[a], Niina Kuittinen[b], Timo Murtonen[a], Hannu Vesala[a], Päivi Koponen[a], Rasmus Pettinen[a], Kimmo Teinilä[c], Minna Aurela[c], Sanna Saarikoski[c], Panu Karjalainen[b], Leonidas Ntziachristos[b], Jukka-Pekka Jalkanen[c], Topi Rönkkö[b], Hilkka Timonen[c]

a VTT Technical Research Centre of Finland Ltd, Espoo, 02044 VTT, Finland
b Tampere University (TAU), Tampere, Finland
c Atmospheric Composition Research, Finnish Meteorological Institute (FMI), Helsinki, Finland
** paivi.aakko-saksa@vtt.fi*

Abstract

Ship emissions have a significant negative impact on human health, environment and climate. Consequently, the IMO has implemented regulations to reduce emissions of sulphur and nitrogen oxides, and new emission regulations e.g. for black carbon emissions are anticipated. Reliable information concerning the impact of different emission control technologies of ship emissions on health, environment and climate is needed. We present particulate matter (PM), black carbon (BC) and non-volatile particle number (above 23 nm) emissions for several marine engines, fuels and emission control options in comparison to road transport. We realized that knowledge of total PN emissions from modern ships is practically lacking, although it would be essential for assessing the health and environmental impacts of ship emissions. This represents a serious gap in our knowledge. We also discussed uncertainties relating to exhaust emission measurements in controlled and uncontrolled conditions.

Keywords: Ship exhaust emissions; marine; road vehicles; particulate matter; black carbon; particle number

997 Finding NOx-cheaters on the spot with Remote Sensing Devices

Javier Buhigas[a]*, Josefina de la Fuente[a], José Montero[a], Ana Rueda[a]

a Opus Remote Sensing Europe, Gaztambide 45, Madrid 28015, Spain
** javier.buhigas@opusrse.com*

Abstract

Many heavy-duty vehicles circulating on European roads may have some form of emission control manipulation. The most common manipulation nowadays is to disconnect the AdBlue injection that reduces NOx emissions in diesel trucks. These manipulations are always hard to find, so the only option is catching the cheaters in the act, with on-road inspections, measuring their real-driving emissions with Remote Sensing Devices (RSD). This study shows the results of the campaign performed between OPUS RSE and Spanish GUARDIA CIVIL in the year 2018 as part of the EU-funded LIFE program GySTRA. Remote Sensing Devices have been used to find on the spot and remotely illegally manipulated commercial trucks. This application has made it possible to find trucks suspected of being handled with high efficiency and also to quantify the environmental impact of cheating this emission control system.

Keywords: Remote; sensing; emissions; truck; AdBlue; RSD

1.7 Scientific and technical session 7: Clearing roadblocks for mobility as a service

326 Car sharing perspectives in a business as usual scenario: Findings from the STARS project

Andrea Chicco[a]*, Marco Diana[a], Jeffrey Matthijs[b], Johannes Rodenbach[b]

a Politecnico di Torino, Department of Environment, Land and Infrastructure Engineering, Corso Duca degli Abruzzi 24, 10129 Turin, Italy
b Autodelen.net, K. Maria Hendrikaplein 65B, 9000 Gent, Belgium
** andrea.chicco@polito.it*

Abstract

This paper summarises some interim results of the Horizon 2020 STARS project (http://stars-h2020.eu/) by giving insights on car sharing growth perspectives and expected changes from both operators and policy makers viewpoint. Actions and development plans in the short-medium term that are already being prospected in some European cities by car sharing operators, industrial players and policy makers concur to define the business as usual scenario analysed here and reconstructed through an extensive surveying activity. The analyses take into consideration the perspectives of different categories of car sharing, which are resulting from the classification of 186 existing car sharing services. Services are expected to grow in future, however operators belonging to different categories tend to be more optimistic on the expansion of the kind of service they are providing. Expansion to suburbs and fleets diversification are the most cited likely evolutions, while rising costs of fuel represent the worst threat.

Keywords: Car sharing; Growth trends; Mobility scenarios; Transport policies; Descriptive statistics

Full paper: http://hdl.handle.net/11583/2803095

462 Business models in the shared electric mobility field: A market overview towards electric Mobility as a Service (eMaaS)

J. Roberto Reyes García[a]*, Steven Haveman[a], Marlise W. Westerhof[a], G. Maarten Bonnema[a]

a University of Twente, Drienerlolaan 5, 7522 NB, Enschede, The Netherlands
** j.r.reyesgarcia@utwente.nl*

Abstract

In response to the increasing demand for shared mobility and multimodal passenger transport services, new mobility concepts such as Mobility as a Service (MaaS) and electric Mobility as a Service (eMaaS) are becoming commonplace. However, in order for new MaaS and eMaaS providers to become competitive, innovative business models (BMs) and effective market strategies are needed. This paper presents a market analysis of 229 existing providers and mobile apps within the Shared Electric Mobility (SEM) field. The goal of the analysis presented in this paper is to provide an overview of both the current BMs used in practice and the state of the market for MaaS and eMaaS endeavours. The results of the analysis determine which are the strengths of the key players within the SEM market, and how the core characteristics of their BMs can contribute to the further development of eMaaS.

Keywords: Business Model; Mobility as a Service (MaaS); electric Mobility as a Service (eMaaS); Market Analysis; Shared Electric Mobility (SEM)

464 Laying the foundation for European TM2.0 deployment within a trusted network of stakeholders: The TM2.0 Trust Model

Jop Spoelstra[a]*, Samaneh Beheshti Kashi[b], Johanna Tzanidaki[c]

a Technolution, Burgemeester Jamessingel 1, 2803 WV, Gouda, The Netherlands
b Free and Hanseatic City of Hamburg, Agency for Roads, Bridges and Waters, Sachsenfeld 3-5, 20097, Hamburg, Germany
c ERTICO ITS-Europe, Avenue Louise 326, B-1050, Brussels, Belgium
** jop.spoelstra@technolution.nl*

Abstract

With the continuing connectivity in the mobility domain, a new range of opportunities arise in traffic management, such as improved road infrastructure data and the use of in-car services. Throughout Europe ITS developments are showing a gradual shift from focusing on deploying 'collective' measures towards more individualised and tailor-made traffic management (Traffic management 2.0). These TM2.0 collaborations show added value to both public and private stakeholders, but also require stakeholders with different (public and private) or very similar (direct competitors) backgrounds to rely on each other to build towards this win-win collaboration. In this paper the TM2.0 trust model is introduced, and requirements for establishing trust are identified. Using this TM2.0 Trust Model in shaping TM2.0 collaboration will enable laying the foundation on which a network of trusted TM2.0 stakeholders can gradually build their collective trust.

Keywords: TM2.0, Trust, Trusted Network, Interactive Traffic Management

Full paper: http://tm20.org/wp-content/uploads/sites/8/2019/08/TM2.0-TF-Trusted-network-Final-report.pdf

501 Introducing TrønderMaaS: investigating business models, sustainability and users' acceptance of a MaaS system in Stjørdal and Trondheim region, Norway

Giuseppe Marinelli[a]*, Özlem Simsekoglu Nordfjærn[a], Wenche Kristin Aarseth[a], Kelly Pitera[b]

a Nord University, Wessels veg 75, 7502 Stjørdal, Norway
b NTNU – Norwegian University of Science and Technology, Høgskoleringen 7A, 7491 Trondheim, Norway
** giuseppe.marinelli@nord.no*

Abstract

This paper describes the aim, methodology, objectives and expected impacts of a project proposal submitted to the Research Council of Norway in April 2019. TrønderMaaS assesses the implementation of Mobility as a Service (MaaS) solutions in Norway using multiple perspectives, focusing on business models, users' acceptance and environmental impact. The assessment will be performed through a full-scale Pilot Test in the Trondheim-Stjørdal region, testing several business models, pricing strategies and operational conditions. Researchers will work with the technology development partner and local transport providers to develop a MaaS app/platform prototype that will offer a multimodal travel solution for a limited period. Users involved in the test will actively participate to the assessment through interviews, surveys and direct feedback. Public Authorities will help in the assessment by giving support and feedbacks during the project development. Future results of the project will foster the development of integrated mobility throughout Norway, and beyond.

Keywords: Mobility as a Service; Business Model; Users' Perspective; Sustainability

Full paper:
www.researchgate.net/publication/339788203_Introducing_TronderMaaS_investigating_business_models_sustainability_and_users'_acceptance_of_a_MaaS_system_in_Stjordal_and_Trondheim_region_Norway

599 Toolkit for rural Mobility as a Service development

Jenni Eckhardt[a]*, Erkki Siiraa, Maria Merisalo[a], Arttu Lauhkonen[a], Janne Lahti[a], Ville Valovirta[a], Juha Oksanen[a], Juho Kostiainen[b]

a VTT Technical Research Centre of Finland Ltd., Kaitoväylä 1, 90570 Oulu, Finland
b City of Helsinki, Unioninkatu 28, 00100 Helsinki, Finland
** jenni.eckhardt@vtt.fi*

Abstract

Mobility as a Service (MaaS) is an emerging concept of integrated transport services that is seen to tackle future mobility challenges and meet customer needs. In rural areas, with long distances and sparse population, integration of different types of transportation is needed to gain efficiency. This paper presents a Toolkit, which assist local and regional authorities to implement MaaS in sparsely populated areas. The Toolkit provides guidelines and recommendations and covers best practices, procurement models and a framework for the evaluation of openness and scalability of MaaS solutions. The study is based on case studies piloting new mobility services in sparsely populated areas in Finland. They are developed in collaboration between public and private sector and include e.g. demand-responsive-transport and services integrating different user groups, such as statutory social and health service transportation, service transport targeted e.g. for elderly, and other self-paying customer utilizing a smartphone app.

Keywords: MaaS; PPP; rural; best practice; procurement; scalability

Full paper: https://cris.vtt.fi/en/projects/alueellisen-liikkumisen-palveluiden-integroitu-operointi

657 Risks needing more research before MaaS becomes widespread

Moshe Givoni[a], Eric Bruun[b]*

a Tel Aviv University, Israel
b Kyyti Group, Ltd., Finland
** eric.bruun@kyyti.com*

Abstract

This research addresses the prospects for a largely private-sector led MaaS industry versus public. It defines MaaS as consisting of three fundamental components: a journey planner, a one stop information and payment site combined, and shared vehicles. A table is presented that summarizes main risks under four themes related to 1) Private sector led MaaS and associated business models, 2) focus (or more weight) on car transport vs. larger public transport vehicle, 3) focus on technological development rather than service development (as the name MaaS would imply), and 4) governance in an age where most price setting and service integration responsibility is relocated. Most results described suggest a need to favor a publicly-owned non-profit MaaS set up to reflect goals of financial and environmental sustainability and long-term development goals. We conclude that for the benefits of MaaS to be realized with the risks minimized, specific research is urgently needed.

Keywords: Mobility as a Service, Transport Governance, Transport Policy, Public Transport, Sustainability

Full paper:
https://docs.google.com/document/d/1RrBOGtvPBUb5nR5DvR_fSNegbqStyhIV7_QR3VoEz0E/edit?usp=sharing

708 Mobility-as-a-Service is not only about technology: the importance of MaaS ethos in the design of the public policy framework

Renata Lajas[a]*, Rosário Macário[b]

a Instituto Superior Técnico, Av. Rovisco Pais 1, 1049-001 Lisboa, Portugal
b Instituto Superior Técnico, Av. Rovisco Pais 1, 1049-001 Lisboa, Portugal
** renatalajas@gmail.com*

Abstract

The continuous growth of the world population and rising urbanization poses several challenges to urban mobility systems. At the same time the digitalization megatrend is reshaping lives worldwide and data is seen as the new "oil" of the 21st century, while the sharing economy is thriving. Given the existing diversity of transport services, "MaaS" emerges as a potential mobility disruption. This paper sets out to propose a "Mobility-as-a-Service (MaaS) Public Policy Framework", applying a twostage approach. Firstly, structuring a "MaaS" concept and proposing a "MaaS topology"; and secondly, identifying the policy instruments and stakeholder responsibility at each urban mobility management decision level and "MaaS" feature, with the ultimate aim of proposing a public policy framework for implementation. If "MaaS" is considered a Mobility Management tool by authorities, supported by a coherent public policy framework, this will enable the supporting of

monitoring functions, which can have an important impact on the implementation of sustainable mobility policy goals.

Keywords: Mobility-as-a-Service; Public Policy; "MaaS"; Policy Instruments; Mobility; Topology

746 MyCorridor MaaS: A stakeholder-inclusive MaaS platform

Athanasios I. Salamanis[a]*, Theodoros Ioakeimidis[a], Dionysios Kehagias[a], Maria Gkemou[b], Dimitrios Tzovaras[a]

a Information Technologies Institute, Centre for Research & Technology Hellas, P.O Box 60361, GR 57001 Thermi-Thessaloniki, Greece
b Hellenic Institute of Transport, Centre for Research & Technology Hellas, P.O Box 60361, GR 57001, Thermi-Thessaloniki, Greece
** asal@iti.gr*

Abstract

With the rapid growth of the global population and its concentration in large urban centres, the need for smart and sustainable mobility solutions has become more imperative than ever. Among the mobility paradigms advocating the shift from vehicle ownership to vehicle usership, the Mobility as a Service (MaaS) paradigm, namely the mobility system that brings together several heterogeneous mobility offerings from different service providers enabling end-users access on them via a single digital interface, seems as the most feasible solution. The acceptance of the MaaS paradigm by the vast majority of citizens requires putting people and their needs in the center of the MaaS design. This paper presents the MyCorridor MaaS, a user-centric MaaS delivery platform, which introduces design and implementation principles for the key components of a MaaS platform, aiming at maximizing the MaaS paradigm user acceptance.

Keywords: MaaS; urban mobility; MaaS API; MaaS platform

Full paper:
https://www.researchgate.net/publication/339352793_MyCorridor_MaaS_A_stakeholder-inclusive_MaaS_platform

775 Shaping urban mobility

Johan Wallin[a]*

a Synocus Group, Bulevardi 5 A 5, Helsinki 00120, Finland
** johan.wallin@synocus.com*

ABSTRACT

This paper is based on clinical research of the evolving Nordic mobility ecosystem NUME (Nordic Urban Mobility Ecosystem), which was initiated with the support of Business Finland during spring 2017. NUME is a sub-community of the World Alliance for Low Carbon Cities (WALCC), supporting innovations in the Finnish transport sector. During its first two years of operation, the ecosystem has gone through different stages in the establishing of the more stable network, which ultimately has become a platform for new projects supporting the goal of promoting lower-carbon urban transport solutions. Business models and capability maps have been used as tools when orchestrating the evolving ecosystem.

Keywords: business models; capabilities; ecosystems; orchestration

Full paper: https://www.synocus.com/wp-content/uploads/2020/03/TRA2020_11102019_wallin.pdf

974 The Shared Mobility Agency operating in Elba: a first step towards a rural MaaS initiative

Saverio Gini[a], Giorgio Ambrosino[a]*

a MemEx srl, Piazza Benamozegh 17, Livorno-I57123, Italy
** giorgio.anbrosino@memexitaly.it*

Abstract

This paper details the concept, identifies the main work phases and milestones and details the activities carried out by MemEx and Portoferraio Municipality within CIVITAS Destinations project to design and implement the Shared Mobility Agency as first milestone for the future development of a rural Mobility as a Service (MaaS) initiative in Elba island. The paper details the main results of the user needs analysis, how the Agency concept was built on the top of this and the road to its implementation. The features and the functional specifications of the technological platform supporting operation of the Agency are spotlighted. In October 2019 the first internal tests will start followed by an extensive public testing phase involving selected groups of users. The launch is planned in March 2020. The presentation will be updated with the results of public testing phase and first feedbacks after the launch.

Keywords: sharing services, infomobility, networking

1175 Insights on the acceptance of direct private car rental for supporting peer to peer mobility solutions – a case study on Italy and Greece

Dimitrios Kourtesis[a], Nikolaos Tsoniotis[b], Stefanos Tsiakmakis[a,c], Michail Makridis[d], Georgios Fontaras[d]*

a Ideas Forward, Thessaloniki, Greece
b Information Technologies Institute, Centre for Research and Technology Hellas, Thessaloniki, Greece
c BIO2CHP, Thessaloniki, Greece
d Sustainable Transport Unit, Directorate for Energy, Transport and Climate Change, European Commission Joint Research Centre, Ispra, Italy
** georgios.fontaras@ec.europa.eu*

Abstract

Passenger and goods transport are two sectors that undergo rapid changes. The sharing economy is transforming markets around the world and passenger transport markets are no exception. This study focused in particular on peer-to-peer (P2P) car sharing. For any such service to function it is important to have a good understanding of the expected acceptance of the sharing concept within the local communities. The paper presents the results of the investigation made in the Greek and Italian market in order to understand the perception of vehicle owners about peer-to-peer car sharing. Validation experiments were elaborated in a questionnaire that resulted in collecting answers from 254 participants mainly originating from Greece and Italy with a wide age distribution. Out of them 29.1% would be willing to rent out their car at €36, a price competitive to alternative options such as car rentals. Insurance issues appear to be the most prominent issue for participating in such a service, while some prior knowledge and the ability to monitor the conditions of the vehicle rental also attracted the concern of the respondents.

Keywords: peer-to-peer car sharing, cars, questionnaire, public acceptance

1.8 Scientific and technical session 8: Shared and servitised mobility

123 ComplexTrans – global land transportation system

Jiri Hofman[a], Roman Cermak[b]

a University of West Bohemia, Univerzitni 8, 30100 Pilsen, Czech Republic
b University of West Bohemia, Univerzitni 8, 30100 Pilsen, Czech Republic
** hofman.ji@gmail.com*

Abstract

Land-transportation can´t further meet its demands. Crowded highways, crowded cities, dangerous emissions, traffic accidents, delays, expensive railways. Solutions are being sought to transfer a large part of passengers- and especially freight-traffic to (high-speed) rail and to go electromobility, car-sharing, 5G-connectivity, autonomous ride, MaaS-transport-coordination, Hyperloop-type solutions. However, all these solutions have other problems and limitations. Solutions are not sought where they really exist - in the mutual adaptation of road and rail vehicles and their deep cooperation. ComplexTrans-project shows that simply adapting dimensions and functions of road and rail vehicles can eliminate (at least substantially reduce) all the problems of existing land transport, resulting in - ample parking space, reduced traffic density in and outside of cities, electric-vehicles with unlimited range and cheaper than standard cars, cheaper and easy affordable recharging of batteries, autonomous ride, self-financing rail-transport, transfer of intercity freight to rail, replacing part of continental air-transport and many others.

Keywords: intermodal; door-door; city; intercity; rail road

Full paper: http://hdl.handle.net/11025/36516

218 Exploring the adoption of moped scooter sharing systems in Spanish urban areas

Álvaro Aguilera-García[a]*, Juan Gomez[a], Natalia Sobrino[a]

a Centro de Investigación del Transporte (TRANSyT) - Universidad Politécnica de Madrid., Calle Profesor Aranguren 3, 28040 Madrid, Spain
** alvaro.aguilera@upm.es*

Abstract

Innovative mobility solutions are emerging in urban areas. These alternative transport modes enable people short-term access to transportation modes on an as-needed basis. Within this new trend, moped scooter sharing is experiencing a great boom in many cities worldwide, particularly in Europe. To date, almost no efforts have been devoted to exploring the adoption of this mobility alternative. Based on the information collected through an online survey disseminated in different Spanish cities, we developed a generalized ordered logit model to identify the key drivers determining the adoption and frequency of use of moped scooter sharing services in urban areas. The research concludes the main role played by some sociodemographic and travel-related variables, such as age or level of education, while personal opinions and attitudes were not generally found statistically significant. Furthermore, a better understanding of this shared mobility option is provided, as well as some implications on mobility.

Keywords: moped scooter sharing; shared mobility; urban mobility; user perception; generalized ordered logit model; Spain

283 What are the factors and needs promoting Mobility-as-a-Service? Findings from the Swiss Household Energy Demand Survey (SHEDS)

Raphael Hörler[a], Anna Stünzi[b]*, Anthony Patt[c], Andrea Del Duce[a]

a Institute for Sustainable Development, Zurich University of Applied Sciences (ZHAW), Technikumstrasse 9, 8401 Winterthur, Switzerland
b Center for Economic Research, MTEC, Swiss Federal Institute of Technology (ETH), Zürichbergstrasse 18, 8092 Zürich, Switzerland
c Institute for Environmental Decisions, Swiss Federal Institute of Technology (ETH), Universitätsstrasse 16, 8092 Zurich, Switzerland
** stuenzia@ethz.ch*

Abstract

Mobility-as-a-Service (MaaS) is a service that supports customers' transportation needs by providing information and ticketing for a multitude of transport modes in one interface; thus, it potentially represents an important lever to reduce negative transportation impacts such as emissions and congestion. By means of an online survey conducted in Switzerland, we try to understand potential user needs as well as factors that would motivate the use of MaaS. The results indicate the lowest level of openness to MaaS for commuting and the highest for weekend leisure trips. Factors that positively influence openness to using MaaS for leisure activities include a higher education degree, experience with carsharing and the use of announcements of future transportrelated climate policy. On the other hand, intention to reduce car usage was positively related to openness to MaaS in commuting. These findings suggest focusing specifically on either commuting or leisure activities when designing policy measures.

Keywords: Mobility-as-a-Service; influential factors; peer effect; policy recommendations; logistic regression; user needs

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

506 Opportunities and barriers to multimodal cities: Lessons learned from in-depth interviews about attitudes towards Mobility as a Service

Melinda Matyas[a]*

a MaaSLab, Energy Institute, University College Lonodn, 14 Upper Woburn Place, WC1H 0NN, London, UK
** melinda.matyas@ucl.ac.uk*

Abstract

With the emergence of the Mobility as a Service (MaaS) concept, it is important to understand whether it has the potential to support behaviour change and the shift away from private vehicle ownership and use. This paper aims to identify potential ways that MaaS (specifically MaaS plans) could help encourage behavioural change; and understand the barriers to using alternative transport modes. In-depth interviews and qualitative analysis are applied to the case study of London. The results indicate that individuals segment the transport modes offered via MaaS into three categories: essential, considered and excluded. Soft measures should target each individuals' consideration set as this is where the most impact can be made regarding behaviour change. Respondents also highlighted factors that make them apprehensive towards certain modes, such as safety, service characteristics and administration. Interventions that focus on the socio-demographic groups that are most affected could help make these modes more appealing.

Keywords: Behaviour change, Transport policy, Mobility as a Service, MaaS, Interviews, Qualitative analysis

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

509 Driver choices towards ride sharing in Athens

A. Boulougari[a], P. Papantoniou[b]*, G. Yannis[a]

a National Technical University of Athens, Department of Transportation Planning and Engineering, 5 Heroon Polytechniou str., GR-15773, Athens, Greece
b Chair of Transportation Systems Engineering, Department of Civil, Geo and Environmental Engineering, Technical University of Munich, Arcisstrasse 21, Munich 80333, Germany
** p.papantoniou@tum.de*

Abstract

The objective of this paper is to investigate and analyse the drivers' preferences toward ridesharing, with focus on examining whether the passengers intend to use a shared vehicle and identifying the main factors which determine the choice of ridesharing service as a way to travel. For this purpose, a stated preference experiment (questionnaire survey) was carried out in order to capture travelers' preferences on ride sharing preferences in Athens. In the next step, an appropriate modelling methodology has been developed, including descriptive analysis in order to explore the large database followed by two binary logistic regression models which were developed. Results indicate that especially young and female travelers were found to state that they would use ridesharing services to a higher degree. Furthermore, regarding traveling for work purposes, it was found that increasing transit time and number of weekly trips for work seems to lead to increase probability of the future ridesharing option.

Keywords: ridesharing services; drivers' preferences; stated preference analysis; binary logistic regression

536 Determinants of Success and Constraints of Integrated Ridesharing in Rural Areas

Jonas Harz[a]*, Carsten Sommer[a]

a University of Kassel, Chair of Transportation Planning and Traffic Systems, Mönchebergstraße 7, 34125 Kassel, Germany
** jonas.harz@uni-kassel.de*

Abstract

Ridesharing is often seen as a possibility to increase the mobility of citizens in rural areas, especially in connection with existing public transport. Two platforms were examined and evaluated in the research project GetMobil, which focused on the barriers and potentials in relation to the effects achieved. This was done with several surveys, analysis of usage data and expert interviews. The research showed that one common feature of both platforms was the low number of successfully completed rides. The question arising from this is: how should a ridesharing platform be designed in order to achieve a high proportion of matches between ridesharing offers and requests, motivate as many people as possible to participate actively and increase the mobility of residents in the region. Based on the examinations, recommendations were compiled for implementing ridesharing services.

Keywords: ridesharing; mobility as a service; rural areas; public transport

683 Examining preference heterogeneity for Mobility-as-a-Service Plans

Melinda Matyas[a]*, Maria Kamargianni[a]

a MaaSLab, Energy Institute, University College London, 14 Upper Woburn Place, WC1H 0NN, London, UK
** melinda.matyas@ucl.ac.uk*

Abstract

The concept of Mobility as a Service (MaaS) plans, where users pre-pay for a specific combination and amount of transport modes bundled together into a single product, has been a topic of discussion since early stages of MaaS developments. This paper aims to examine individual preferences for MaaS plans, specifically addressing the question of preference heterogeneity. In doing so, a Latent Class Choice Model developed, allowing us to segment respondents into a finite number of groups and improve our understanding of how individual characteristics and mobility habits lead to the choice of MaaS plans. The results indicate significant heterogeneity with regards to preferences towards MaaS plans. Five latent classes emerged through the analysis, all with different MaaS plan preferences and individual characteristics. Current travel behaviour and individual characteristics were shown to play a role in a person's willingness to purchase MaaS plans.

Keywords: Mobility as a Service, MaaS, Latent Class Choice Model, LCCM, Heterogeneity, User Groups

763 electro-Mobility-as-a-Service (eMaaS) in the EU funded STEVE Project experience

Daniele Baranzini[a]*, Diana Trojaniello[a], Riccardo Groppo[b], Marco Annoni[c], Massimo Violante[d], Davide Tavernini[e], Dolores Ordonez[f], Francesca Bena[g], Giuseppe Roccasalva[h], Alberto Sanna[a], Johann Massoner[i], Jochen Reisinger[j]

a Ospedale San Raffaele, Via Olgettina 60, 20132 Milano, Italy
b Ideas & Motion, Via Moglia, 19, 12062 Cherasco, Italy
c VEM Solutions, Via Aosta 20/22/24, 10078 Venaria Reale, Italy
d Politecnico di Torino, C.so Duca degli Abruzzi 24, 10129 Torino, Italy
e Centre for Automotive Engineering, University of Surrey, Guildford GU2 7XH, U.K.
f Any Solutions, S.L. Camí de ca na Gallura, 7 07010 Palma de Mallorca, Spain
g Comune di Torino, Piazza Palazzo Di Citta 1, 10122 Torino, Italy
h Comune di Venaria Reale, Piazza Martiri Della Liberta 1, 10078 Venaria Reale, Italy
i Infineon technologies Austria AG, Siemensstrasse 2, 9500 Villach, Austria
j Infineon technologies AG, Am Campeon 1-15, 85579 Neubiberg, Germany
** baranzini.daniele@hsr.it*

Abstract

Today's modern light electric vehicles (LEVs) range from two-wheel motorbikes, e-bikes, to low speed micro fourwheelers, i.e. light and heavy quadricycles (L6e and L7e). In the context of the EU H2020 funded STEVE project, the future LEV users are involved. The concept of profiling prospective LEVs users refers to a non-commercial operation to gather and aggregate data and knowledge about present users' propensity to engage in with LEVs, comodality and gamification services. This contribution targets new urban services, LEV solutions and relative pilot tests for final users' profiles as essential elements to increase and promote next generation mobility in Europe. The paper aims to describe the STEVE methodological approach, preliminary results and recommendations on what prospective LEV users are revealing in terms of their needs, preferences and appreciation of future electric mobility services.

Keywords: automotive; electro-Mobility-as-a-Service (eMaaS); electric vehicle; LEVs, User experience and requirements

770 Simulation of effects of ride sharing interconnected with public transport in rural areas

Ramón Briegel[a]*, Maria Daskalakis[b], Carsten Sommer[a]

a Department of transport planning and transport systems, University of Kassel, 34109 Kassel, Germany
b Department of economic policy, innovation and entrepreneurship, University of Kassel, 34109 Kassel, Germany
** ramon.briegel@uni-kassel.de*

Abstract

In rural areas, mobility is dominated by the private car, while public transport is often insufficient. On-demand services and ride sharing interconnected with public transport try to fill the gaps of classic public transport. We investigate the potential of cognitive-motivational and structural interventions to foster the use of such a ride sharing system in the light of the economic, ecological and social sustainability dimensions by means of agent-based computer simulations. Fishbein and Ajzen's reasoned action approach and Herbert Simon's action model constitute the main theoretical foundations of the simulation model; two surveys in the area of investigation serve as empirical foundation. Simulation results indicate that the overall potential of this kind of ride sharing system regarding the economic and ecologic sustainability dimensions is rather low. While monetary incentives are ineffective, cognitive-motivational interventions addressing altruistic and environmental aspects perform somewhat better, in particular when two such interventions are combined.

Keywords: Ride sharing; public transport; rural area; multi-agent system; cognitive-motivational intervention; sustainability

782 Shared mobility services in Malta: User needs and attitudes

Suzanne Maas[a]*, Maria Attard[a]

a Institute for Climate Change and Sustainable Development, University of Malta, Msida, Malta
** suzanne.maas@um.edu.mt*

Abstract

The past 2 years have seen the introduction of (e-)bicycle and car sharing in Malta. To understand the awareness and acceptance of these shared mobility services, a repeated cross-sectional survey with a sample representative of the Maltese population was held. The results provide insight in the attitudes of people towards bicycle- and car-sharing services, as well as their user needs, through the analysis of factors that encourage or discourage people from considering using shared mobility services. The paper ends with a discussion of the results and recommendations to support further promotion of shared mobility services. Improved road safety and safe infrastructure, investment in cycling skills and road safety education have the potential to encourage respondents to consider using bicycle sharing. More information about financial savings, and time and cost savings because of the use of reserved parking spaces and priority lanes can convince people to use car sharing.

Keywords: sharing economy; user needs; bicycle sharing; car sharing; cross-sectional survey; Malta

992 Smart mobility for all: integrating accessibility holistically

Terhi Tamminen[a]*, Petteri Alinikula[a], Marjo Kivi[a], Sakari Somerpalo[b], Azra Tayyebi[a]

a Avaava Oy, Katariina Saksilaisen katu 6, 00560 Helsinki, Finland
b Linea Konsultit Oy, Ruoholahdenkatu 8, 00180 Helsink, Finland
** terhi.tamminen@avaava.fi*

Abstract

Mobility and transportation are facing radical changes in the coming years. The upcoming smart mobility covers the infrastructure, services, and business models. The new services are enabled by Mobility as a Service (MaaS), shared economy and autonomous vehicles. The promise of smart mobility is not fulfilled if accessibility in different modalities of transportation is not handled holistically. The transport routes need to be accessible end-to-end and the applications for route planning, vehicle reservation and purchasing tickets need to include the accessibility data. The data needs to be dynamically updated if, e.g., a bus is replaced by a non-accessible bus due to an accident. The user interface – the mobile application – must be optimized for all including blind, partially sighted, hard-of- hearing, people using wheelchairs, and people with cognitive challenges. In this study we suggest a data architecture based on the analyzed user needs for accessible MaaS routes.

Keywords: Mobility as a Service; data architecture; mobile application; accessibility

1069 Drivers and Barriers of Mobility-as-a-Service in urban areas

Y. Araghi[a]*, N. Larco[a,b], G.M. Bouma[d], C. Doll[c], D.M. Vonk Noordegraaf[a], K. Krauss[e]

a Sustainable Urban Mobility and Safety, TNO, Anna van Buerenplein 1, 2595 DA Den Haag, The Netherlands
b Urbanism Next Center, University of Oregon, 70 NW Couch Street, Portland, OR 97209, USA
c Sustainability and Infrastructure Systems, Fraunhofer-ISI, Breslauer Strasse 48, 76139 Karlsruhe, Germany
d Strategy and Policy, TNO, Anna van Buerenplein 1, 2595 DA Den Haag, The Netherlands
e Systems and Innovation Research, Fraunhofer-ISI, Breslauer Strasse 48, 76139 Karlsruhe, Germany
** yashar.araghi@tno.nl*

Abstract

Around 70% of world population will be living in urban areas by year 2050. Therefore, urban transport providers need to be more efficient and innovative to be able to cope with the large demand. The concept of Mobility-as-a-Service (MaaS) is an innovative approach that can potentially offer a way forward to deal with this demand in urban areas in future. In this paper, we discuss expected positive outcomes, drivers and barriers of MaaS. We provide two national case studies from the Netherlands and Germany to put the mentioned drivers and barriers into perspective. Finally, we provide some food-for-thought and action points for decision makers in transport regarding the arrival of MaaS and preparing the transport sector in anticipation of the large urban mobility demand.

Keywords: New mobility, Mobility-as-a-Service, drivers and barriers, transport policy

1146 Assessment and categorization of shared on-demand mobility services

Tero Haahtela[a]*

a Aalto University, Department of Industrial Engineering, Maarintie 8, Espoo, 00076 AALTO, Finland
** tero.haahtela@aalto.fi*

Abstract

The aim of this paper is to describe the process of developing an assessment model for shared on-demand mobility services. The purpose of this assessment is to provide more information on the topic for different stakeholders, while the primary viewpoint is the cities' and their transport authorities' perspective. This information helps in analyzing how these services can complement the existing local multimodal public transportation. Based on the preliminary results, a categorization for the shared on-demand mobility service types is presented as well.

Keywords: on-demand mobility; mobility service assessment; Mobility-as-a-Service

1.9 Scientific and technical session 9: Data and big data in mobility

336 Spatial analysis of driver safety behaviour using data from smartphones

Ilias Parmaksizoglou[a], Dimitrios I. Tselentis[a], George Yannis[a]*

a National Technical University of Athens, Department of Transportation Planning and Engineering, 5, Iroon Polytechniou str. GR-15773, Athens, Greece
** geyannis@central.ntua.gr*

Abstract

The aim of this research is to conduct a spatial analysis of driver safety behavior using data from smartphones. More specifically, it is investigated how the number of harsh accelerations and decelerations per day, which are key elements of everyday driving, is influenced with both the road environment and road users' behaviour. Data were processed in a GIS computer software, resulting to the creation of new tables describing the phenomena observed on the signalized arterial studied (Leoforos Mesogeion) in node and link areas. Additionally, analytic maps were developed that aimed to indicate patterns of the accumulation and ranking of the harsh events in the selected road segments. Finally, four linear regression models were developed, which demonstrated speed as the most statistically significant factor in predicting the number of harsh events per day on a region basis.

Keywords: driver behaviour; harsh events; spatial analysis; GIS; linear regression

489 Estimating passenger experience from vehicle data: Preconditions for using machine learning

Timo Laakko[a]*, Juho Kostiainen[a], Olli Pihlajamaa[a]

a VTT Technical Research Centre of Finland Ltd., P.O. Box 1000, FI-02044 VTT, Finland
** timo.laakko@vtt.fi*

Abstract

These days, there is a vast amount of data available from public transport vehicles. This data has potential to be used for estimating passenger experience and comfort. Automatic and continuous monitoring of parameters affecting user experience can help in, for example, designing and developing better vehicles, using the

information for operator rewards or for training drivers. This paper looks at how machine learning can be applied for estimating (electric) bus passenger experience automatically by using commonly available vehicle and sensor data. The focus is on how to ensure that data is interpreted correctly. We compare data collected from electric buses with passenger survey results and passenger feedback to identify relevant data types. Along with promising parameters for evaluating passenger experience, we provide recommendations on what needs to be considered in collecting actual user experiences for validating causation and results.

Keywords: artificial intelligence; machine learning; user experience; public transport; big data

Full paper:
https://www.researchgate.net/publication/339848623_Estimating_passenger_experience_from_vehicle_data_Preconditions_for_using_machine_learning

570 Assessing the impact of Big Data for improving transport efficiency: A cross-modal approach

Pablo Vázquez-Puig[a]*, Andrés Monzón[b], Alessandra Boggio-Marzet[a], Víctor J. Corral[c]

a TRANSyT - Transport Research Centre, Universidad Politécnica de Madrid, Calle Profesor Aranguren 3, 28040 Madrid, Spain
b Dept. Transport Engineering, Urban and Regional Planning, U. Politécnica de Madrid, Profesor Aranguren 3, 28040 Madrid, Spain
c Research and Innovation, Atos Spain, Albarracín 25, 28037 Madrid, Spain
** pablo.vazquez@upm.es*

Abstract

Data collectors and their technology embedded are exponentially increasing and the major interest of enterprises is focused on how this data can be analysed and put into real-time service for users and operators. The EU H2020 project Transforming Transport (TT) has leveraged Big Data technologies to demonstrate their impact on thirteen pilots working on seven specific transport areas such as highways, connected vehicles, rail, ports, airports, urban mobility and e-commerce. Throughout several KPI consciously selected, it has been possible to assess the benefits of the Big Data implementation on the transportation sector. This paper presents the results of this assessment, which reveals improvements around 40-60% regarding the operative cost, energy consumption, environmental quality and the enhancement of the predictive maintenance of assets, among others.

Keywords: Big Data; Transportation Sector; Key Performance Indicators; Assessment Category; Pilot Domain; Global Assessment Objectives

799 A Decision Support Tool for Evaluating Big Data Investment in Transport: Empirical evidence from European use cases of NOESIS project

Christos Katrakazas[a]*, Natalia Sobrino[b,c], Ilias Trochidis[d], Jose Manuel Vassallo[b], Stratos Arampatzis[d], Constantinos Antoniou[e]

a National Technical University of Athens, Department of Transportation Planning and Engineering,15773, Athens, Greece
b Transportation Research Centre –TRANSyT, Universidad Politecnica de Madrid, Madrid 28040 , Spain
c Civil Engineering: Construction, Infrastructure and Transport Department, Universidad Politecnica de Madrid, Madrid 28014 , Spain
d Ortelio LTD, Coventry University Technology Park, Puma Way, Coventry, CV1 2TT, United Kingdom

e Chair of Transportation Systems Engineering, Technical University of Munich, Munich 80333, Germany
** c.katrakazas@tum.de*

Abstract

Big Data technologies have become extremely popular in transportation applications worldwide. The European Union (EU) Horizon 2020 (H2020) NOESIS project (http://www.noesis-project.eu) aims at improving the understanding about the impact of big data by creating a Decision Support Tool for evaluating big data investment in transport. Towards this aim, key challenges of Big Data utilization in the transportation domain are identified, use cases of applications are recorded and a benefit evaluation of Big Data applications is designed, in order to support future decisions. These tasks form the scope of this research. Initially, 13 areas of focus for Big Data in Transport are presented, followed by the first library of recorded Big Data use cases, along with a Data Benefit Analysis methodology and a decision support tool. As a result, a first holistic approach towards exploiting the socioeconomic impact of transportation investments using Big Data is formed.

Keywords: Big data, Transport, Decision support tool, Data Benefit Analysis

833 Big data and inland waterway traffic management: Lessons from the 'Blauwe Golf Verbindend' case study

Bastiaan van Berne[a]*, Ivo Hindriks[a], Martijn van Hengstum[b], Arnaud Burgess[a]

a Panteia BV, Bredewater 26, Zoetermeer 2715 CA, The Netherlands
b Rijkswaterstaat, Derde Werelddreef 1, Delft 2622 HA, The Netherlands
** b.van.berne@panteia.nl*

Abstract

In response to the increase in transport demand and the pressure on resources for real-time traffic management and in combination with technological advancements, traffic managers started to design more intelligent transport systems based on big data. This paper presents the challenges and enablers involved in the implementation of a data-based traffic management solutions by looking at one specific case called Blue Wave Connected (BWC, in Dutch: 'Blauwe Golf Verbindend'). BWC is a knowledge and open data platform for traffic established by regional governments in the Netherlands. It aims to optimize the situation for both IWW vessel and road vehicles by optimizing IWW traffic through traffic management and providing IWW services. The results point to how the application of big data does not necessarily pose a technological issue, but more importantly an organisational issue.

Keywords: Real-Time Traffic Management, Big Data, Inland Waterways

915 Using Digital Twin Technology to Ensure Data Quality in Transport Systems

Mikael Manngård[a], Wictor Lund[a], Jerker Björkqvist[a]*

a Åbo Akademi University, Domkyrkotorget 3, 20500 Turku, Finland
** jerker.bjorkqvist@abo.fi*

Abstract

Autonomous transport systems are dependent on real-time data from their environment. The data is read from a multitude of sensors ranging from sensors measuring temperature, pressure, and flow to advanced sensor systems such as GPS and Lidar systems. When the sensor data is used as input to an automation

system, measurement errors and sensor faults may lead to invalid situation awareness or even catastrophic failure. Digital Twins (DTs) are digital representations of a physical systems, where the physical rules of a system are expressed in a mathematical form. When feeding sensor data to the DT, sensor values can be checked against the rules of the physical system. This enables feasibility checking of sensor values, and together with sensor redundancy, faulty measurements can be corrected. In this paper, we present the DT for a marine vessel energy subsystem and use the DT for validating and cleansing of representative data for that subsystem.

Keywords: Digital Twin, Data Quality, Energy Systems, Heat Exchanger

Full paper:
https://www.researchgate.net/publication/339875335_Using_Digital_Twin_Technology_to_Ensure_Data_Quality_in_Transport_Systems

937 Passive Wi-Fi Monitoring in Public Transport: A case study in Madeira Island

Miguel Ribeiro[a]*, Bernardo Galvão[b], Catia Prandi[c], Nuno Nunes[a]

a ITI/LARSYS, Instituto Superior Tecnico - ULisboa, Lisboa, Portugal
b ITI/LARSYS, Funchal, Portugal
c University of Bologna, Bologna, Italy
** miguelsribeiro@gmail.com*

Abstract

Transportation has become of evermore importance in the last years, affecting people's satisfaction and significantly impacting their quality of life. In this paper we present a low-cost infrastructure to collect passive Wi-Fi probes with the aim of monitoring, optimizing and personalizing public transport, towards a more sustainable mobility. We developed an embedded system deployed in 19 public transportation vehicles using passive Wi-Fi data. This data is analyzed on a per-vehicle and per-stop basis and compared against ground truth data (ticketing), while also using a method of estimating passenger exits, detecting peak loads on vehicles, and origin destination habits. As such, we argue that this data enables route optimization and provides local authorities and tourism boards with a tool to monitor and optimize the management of routes and transportation, identify and prevent accessibility issues, with the aim of improving the services offered to citizens and tourists, towards a more sustainable mobility.

Keywords: passive Wi-Fi; sensory data; sustainable mobility

Full paper: http://feto.arditi.pt/pubs/TRA2020_Passive_Wi-Fi_Monitoring_in_Public_Transport.pdf

1030 Data-based Synthetic Population Generator for Activity Based Transport Models

Petr Hajduk[a]*, Claudio Roncoli[b], Mikko Pihlatie[a]

a VTT Technical Research Centre of Finland, Vuorimiehentie 3, Espoo 02044, Finland
b Department of Built Environment, Aalto University, Otakaari 4, Espoo 02150, Finland
** petr.hajduk@vtt.fi*

Abstract

Transport models are a key to understanding the mobility inside cities. Despite the fact that activity-based transport models offer better level of detail and finer

interactions compared to four-step models, they lack a suitable methodology for creating a meaningful population out of open data without the burden of privacy sensitivity. This paper is trying to bridge this gap by introducing a new methodology and its implementation for the Capital Region of Helsinki, Finland. The generated population is finally tested as a part of activity-based transport model for the same area. Results show that generating the population solely from open aggregated data is possible and shows good correlation with the observed data.

Keywords: activity-based model, transport model, simulation, agent-based simulation, open data

1067 Context-sensitive modeling of public transport data

Inês Leite[a], Anna Carolina Finamore[a], Rui Henriques[a]*

a INESC-ID and Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal
** rmch@tecnico.ulisboa.pt*

Abstract

Despite the efforts placed by major European cities to optimize public transportation, traffic data analytics often disregard vital situational context. This work proposes a methodology to integrate situational context (including public events, planned interventions and citizen notifications) in the analysis of public transport data. The major contributions are the: online consolidation and labeling of heterogeneous sources of context; calendar-driven statistical modeling of expected traffic behavior; and the integrative display of traffic and its situational context, accompanied by spatiotemporal navigation and zooming facilities. Preliminary results collected from the Lisbon's subway network system shows the relevance of these contributions to support context-sensitive decisions.

Keywords: situational context, sustainable mobility, subway network traffic data, integrative descriptive analytics

Full paper: http://web.ist.utl.pt/rmch/upload/publications/TRA_ContextModelingTransportData_LeiteFinamoreHenriques.pdf

1144 Benefits of real time information flow in multimodal transport chains on ferry shipping example

Ludmiła Filina-Dawidowicz[a]*

a West Pomeranian University of Technology, al. Piastów 17, Szczecin 70-310, Poland
** ludmila.filina@zut.edu.pl*

Abstract

Nowadays, the changes in multimodal transport chains functioning are observed. They are influenced among others by continuously growing requirements for transport services. One of them deals with information flow, customers want to be well informed on the performance of the particular stage of transport processes. That is why real time information sharing between the particular stakeholders of multimodal transport chains becomes up-to-date. The article aims to present the range of possible benefits that may be achieved by users of real time data of multimodal transport chains on the ferry shipping example. On the basis of literature analysis and interviews held with stakeholders who use ferry connections in the Baltic Sea region it was possible to identify the scope of possible benefits and

divide them into groups perceived from different perspectives, including those related to the specific groups of users.

Keywords: multimodal transport, real time data, ferry shipping, benefits

1.10 Scientific and technical session 10: Safety through data, digitalisation and automation

219 Investigation of the impact of weather conditions to young drivers' behaviour and safety in cities

Maria Chaireti[a], Armira Kontaxi[a]*, Dimosthenis Pavlou[a], George Yannis[a]

a National Technical University of Athens, Department of Transportation Planning and Engineering, 5 Heroon Polytechniou str., GR-15773, Athens, Greece
** akontaxi@mail.ntua.gr*

Abstract

Driving in adverse weather conditions is not only associated with a high risk of being involved in an accident, but it also affects the severity of an accident. The objective of this research is to investigate the impact of weather conditions on young drivers' behaviour and safety in urban areas. In order to achieve this objective, an experimental process on a driving simulator was carried out, in which 40 participants drove in different driving scenarios. Regression statistical models were developed to investigate the impact of weather conditions on the mean speed (linear) and the accident probability (logistic). The models' application shows that driving in the rain contributes to a small reduction in speed, but also to a significant increase in the probability of an accident. When driving in fog, drivers seem to be more cautious, resulting to a decreased accident probability.

Keywords: weather conditions; driving simulator; speed; road accidents; linear regression; binary logistic regression

226 Analysis of highly automated vehicles' potential to prevent pedestrian crashes when prioritizing safety and traffic flow

Roni Utriainen[a]*, Markus Pöllänen[a]

a Transport Research Centre Verne, Tampere University, P.O. Box 600, Tampere 33014, Finland
** roni.utriainen@tuni.fi*

Abstract

Interaction between drivers and pedestrians enables that the pedestrians may cross the street without a conflict. When highly automated vehicles (HAVs) become prevalent, interaction will change. Albeit an HAV can be able to identify pedestrians, it may not be able to assess pedestrians' intentions to cross the street. This study assesses HAVs' hypothetical possibilities to avoid 40 in-depth investigated fatal pedestrian crashes, which occurred with conventional vehicles. The analysis was made by two different approaches as assumptions; the HAVs could be programmed to prioritize 'pedestrian safety' or 'traffic flow'. In the 'pedestrian safety' approach, the HAV decreases speed nearby pedestrians, which reduces traffic flow due to frequent decelerations. 37 of 40 crashes are avoidable. In the 'traffic flow' approach, the HAV avoids unnecessary decelerations, as the HAV only decelerates, when the pedestrian is in a collision course. This leads to smaller safety potential as 32 of 40 crashes are avoidable.

Keywords: Highly automated vehicle; pedestrian; safety potential; interaction

612 Identification of Road Safety Risk Factors in Africa

George Yannis[a], Stergios Mavromatis[a]*, Katerina Folla[a], Alexandra Laiou[a], Dimitris Nikolaou[a], Susanna Zammataro[b], Julia Funk[b], Athanasios Theofilatos[c], Ruth Welsh[c], Rachel Talbot[c], Eduard Fernandez[d], Vlad Sogodel[d], Jac Wismans[e], Ludo Kluppels[f], Laurant Carnis[g], Dominique Mignot[g]

a National Technical University of Athens, 5 Iroon Polytechniou str., Athens GR-15773, Greece
b International Road Federation, 2 Chemin de Blandonnet, Vernier CH-1214, Switzerland
c Loughborough University, Ashby Road, Loughborough LE11 3TU, United Kingdom
d CITA, Rue du Commerce 123, Brussels - 1000, Belgium
e SAFER, P.O. Box 8077, Göteborg SE-402 78, Sweden
f VIAS, Chaussée de Haecht 1405, Brussels 1130, Belgium
g IFSTTAR, Boulevard Isaac Newton 14, Marne La Vallee Cedex FR-77447, France
** stemavro@central.ntua.gr*

Abstract

The paper presents the results of the analysis of road safety data, collected within the research project "SaferAfrica - Innovating dialogue and problems appraisal for a safer Africa", aiming to support policy makers and stakeholders with evidence on critical risk factors, related actions and good practices drawn from high quality data and knowledge. The project is funded by the European Union's Horizon 2020 research and innovation programme. The overall objective is to identify key risk factors affecting road safety in African countries. More specifically, a data organisation and analysis system was developed for the data gathered in order to produce indicators and define critical areas and challenges per topic and region of Africa. The analysis of the data for identifying key risk factors was performed on 5 different topics and priority areas for road safety actions and interventions were highlighted.

Keywords: road safety; SaferAfrica; risk factors; priority areas

747 FERSI position paper: Safety through automation? Ensuring that automated and connected driving contribute to a safer transportation system

Anna Anund[a]*, Anders Lindström[a], Ingrid van Schagen[b], Astrid Linder[a]

a VTI, SE-581 95 Linköping. Sweden
b SWOV Institute for Road Safety Research, PO Box 93113, NL-2509 AC The Hague, The Netherlands
** anna.anund@vti.se*

Abstract

In 2018, the Forum of European Road Safety Research Institutes (FERSI) published a report on automated driving (AD) from a road safety point of view, prepared by a dedicated FERSI Working Group with experts from eleven European countries. The group identified 23 high priority concerns or questions, clustered into four categories, to ensure that connected AD and co-operative ITS successfully contribute to a smart, green, and integrated transport system which at the same time is a safe transport system. The discussions resulted in ten principles to be fulfilled in order to optimise the safety effects of AD. Even if these principles may seem straightforward, the underlying questions are complex, and the identification and realisation of cost-efficient and effective solutions will require considerable effort. Many strong industrial and political driving forces exist, but so far improving

road safety seems to get insufficient priority. FERSI therefore recommends a number of focused actions.

Keywords: Automated driving; Connectivity; Road safety; Policy making; Research

Full paper: https://fersi.org/wp-content/uploads/2020/03/TRA2020-FERSI-Safety-through-automation.pdf

772 Road safety comparative analysis in the Maghreb

Mohamed Mouloud Haddak[abc]*

a University of Lyon, F-69622, Lyon, France
b University of Lyon 1, UCBL, F-69373, Lyon, France
c Epidemiological Research and Surveillance Unit in Transport, Occupation and Environment (UMRESTTE), French Institute of Science and Technology for Transport, Development and Networks (IFSTTAR), 25, av. François Mitterrand, F-69675, Bron, France
** Mouloud.haddak@ifsttar.fr*

Abstract

Review of recent WHO reports on road safety in the world shows

- The Maghreb is at high risk,
- The data provided are of poor quality.

In one country, the more incomplete the collection of data on the victims of road accidents, the more biased the road safety vision, the more likely the road safety policy in that country will be ineffective. In Maghreb area, only deaths on the spot are counted as killed on the roads. Secondary deaths are not recorded. This underreporting is even more important for injured ones. This reveals the lack of means implemented to assess the real state of the situation and to carry out an efficient prevention policy. It is not enough to remember that 90% of accidents are due to the human factor. This does not relieve the public authorities of their responsibilities if they do not offer road users viable alternatives.

Keywords: Road Safety; Road Traffic Accident; Prevention; Road Trauma Care; Maghreb

Full paper: https://hal.archives-ouvertes.fr/hal-02507251

783 Impact evaluation of the Porokello alert service

Satu Kotituomi[a]*, Matti Huju[a], Risto Kulmala[a], Ahti Lahtela[b], Anna Schirokoff[c]

a Traficon Ltd, Länsiportti 4, 02210 Espoo, Finland
b Paikkatieto Online Oy, Puulammenpolku 30, 98100 Kemijärvi, Finland
c Finnish Transport and Communications Agency Traficom, Kumpulantie 9, 00520 Helsinki, Finland
** satu.kotituomi@traficon.fi*

Abstract

There have been about 4,000 reindeer collisions annually in northern Finland. Preventing collisions has proved to be challenging. In 2013 a reindeer alert service that combined location data and mobile phone technology was trialled for the first time. In 2017 Porokello application was published. The objective of this evaluation was to investigate whether the Porokello warning system has had an impact on traffic safety, and to make recommendations which could result in improvements of the service. On the basis of examination of statistics and maps can be seen that the number of reindeer accidents and the accident rate have decreased since the introduction of Porokello. It is probable that the positive change in the number of reindeer accidents is due to the service. However, as the data covered only two

years in this study it was not possible to differentiate the impact of Porokello and the effect of other factors.

Keywords: reindeer warning; reindeer collision; reindeer accident; impact assessment; traffic safety; information service

991 Peer pressure on road safety: the case of the Aristotle University of Thessaloniki, Greece

Evangelia Beli[a], Dimitrios Nalmpantis[a]*

a School of Civil Engineering, Faculty of Engineering, Aristotle University of Thessaloniki, PO Box 452, 541 24 Thessaloniki, Greece
** dnalba@civil.auth.gr*

Abstract

Many attempts have been made to correlate road safety with a large number of factors. This paper attempts to investigate the correlation of road safety with peer pressure in the case of university students. Student drivers are young and novice and, as such, overrepresented in traffic accidents. A questionnaire survey took place, in which 309 students of the Aristotle University of Thessaloniki participated. The main factors that we investigated were the involvement in traffic accidents correlated with personal characteristics, elements of driving behavior, gender, and origin. The main results are the following: a) there is a positive correlation between self-reported driving capability and accident involvement/causation, b) students from small villages are more often responsible for accidents, c) driving from a young age without proper training and a driving license leads to long-term risk exposure, and d) students do not fully realize how much peer pressure influences their driving behavior.

Keywords: peer pressure; road safety; traffic accidents; students; Aristotle University of Thessaloniki (AUTh)

Full paper: https://doi.org/10.5281/zenodo.3708323

1016 Clash of cultures in Greek traffic? What happens when a Southern European road safety culture is mixed with a Northern European road safety culture?

Tor-Olav Nævestad[a]*, Torkel Bjørnskau[a], Alexandra Laiou[b], Ross O. Phillips[b], George Yannis[b]

a Institute of Transport Economics, Norway, Oslo 0349, Norway
b National Technical University of Athens, Athens, GR-15773 Athens, Greece
** ton@toi.no*

Abstract

Traffic accidents are the second most important cause of death for international tourists. In the present paper, this is related to differences in national road safety cultures (RSC). Previous research indicates that RSC, specified as shared expectations to other road users and perceptions of what is normal behaviour in traffic, continuously is (re)created through road user interaction in traffic settings. But what happens when road users from different RSCs interact? In the present paper, this process is examined focusing on the local driving population and international tourists on the Greek Island of Rhodes. The aims of the study are to examine: 1) To what extent do road safety cultures of international tourists and locals differ in Rhodes?, 2) Who is influenced by whom: Do the locals adapt their

behaviour to the tourists, or is it the other way around?, 3) What are the (potential) safety outcomes of these processes?

Keywords: Tourists, car drivers, motorcycle riders, road safety culture, Greece

1111 Impact of Automated Highway Autopilot on the Performance and Safety of Weaving Sections

Marieke S. van der Tuin[a]*, Haneen Farah[a], Gonçalo H.A. Correia[a]

a Department of Transport and Planning, Faculty of Civil Engineering and Geosciences, Delft University of Technology, P.O. Box 5048, 2600 GA Delft, The Netherlands
** m.s.vandertuin@tudelft.nl*

Abstract

Allowing level 4 Automated Vehicles to drive on highways could significantly impact the traffic efficiency and safety. Although it might probably take a while before AVs are on the road, NRAs (National Road Authorities) are already investigating how to adapt their current infrastructure to make it ready for AVs – while optimizing both traffic efficiency and safety. Therefore, in this paper we simulate a highway section in VISSIM including a weaving section calibrated with empirical data. We test different taper lane lengths, different demand levels (0.55 and 0.80 F/C ratios) and different CAV penetration rates (0-100%) and we assess the impact on traffic efficiency and safety. It is concluded that increasing AV penetration rates lead to decreasing travel times for all road users (automated and non-automated). Different taper lane lengths as well as different traffic flow levels do not seem to influence the observed pattern much.

Keywords: autonomous vehicles; highway autopilot; VISSIM; weaving section; NRA

Full paper: http://resolver.tudelft.nl/uuid:974aa551-67c4-4da1-99cf-8f3071cc15f4

1149 Development of a Platform for Global Road Safety Data Analysis

George Yannis[a]*, Katerina Folla[a], Dimitrios Nikolaou[a], Anastasios Dragomanovits[a], Xuesong Wang[b]

a National Technical University of Athens, 5 Heroon Polytechniou str., 15773, Athens, Greece
b Tongji University, 4800 Cao'an Road, 201804, Shanghai, China
** geyannis@central.ntua.gr*

Abstract

Road accidents constitute a major social problem in modern societies, with very high discrepancies between the different regions and countries of the world. Within the Greek-China cooperation project i-safemodels, the objective of this research is the development of a platform for global road safety data to support macroscopic analyses. A methodological framework was designed for the development of the global data platform, combining the five road safety pillars of WHO Global Plan of Action with the concept of the SUNflower pyramid, suitably adjusted in order to serve more efficiently the needs of global road safety analysis. A set of numerous indicators and data have been selected to be included in the database from various international databases. A "big data" platform is also designed, combining transport data coming from new technologies, with the traditional road safety indicators, used for monitoring road safety performance, in order to better support decision making process.

Keywords: safety, injuries, fatalities, data analysis, global database

1.11 Scientific and technical session 11: Novel perspectives to C-ITS and autonomous road transport

157 Designing cooperative interaction of automated vehicles in mixed traffic environments: Insights from the interACT project

Anna Schieben[a]*, Marc Wilbrink[a], André Dietrich[b], Johannes Ruenz[c], Evangelia Portouli[d], Angelos Amditis[d], Mathias Althoff[e], Marc Kaup[f], Fabio Tango[g], Yee Mun Lee[h], Gustav Markkula[h], Natasha Merat[h], Florian Weber[i]

a German Aerospace Center, Institute of Transportation Systems, Lilienthalplatz 7, 38108 Braunschweig, Germany
b Technical University of Munich, Department of Mechanical Engineering, Boltzmannstr. 15, 85747 Garching, Germany
c Advanced Engineering, Chassis Systems Control, Robert Bosch GmbH, Postfach 13 55, 74003 Heilbronn, Germany
d ICCS, Iroon Politechneiou 9, Zografou 15773, Greece
e Technical University of Munich, Deparment of Informatics, Boltzmannstr. 3, 85748 Garching, Germany
f Lighting Innovation, HELLA GmbH & Co. KGaA, Rixbecker Str. 75, 59552 Lippstadt, Germany
g Centro Ricerche Fiat STRADA TORINO 50, 10043 Orbassano, Italy
h Institute for Transport Studies, University of Leeds, Leeds, United Kingdom
i BMW group, Petuelring 130, 80788 Munich, Germany
** anna.schieben@dlr.de*

Abstract

As Automated Vehicles (AVs) will be deployed in mixed traffic, they need to interact safely and efficiently with other traffic participants. The EU H2020 project interACT works towards the safe integration of AVs into mixed traffic environments. In this paper, we summarize the main objectives of the project and the results achieved to date. Starting from the observation and modelling of human-human interactions in urban environments, we improved the intention and behaviour recognition algorithms for the AV, worked on the core intelligence of the vehicle – the Communication and Cooperation Planning Unit – and designed new external and internal HMI concepts to communicate with surrounding traffic participants and promote safe interaction. The results of the project are evaluated by using new evaluation methodologies to assess the cooperation quality of the AV.

Keywords: Automated vehicles, human behaviour models, external HMI, vehicle intelligence, intention recognition algorithms

368 Enhancing Acceptance in Automated Vehicles through a new paradigm for colouring automated driving with human emotions

José S. Solaz[a]*, José Laparra-Hernández[a], Begoña Mateo[a], Elisa Signes[a], Juan-Manuel Belda-Lois[a], Sofía Iranzo[a], Nicolás Palomares[a]

a Instituto de Biomecánica de Valencia. Universitat Politècnica de València, Camino de Vera s/n, Valencia 46022, Spain
** jose.solaz@ibv.org*

Abstract

While the deployment of connected automated vehicle (CAV) turns into reality, its acceptance has been called into question. Societal issues regarding public acceptance, user awareness and ethics, therefore, become priority concerns. The approach based on the technology push, jeopardizes social viability of innovative technology like CAV, as it creates a gap between the well-thought technical

reliability and public acceptance. The H2020 SUaaVE project (SUpporting acceptance of automated VEhicle) will solve this gap by leaning on a Human-Driven Design (HDD) approach, enhancing synergies social science, human factors research and automotive market by means of an iterative process of assessment, co-design and prototyping. Participatory process will involve above 4,000 users (passengers, traditional and future drivers, VRU) and 100 experts and stakeholders along the project. The paper will present an overview of the objectives and the methodology to be followed in SUaaVE.

Keywords: Connected and Automated Driving; Human-Driven Design; Cognitive and Emotional Model; Acceptance; Situational Awareness; Artificial Intelligence

389 Enhanced Traffic Management Procedures of Connected and Autonomous Vehicles in Transition Areas

Sven Maerivoet[a]*, Anton Wijbenga[b], Jaap Vreeswijk[b], Evangelos Mintsis[c], Dimitrios Koutras[c], Xiaoyun Zhang[d], Robbin Blokpoel[d], Alejandro Correa[e], Leonhard Lücken[f], Robert Alms[f], Yun-Pang Flötteröd[f]

a Transport & Mobility Leuven, Belgium
b MAP traffic management, The Netherlands
c Hellenic Institute of Transport (CERTH/HIT), Greece
d Dynniq, The Netherlands
e Universitas Miguel Hernández (UMH), Spain
f German Aerospace Center (DLR), Germany
** sven.maerivoet@tmleuven.be*

Abstract

In light of the increasing trend towards vehicle connectivity and automation, there will be areas and situations on the roads where high automation can be granted, and others where it is not allowed or not possible. These are termed 'Transition Areas'. Without proper traffic management, such areas may lead to vehicles issuing take-over requests (TORs), which in turn can trigger transitions of control (ToCs), or even minimum-risk manoeuvres (MRMs). In this respect, the TransAID Horizon 2020 project develops and demonstrates traffic management procedures and protocols to enable smooth coexistence of automated, connected, and conventional vehicles, with the goal of avoiding ToCs and MRMs, or at least postponing/accommodating them. Our baseline simulations confirmed that, e.g., a coordinated distribution of takeover events can prevent drops in traffic efficiency, which in turn leads to a more performant, safer, and cleaner traffic system, when taking the capabilities of connected and autonomous vehicles into account.

Keywords: Traffic management; connected and autonomous vehicles (CAVs); V2X; transition areas

Full paper: https://www.transaid.eu/wp-content/uploads/2017/Publications/2020-04-27-tml-finland.pdf

438 Intelligent Traffic Signal – coordinated or isolated control?

Cristina Vilarinho[a]*, José Pedro Tavares[a], Rosaldo J. F. Rossetti[b]

a Centro de Investigação do Território, Transportes e Ambiente, Departamento de Engenharia Civil, Faculdade de Engenharia da Universidade do Porto, Rua Roberto Frias, 4200-465 Porto, Portugal
b Laboratório de Inteligência Artificial e Ciência de Computadores, Departamento de Engenharia Informátic, Faculdade de Engenharia da Universidade do Porto, Rua Roberto Frias, 4200-465 Porto, Portugal
** cvilarinho@fe.up.pt*

Abstract

This paper presents a review of traffic control strategies at the level of control scope, i.e., over what area the strategy is applied, namely coordinated or isolated. In addition, a novel traffic signal control approach is proposed for isolated intersection scope, which includes signal plan design and signal timing optimization with real-time information. The isolated control scope allows each intersection to operate independently from other intersections, so each intersection has the freedom and flexibility to calculate and implement any traffic control settings. In this way, the research contributes to the development of a new strategy, which breaks with the traditional concepts of traffic control such as: the cycle length, the maximum green, and a signal plan to follow. The case study investigates the application of the strategy to a network of two signalized intersections, in four demand periods. However, the proposed approach only shows better results for low demand periods.

Keywords: traffic signal control, control scope, signal timing optimization, signal plan design

Full paper: https://sigarra.up.pt/feup/pt/pub_geral.show_file?pi_doc_id=238148

472 Acceptance and use of ADAS

Merja Penttinen[a], Juha Luoma[b]*

a VTT, Technical Research Centre LtD, P.O.Box 1000, 02044 VTT, Finland
b Independent consultant, Helsinki, Finland
** merja.penttinen@vtt.fi*

Abstract

This study was designed to investigate how many Finnish drivers with new cars have ADAS in their vehicles, and how frequently and in which context they use those systems, ACC and Lane Keeping (LKA) in particular. In addition, the impacts of these systems were to be assessed. Moreover, limitations of the current systems, willingness to have the systems in the future, and willingness to pay for such systems or higher automation levels were of interest.

The data was collected with an online survey of 1,005 drivers who drive regularly and have purchased their vehicle in 2016 or later. The selection of driver sample seemed to be successful and allowed collecting versatile quantitative data of the usage of the systems in various contexts and self-reported benefits of the systems. This paper concentrates into the results concerning longitudinal support systems, cruise control and adaptive cruise control.

Keywords: ADAS; user acceptance; impacts; context of use; user survey; focus groups

Full paper: https://cris.vtt.fi/en/publications/acceptance-and-use-of-adas

524 Combined ITS-G5 and 5G test track for vehicle winter testing and advanced road weather services

Timo Sukuvaara[a]*, Kari Mäenpää[a], Daria Stepanova[a], Tero Siili[a], Virve Karsisto[a]

a Finnish Meteorological Institute, Erik Palménin aukio 1, FI-00560 Helsinki, Finland
** timo.sukuvaara@fmi.fi*

Abstract

In order to conduct successful long-term service and system architecture development, permanent infrastructures and development environment are

essential. For this purpose, FMI is operating a vehicle winter testing track with advanced communication capabilities within ITS-G5 and 5G test network, along with accurate road weather data and services supported by road weather stations and on-board weather measurements. The track is in Sodankylä, Northern Finland, where the long arctic winter period of more than half year allows road weather services development in (and for) severe weather conditions. This environment provides favourable conditions for the development of advanced ITS safety services equally for traditional, autonomous and alternate energy vehicles, tailored road weather services for each special use case and accurate estimation of performance. Not forgetting the energy efficiency of traffic and communication infrastructures themselves, which are critical elements in the development of the future ITS. The focus is on the test track introduction.

Keywords: ITS-G5, 5G, road weather services, autonomous driving, energy efficiency

Full paper: https://5gsafeplus.fmi.fi/docs/Sukuvaaraetal_TRA2020.pdf

525 Automated Valet Parking using IoT: Design, user experience and business opportunities

Johan Scholliers[a]*, Pasi Pyykönen[a], Ari Virtanen[a], Elina Aittoniemi[a], Fanny Malin[a], Maija Federley[a], Stella Nikolaou[b]

a VTT Technical Research Centre of Finland Ltd, P.O.Box 1300, 33101 Tampere, Finland
b Center for Research & Technology Hellas (CERTH), 52, Egialias Str., 15125, Marousi, Athens, Greece
** johan.scholliers@vtt.fi*

Abstract

Automated Valet Parking can be made more efficient with Internet of Things (IoT) techniques for e.g. reservation and detection of free parking spaces. In the framework of the H2020 AUTOPILOT project, a prototype vehicle and service have been developed and demonstrated in Tampere, Finland. The vehicle uses a reservation application for assigning the parking place and a traffic camera for detection of obstacles in the projected path and on the reserved parking space. User tests have been performed to assess the user acceptance of the service. The business opportunities of the services have been assessed in workshops with stakeholders.

Keywords: Automated vehicles; Internet of things; user acceptance; Automated Valet Parking

Full paper: https://cris.vtt.fi/en/publications/automated-valet-parking-using-iot-design-user-experience-and-busi

581 Applying the FESTA methodology to automated driving pilots

Satu Innamaa[a]*, Tyron Louw[b], Natasha Merat[b], Guihermina Torrao[b], Elina Aittoniemi[a]

a VTT Technical Research Centre of Finland Ltd., P.O. Box 1000, FI-02044 VTT, Finland
b Institute for Transport Studies, University of Leeds, University Road, Leeds LS2 9JT, UK
** satu.innamaa@vtt.fi*

Abstract

This paper discusses the methodological challenges related to automated driving (AD) pilots in the real world, providing an overview of some of the solutions offered by the H2020 project L3Pilot. The FESTA methodology was developed in Europe in

2008, as part of the FP7 FESTA project, to provide guidance on a suitable methodology for conducting Field Operational Tests (FOTs). Although the overall methodology has been developed quite extensively for driver support systems, our efforts in the L3Pilot project show that the evaluation process can also be adapted to suit the needs of AD pilot projects, as long as some caveats related to the pilot nature of AD studies are acknowledged. This paper discusses how to use the FESTA methodology, and recommends an adapted FESTA V to be applied to an AD pilot made for the L3Pilot project.

Keywords: Real-world study; automated driving pilot; L3Pilot methodology; FESTA methodology

Full paper: https://cris.vtt.fi/en/publications/applying-the-festa-methodology-to-automated-driving-pilots

604 The impact of adaptive cruise control on tractive energy consumption in real-world highway multiple-car-following scenarios

Yinglong He[a], Michail Makridis[b]*, Georgios Fontaras[b], Konstantinos Mattas[b], Hongming Xu[a], Biagio Ciuffo[b]

a University of Birmingham, UK
b European Commission, Joint Research Centre (JRC), Italy
** michail.makridis@ec.europa.eu*

Abstract

Adaptive cruise control can govern the vehicle longitudinal driving for extended periods, however, how energy consumption is affected by ACC in real-world applications is poorly understood but may have implications in vehicle design and product planning. In this paper, the ACC impact on tractive energy consumption is evaluated with real-world driving data from a highway multiple-car-following campaign, including five ACC- or manually-driven passenger cars. The results demonstrate that consecutive ACC followers can cause string instability, however, the manual counterparts can mitigate the speed perturbations propagating upstream. Consequently, there exists a considerable energy consumption increase (3 – 21 %) regarding ACC car-following behaviours, compared with the manual counterparts. This finding is contrary to a recent study by General Motor because it didn't exclude the fuel-efficient ACC free-flow driving. Additionally, the energy consumed by ACC followers in the same fleet tend to increase (11.2 – 17.3 %) as the speed perturbations propagate upstream.

Keywords: tractive energy consumption; adaptive cruise control; multiple-car-following; driving behaviour; real-world data

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

811 Connected and cooperative intelligent systems to benefit vulnerable road users - case motorcyclists

Aki Lumiaho[a]*, Kimmo Kauvo[a], Pasi Pyykönen[a], Tero Peippola[a]

a Technical Research Centre of Finland Ltd, Visiokatu 4, 33560 Tampere, Finland
** aki.lumiaho@vtt.fi*

Abstract

This paper deals with preparing a powered two-wheeler with enhanced on-board data communication and environment perception technologies as well as how the

sensors of current in-vehicle driver assistance systems should be enhanced in order to improve the safety of vulnerable road users, in this paper namely the motorcyclists. The path for increased motorcyclist safety is divided in three domains, namely enhancements in mobile vehicle-to-vehicle communications, considerations regarding the algorithm improvements of in-vehicle systems, and demonstrating environment perception technologies use in powered two-wheelers. The work reported in this paper was recently initiated, and the first experiences are presented at the TRA2020 Helsinki Congress. The work is carried out in close cooperation between research, industry and user communities.

Keywords: Cooperative intelligent transport systems (C-ITS), powered two-wheelers (PTW), vulnerable road users (VRU), advanced driver assistance systems (ADAS), cooperative environment perception

890 An approach to the definition of generic rules for the traffic control in different transportation modes

Dirk Bruckmann[a]*

a Rhine-Waal University of Applied Sciences. Friedrich-Heinrich-Allee 25, 47475 Kamp-Lintfort, Germany
** dirk.bruckmann@hsrw.eu*

Abstract

The paper approves, if principles for traffic operations are mode specific and therefore safety regulations can be transferred from one mode to another. For a comparison of safety regulations between modes, the authors focus on two factors which are safety relevant when it comes to interaction between vehicles. The first factor is the adherence to rules to solve conflicts. These rules can be categorized as four types of rules: Negotiation, fixed rules, adaptive rules and dispatching. The second safety relevant factor is the minimum distance which must be maintained to ensure safety between interacting vehicles. A generalization can be made here by categorizing distance under relative braking, absolute braking, time and fixed block distance. Thus this paper investigates various transport modes to prove the applicability and transferability of generic control systems. There will be remaining differences between railways as controlled system and the other modes as vehicle interactive system.

Keywords: operational rules, interoperability, multi modality, harmonisation

1041 Nordic Way 2 Weather and road condition notifications for road users

Janne Miettinen[a]*

a Finnish Meteorological Institute, Erik Palménin aukio 1, Helsinki 00530, Finland
** janne.miettinen@fmi.fi*

Abstract

Weather conditions are often accused for road traffic accidents. Finnish Meteorological Institute's (FMI) road weather model (RWM) can predict different conditions on the road surface. Combining this information with numerical weather prediction (NWP) model data a prediction of forthcoming driving conditions can be given. As the temporal and spatial accuracy of the NWPs has increased and with present-day technologies it is possible to disseminate this information to the vehicle's cockpit to inform the driver or the vehicle of the forthcoming challenges beforehand. In the past notifications of hazardous driving conditions for vehicles

have been concentrated on winter conditions, but also summertime notifications for heavy cross winds is been produced. During the NW2 project radar based products for high risk of hydroplaning and low visibility has been developed.

Keywords: Road weather, road condition notifications, road safety, Nordic Way 2

1045 Cooperative Automated Driving for managing Transition Areas and the Operational Design Domain (ODD)

Jaap Vreeswijk[a]*, Anton Wijbenga[a], Julian Schindler[b]

a MAP traffic management B.V., Van Deventerlaan 20, 3528AE Utrecht, the Netherlands
b German Aerospace Center (DLR), Braunschweig, Germany
** jaap.vreeswijk@maptm.nl*

Abstract

When cooperative automated vehicles (CAVs) emerge on urban roads, there will be areas and situations where all levels of automation can be granted, and others where highly automated driving will not be allowed or is not feasible. Complex environments or temporary road configurations are examples of situations leading to takeover requests and are referred to as 'Transition Areas'. Such situations are assumed to cause negative impacts on traffic safety and efficiency, in particular with mixed traffic fleets. The TransAID project is developing a digital infrastructure and dedicated traffic management strategies to assist CAVs at transition areas, and preserve safe and smooth traffic flow. This paper explains the relevance of transition areas and the link to the operational design domain (ODD) of automated vehicles. By combining results from different projects with findings from stakeholder consultation workshops, ODD is discussed in detail and a conceptual structure to guide the discussion is provided.

Keywords: automation, connectivity, infrastructure, transition of control, traffic management, operational design domain, ODD, guideline, roadmap

1053 From the perspective of other road users: Acceptance of automated cars

Bernhard Schrauth[a]*, Walter Funk[a], Clemens Kraetsch[a]

a Institute for Empirical Sociology at the FAU Erlangen-Nuremberg, Marienstraße 2, 90402 Nuremberg, Germany
** bernhard.schrauth@ifes.uni-erlangen.de*

Abstract

With the advent of automated vehicles on SAE Levels 3, 4 and 5, the limit that drivers always must drive during the journey is exceeded. These changes will not only affect the users of automated cars, but all road users, including so-called "vulnerable road users" (VRU). As part of the EU-funded project "BRAVE", a population survey will be carried out in the seven countries of the participating project partners. The study aims to depict the acceptance as well as expectations and concerns of different types of road users about automated vehicles in the seven nations and to provide findings for the technological and social development process of automated vehicle technology. Preceding focus group discussions provide initial insights into the acceptance of automated cars from the point of view of other road user groups and give directions for the creation of the questionnaire for the online survey.

Keywords: automated vehicles; acceptance; trust; vulnerable road users; social survey

1088 Development and implementation of innovative signal control with autonomous and connected vehicles

Lily Elefteriadou[a]*, Mahmoud Pourmehrab[b], Aschkan Omidvar[a], Patrick Emami[c], Sanjay Ranka[c]

a Civil Engineering, University of Florida, 365 Weil Hall, Gainesville 32611, USA
b Optym, 7600 NW 5th Place, Gainesville, FL 32607, USA
c Computer and Information Science and Engineering, University of Florida, Gainesville 32611, USA
** elefter@ce.ufl.edu*

Abstract

Autonomous vehicle technology has advanced significantly in recent years. In addition, communication capabilities between vehicles and the infrastructure present significant opportunities for improving mobility and safety. This research capitalizes on these capabilities and develops a methodology to jointly optimize signal control and vehicle trajectories at isolated signalized intersections. This paper summarizes the algorithm developed to produce optimal vehicle trajectories and optimal signal control for signalized intersections. The algorithm considers the presence of conventional vehicles, and adjusts the settings when these do not move as anticipated. Simulation results show increases in throughput, particularly as demands and the percentage of Connected and Autonomous Vehicles (CAVs) increase. Field testing in a closed course environment has provided significant insights for implementation of the algorithm in a real-world setting. Field testing of the entire system is planned for spring and summer 2020 at a signalized intersection in Gainesville, Florida, on the University of Florida campus.

Keywords: autonomous vehicles; connected vehicles; signal control optimization

1.12 Scientific and technical session 12: Future of automated transport

62 Specifications for multi-brand truck platooning

Edoardo Mascalchi[a]*, Alessandro Coda[a], Dehlia Willemsen[b]

a CLEPA, European Association of Automotive Suppliers, Cours Saint-Michel 30G, Bruxelles 1040, Belgium
b TNO, Department of Integrated Vehicle Safety, Automotive Campus 30, Helmond, the Netherlands
** e.mascalchi@clepa.be*

Abstract

Platooning technology has made significant advances in the last decade, but to achieve the next step towards deployment of truck platooning, an integral multi-brand approach is required. It is the ambition of ENSEMBLE to realize pre-standards for interoperability between trucks, platoons and logistics solution providers, to speed up actual market uptake and to enable harmonization of legal frameworks in the member states. This paper provides the definition of the specifications of the whole multi-brand truck platooning concept to be implemented in the testing and demonstration trucks of the six European OEMs in the project. It describes the functional architecture and captures the minimum set of operational layer requirements and tactical layer specifications for platooning. The building blocks of truck platooning consist of in-vehicle requirements (longitudinal control, sensors, HMI), infrastructure communication (V2I), communication between the trucks in the platoon (V2V), and platooning strategy (maneuver coordination).

Keywords: truck platooning, specifications, automated driving

Full paper:
https://platooningensemble.eu/storage/uploads/documents/2020/03/13/TRA2020_01112019_mascalchi.pdf

170 Vehicle occupancy automatic sensor fosters HOV lane implementation

F. Aliaga[a], P. Petitjean[b], E. Purson[b], C. Stein[b], L. Taraschini[b], A. Bacelar[a]*, E. Klein[b]

a CEREMA CENTRE-EST, Bron, France
b CEREMA EST, Metz, France
** alexis.bacelar@cerema.fr*

Abstract

This study reports the first European evaluation of a vehicle occupancy sensor on a high traffic highway. Until 2013, no road side control system was able to detect occupants in vehicles with the level of efficiency and reliability required for automatic control of High Occupancy Vehicle (HOV) lanes. Non accurate Vehicle occupancy verification is the principal impediment to more effective HOV lane enforcement. A system measuring the vehicle occupancy, was evaluated on the two lanes of the A86 motorway in Paris. The predictions of the automatic vehicle occupant detection system are accurate at more than 90 % for detecting Single Occupancy Vehicle. An innovative methodology for evaluating occupancy sensor is described in the paper.

Keywords: Occupancy; Sensor; Carpooling; HOV lane

276 Predicting impacts of connected and automated vehicles

Rune Elvik[a]*, George Yannis[b], Pete Thomas[c]

a Institute of Transport Economics, Gaustadalleen 21, 0349 Oslo, Norway
b National Technical University of Athens, 9 Iroon Polytechniou Street, Athens, Greece
c Loughborough University, Epinal Way, Loughborough LE11 3TU, United Kingdom
** re@toi.no*

Abstract

This paper shows how impacts of connected and automated vehicles can be predicted. To develop a predictive method, a taxonomy of potential impacts was developed. A total of 33 potential impacts were identified. Impacts were classified with respect to whether they occur immediately or in the longer term and whether they occur within the transport system or outside it. Numerical predictions of impacts have been developed in terms of dose-response curves. The dose is the market penetration of automation technology, stated as a percentage of vehicles in traffic that have a certain level of automation (SAE-scale). The response is a specific impact, stated as a function of market penetration level. Dose-response curves have so far been developed for accidents (three categories), road capacity, junction capacity, congestion delays, travel time. The paper gives examples of the dose-response curves.

Keywords: Connected and automated vehicles; impacts; market penetration; dose-response curves

295 Scenario-based validation of highly automated vehicles - Results of the ENABLE-S3 research project

Andrea Leitner[a], Michael Paulweber[a]*

a AVL List GmbH, Hans Listplatz 1, 8010 Graz, Austria
** michael.paulweber@avl.com*

Abstract

Automated cyber-physical systems will help to solve many societal challenges in different domains (as automotive, rail, aerospace, farming or health). For example, automated vehicles will serve the need of aging population for environmental conscious mobility. The validation of these automated safety critical systems requires the identification of relevant scenarios, the automatic derivation of manageable sets of test cases from scenarios as well as the application of automated virtual verification and validation methods in combination with physical test – in summary called scenario-based V&V of highly automated cyber-physical systems.

Keywords: Validation; Automated Driving; Scenario based testing; Scenario extraction; Sensor modelling

342 A compendium of infrastructure solutions to support automated mobility on all roads

Philippe Nitsche[a]*, Michael Aleksa[a], Thomas Piribauer[b]

a AIT Austrian Institute of Technology, Giefinggasse 2, 1210 Vienna, Austria
b PRISMA solutions EDV-Dienstleistungen GmbH, Klostergasse 18, 2340 Mödling, Austria
** philippe.nitsche@ait.ac.at*

Abstract

Introducing connected and automated mobility on public roads is expected to solve many traffic safety and capacity problems. However, in the ongoing and presumably long-lasting transition period with conventional road users alongside automated vehicles, there are multiple challenges to overcome. In this context, the interplay between vehicles and infrastructure becomes more important than ever. This article compiles efficient road infrastructure solutions to support automated driving, based on the Austrian research project via-AUTONOM. On the one hand, solutions include measures to adapt the physical road geometry as well as road(side) elements. On the other hand, recommendations for digital infrastructure are made that encompass infrastructure-to-vehicle connectivity and different layers of map data. It can be concluded that additional road infrastructure can expand an automated vehicle's operational design domain (ODD), but it should not be a necessity for the vehicle's intended functionality.

Keywords: Automated Driving; Road infrastructure; Digital map; Connectivity

350 Next-generation communications for V2X applications

Meng Lu[a]*, Robbin Blokpoel[a], Jaime Ferragut[b], Matti Kutila[c], Tao Chen[d]

a Dynniq, Basicweg 16, 3821 BR Amersfoort, The Netherlands
b European Commission – Joint Research Centre, Via E. Fermi, 2749, 21027 Ispra VA, Italy
c VTT Technical Research Centre of Finland Ltd., Visiokatu 4, 33101 Tampere, Finland
d VTT Technical Research Centre of Finland Ltd., Biologinkuja 3, 02150 Espoo, Finland
** meng.lu@dynniq.com*

Abstract

Under the Horizon 2020 ICT-22-2018 call (EU-China 5G collaboration), trials will be conducted addressing two specific scenarios: scenario n°1 - enhanced Mobile Broadband (eMBB) on the 3.5GHz band; and scenario n°2 - Internet of Vehicles (IoV) based on LTE-V2X using the 5.9 GHz band for Vehicle-to-Vehicle (V2V) and the 3.5 GHz band for Vehicle-to-Network (V2N). This paper targets scenario n°2 in the context of the H2020 project 5G-DRIVE (HarmoniseD Research and TrIals for serVice Evolution between EU and China). Concretely, the paper presents the 5G-DRIVE use cases in the domain of Cooperative Intelligent Transport Systems (C-ITS) for automotive industry. In addition, it describes the physical architectures for each use case. Finally, it provides an overview of the V2X joint trials to be conducted in the EU and China in the context of the 5G-DRIVE project.

Keywords: V2X; LTE-V2X; use case; 5G; interoperability

Full paper: www.linkedin.com/pub/meng-lu/4b/12b/758

422 Overview of connected and automated driving test sites

Adewole Adesiyun[a]*, Isabela Erdelean[b], Abdelmename Hedhli[c], Martin Lamb[d], Wolfgang Ponweiser[b], Niklas Strand[e], Ewa Zofka[f]

a Forum of European National Highway Research Laboratories (FEHRL), Blvd de la Woluwe 42/B3, 1200 Brussels, Belgium
b Austrian Institute of Technology (AIT), Giefinggasse 4, 1210 Vienna, Austria
c Institut français des sciences et technologies des transports, de l'aménagement et des réseaux (IFSTTAR), 14-20 Boulevard Newton, Cité Descartes, Champs sur Marne, F-77447 Marne la Vallée Cedex 2, France
d Maple Consulting, Britannia House, Caerphilly Business Park, Van Road, Caerphilly CF83 3GG, Wales
e Swedish National Road and Transport Research Institute (VTI), Olaus Magnus 35, Linköping, Sweden
f Erica Consulting, Liliowa 3, 04-953 Warsaw, Poland
** adewole.adesiyun@fehrl.org*

Abstract

Connected and automated vehicles potentially offer solutions to some key challenges for National Road Administrations (NRAs), such as reduction of accidents, increasing network capacity etc. As a result of this potential, both industry and certain national governments are undertaking trials that are mainly focused on technological challenges such as the ability of vehicles to drive safely in "random" situations etc. Far less attention has been paid to questions around the implications for NRAs. The overall aim of the STAPLE project is to provide a comprehensive review of technological and non-technological aspects of the most relevant connected and automated driving test sites in order to understand the impact of these sites on the NRAs' core business and functions.

Keywords: connected and automated vehicles, catalogue of test sites, National Road Authorities, key performance areas, key performance indicators (KPI)

444 A Review on Societal Impacts of the Future Connected and Automated Transport Systems

Julia Roussou[a]*, George Yannis[a], Bin Hu[b], Evita Papazikou[c], Hitesh Boghani[c], Ashleigh Filtness[c], Pete Thomas[c]

a Department of Transportation Planning and Engineering – National Technical University of Athens, 5 Iroon Polytechniou Str., GR-15773 Athens, Greece
b AIT Austrian Institute of Technology, Center for Mobility Systems,, Giefinggasse 2, 1210 Vienna, Austria
c Loughborough University, Loughborough, LE11 3TU, United Kingdom
** jroussou@mail.ntua.gr*

Abstract

Technical development in the field of vehicle automation is progressing rapidly, enhancing the expectation that connected and automated transport systems (CATS) will be introduced in increasing numbers over the next decade. The foreseen implementation of CATS has raised high expectations in terms of safety, environment, society and economic growth. The Horizon 2020 project Levitate will investigate the potential impacts of CATS, through an innovative multi-disciplinary impact assessment framework and will incorporate the method within a new web-based policy support tool to enable city and other authorities to forecast impacts of CATS on urban areas. The objective of this study is to provide a review of future impacts of CATS, through an extensive targeted review of recent literature on the impacts of connected and automated urban transport, passenger vehicles and freight transport, as well as a comprehensive analysis build on the knowledge gained through existing European level research.

Keywords: connected and automated transport systems; public transport; passenger vehicles; freight transport; impacts; penetration level

523 Vehicle dynamics-based simulation study for the impact of Cooperative and Automated Vehicles on uphill freeway sections

Michail Makridis[a], Ludovic Leclercq[b], Konstantinos Mattas[a], Biagio Ciuffo[a]

a European Commission, Joint Research Centre (JRC), Italy

b Université de Lyon, France

** michail.makridis@ec.europa.eu*

Abstract

One of the common reasons for capacity bottlenecks in freeway networks is uphill road sections. Going uphill, drivers reduce speed and when the traffic is dense, they cannot compensate for the speed loss. Most importantly, the perturbation of the platoon leader creates a flow disturbance that it is propagated upstream, leading, in cases, to stop-and-go traffic conditions. Here, we present a microsimulation study to provide preliminary results regarding the potential impact on traffic flow of automated vehicles (AVs) and of Connected-AVs able to cooperate with the infrastructure. Simulation of manually-driven vehicles is performed with a vehicle dynamicsbased model and a pool of generated driving profiles ranging from timid to aggressive drivers. Impact of automation is assessed by reducing the variability in the driving logic of the simulated vehicles, while the cooperation is explicitly assessed using a realistic control logic based on the capability of each individual car to homogenize the produced accelerations uphill and thus smooth the traffic flow. Results on three different scenarios confirm that homogeneity in terms of vehicle dynamics and driver behavior can play an important role towards improving traffic flow. The cooperation with the infrastructure can limit high variations in the vehicles' accelerations and thus potential traffic jams.

Keywords: Vehicle to Infrastructure, Automated Vehicles, Vehicle Dynamics, Traffic simulation

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

573 Towards a method for getting a grip on societal impacts of automated driving

Elina Aittoniemi[a]*, Yvonne Barnard[b], Gillian Harrison[b], Satu Innamaa[a], Fanny Malin[a], Pirkko Rämä[a]

a VTT Technical Research Centre of Finland Ltd., P.O.Box 1000, FI-02044 VTT, Finland
b Institute for Transport Studies, University of Leeds, Leeds, LS2 9JT, United Kingdom
** elina.aittoniemi@vtt.fi*

Abstract

Impact assessment of automated driving is challenging due to uncertainties in how automated driving will develop as well as a lack of evidence of the system level impacts based on real conditions in the real world. Especially, there is a lack of realistic on-road field operational tests of long-term impacts on how automation will affect our lives. Therefore, other approaches need to be used in order to assess potential impacts on the society and quality of life. This paper proposes a systematic methodology gathering and combining data from different sources: limited pilot tests, online surveys, expert and stakeholder interviews, focus groups, literature and modelling. The impact path framework developed by experts from the EU, US and Japan was used as a basis. Future studies can use the methodology to help determine the sizes and directions of impacts.

Keywords: impact assessment; automated driving; quality of life; methodology

576 NGT CARGO – A market-driven concept for more sustainable freight transport on rail

David Krüger[a]*, Gregor Malzacher[a], Toni Schirmer[b], Mathias Böhm[b]

a German Aerospace Center, Institute of Vehicle Concepts, Pfaffenwaldring 38-40, 70563 Stuttgart, Germany
b German Aerospace Center, Institute of Vehicle Concepts, Rutherfordstraße 2, 12489 Berlin, Germany
** david.krueger@dlr.de*

Abstract

Greenhouse gas emissions from the freight transportation sector must be significantly reduced in line with the European Union’s commitments. Shifting freight transportation from carbon-intensive modes such as air and road to more environmentally friendly modes, such as rail, can be an effective means of accomplishing this goal. In order to compete with the flexibility, speed and price of current road transportation, rail freight needs to apply new technologies and strategies such as automation, energy-dense batteries and virtual coupling between trains. NGT CARGO is a high speed freight train concept, the individual cars of which are capable of independent autonomous travel for short distances and which, as a complete train with locomotives, is capable of high speed platooning operations together with other appropriately equipped passenger and freight trains. With this concept, the capabilities and capacities of rail freight transportation can be expanded while maximizing the utilization of existing infrastructure.

Keywords: Autonomous driving; freight; high speed rail; climate; modal shift

Full paper: https://elib.dlr.de/134378/

710 Sensor fusion: How fused data can support the development of automated driving in virtual environment and provide data for guiding vehicles

Siegfried Seebacher[a]*, Jacqueline Erhart[a], Arnold Präsent[b]

a ASFINAG Maut Service GmbH, Am Europlatz 1, 1120 Vienna, Austria

b Tieto Austria GmbH, Handelskai 94-96, 1200 Vienna, Austria
** Siegfried.Seebacher@asfinag.at*

Abstract

The use of both vehicle and infrastructure sensor data by means of algorithmic sensor fusion considerably increases the quality of data that can be used for virtual vehicle testing and will increase in the future the environmental perception horizon of a vehicle. While infrastructure was not considered a reliable source for data in the past, the automotive industry is identifying the benefits of a joint data provision for autonomous driving and the importance of the interaction with infrastructure. Europe's roads are equipped with different sensor technologies and the deployment of C-ITS systems has started recently. Worldwide, there are several projects addressing the challenges of sensor fusion, but only few already use the data for simulation purposes or for generating new C-ITS messages. ASFINAG, the Austrian motorway operator, has equipped a test track with advanced sensor technologies and is already able to generate vehicles' trajectories applying artificial intelligence and predictive algorithms.

Keywords: sensor fusion; automated driving; simulation; edge computing; perception horizon; meta data; AI approach

869 Scenarios of Automated Mobility in Austria 2030

Aggelos Soteropoulos[a]*, Andrea Stickler[b], Martin Berger[a], Jens S. Dangschat[b]

a Centre of Transportation System Planning, Technical University of Vienna, Augasse 2-6, 1090 Vienna, Austria
b Centre of Sociology, Technical University of Vienna, Augasse 2-6, 1090 Vienna, Austria
** aggelos.soteropoulos@tuwien.ac.at*

Abstract

Developments in the field of automated mobility will greatly change our mobility and the possibilities to get from one place to another. This paper presents different scenarios for personal mobility in Austria in the year 2030 anticipating the possibilities and developments in the field of automated vehicles (AVs). The scenarios were developed using a systematically formalized scenario technique and expand the social and political discourse on automated mobility, which is currently characterized by a lack of experience and visibility as an established transport service. It is not a single image of the future that suggests exclusively a future transport with private AVs, but multiple images of the future with many modes and forms of use such as shared mobility or alternative drive systems, that stand for an uncertain future of automated mobility. The focus should be on a transformation process in the sense of a sustainable, emission-free mobility.

Keywords: Automated Vehicles; Scenarios; Mobility; Austria; Automation; Transport

1.13 Scientific and technical session 13: Safety analysis excellence

90 An analysis of European crash data and scenario specification for heavy truck safety system development within the AEROFLEX project

Ron Schindler[a]*, Michael Jänsch[b], Heiko Johannsen[b], András Bálint[a]

a Department of Mechanics and Maritime Sciences Chalmers University of Technology, Göteborg, Sweden
b Accident Research Unit, Medizinische Hochschule Hannover, Hannover, Germany

* ron.schindler@chalmers.se

Abstract

Heavy goods vehicles (HGVs) are involved in 4.5% of police-reported road crashes in Europe and 14.2% of fatal road crashes. Active and passive safety systems can help to prevent crashes or mitigate the consequences but need detailed scenarios to be designed effectively. The aim of this paper is to give a comprehensive and up-to-date analysis of HGV crashes in Europe. The analysis is based on general statistics from CARE, results about trucks weighing 16 tons or more from national crash databases and a detailed study of in-depth crash data from GIDAS. Three scenarios are identified that should be addressed by future safety systems: (1) rear-end crashes with other vehicles in which the truck is the striking partner, (2) conflicts during right turn maneuvers of the truck and a cyclist and (3) pedestrians crossing the road perpendicular to the direction of travel of the truck.

Keywords: heavy goods vehicle; crash scenarios; GIDAS; CARE; crash causation; European national crash data

120 Modelling the economic impacts of road crashes in Greece

Eleftherios-Marios Kourtis[a], Apostolos Ziakopoulos[a]*, Athanasios Theofilatos[b], George Yannis[a]

a National Technical University of Athens, Department of Transportation Planning and Engineering, 5 Heroon Polytechniou str., GR-15773, Athens, Greece
b Loughborough University, School of Architecture, Building and Civil Engineering, Loughborough, LE11 3TU, United Kingdom
** apziak@central.ntua.gr*

Abstract

This research aims to quantify the willingness-to-pay attitude of the Greek public towards mitigating road crash risk and thus crash involvement in the macroscopic scale. An online questionnaire survey was designed and distributed to participant drivers. Two scenarios of willingness-to-pay in order to reduce crash involvement probability were included: 20% and 50% reductions in probability; 238 valid responses were collected and analyzed. Ordinal and multinomial logistic regression models were used to correlate driver preferences between the two scenarios and several independent variables, in contrast with the do-nothing (0% reduction) scenario. Results indicated that most drivers are very positively predisposed towards a road crash risk reduction. The choice between low and high reductions depends on trip duration and cost increases, family situation, driving experience and annual family income. The calibrated WTP models are used in a case study to calculate the human cost (value of statistical life) in Greece during 2016.

Keywords: road crashes; human cost; stated preference; willingness to pay; ordinal logistic regression; multinomial logistic regression

Full paper: https://www.nrso.ntua.gr/geyannis/publications/

288 An evaluation of the safety impacts of bus priority routes in major Israeli cities

Victoria Gitelman[a]*, Anna Korchatov[a]

a Transportation Research Institute, Technion City, Haifa 32000, Israel
** trivica@technion.ac.il*

Abstract

Bus priority routes promote public transport use in urban areas while their safety impacts are known insufficiently. This study examined safety impacts of bus priority routes, which were introduced on busy urban roads, in three Israeli cities. Accident changes were estimated using after-before evaluations with comparison-groups. The findings demonstrated that introducing bus priority routes was generally associated with increasing accident trends. Streets with curbside bus lanes showed increasing trends in most accident types, while on streets with center-lane bus-ways near two lanes for general traffic mixed trends were observed and on streets with center-lane bus routes near one traffic lane – mainly decreasing trends. The findings support the international experience relating lower accident risks to center-lane bus routes. On all types of bus routes increasing trends were found in pedestrian accidents at junctions emphasizing the need for new engineering solutions to reduce the risk of pedestrian injury.

Keywords: bus priority lanes; safety evaluation; bus-route configurations; injury accidents; pedestrian accidents

Full paper:
https://www.researchgate.net/publication/339875141_An_evaluation_of_the_safety_impacts_of_bus_priority_routes_in_major_Israeli_cities

293 Numerical analysis of motorcyclist impact into beam post of steel safety barrier (SSB) with and without HDPE protection

Jovan Trajkovski[a], Miha Ambrož[a], Robert Kunc[a]*

a University of Ljubljana, Faculty of Mechanical Engineering, Chair of Modelling in Engineering Sciences and Medicine, Aškerčeva 6, 1000 Ljubljana, Slovenia
** robert.kunc@fs.uni-lj.si*

Abstract

The number of registered motorcycles in Europe is continuously growing. This increases the risk of motorcyclist-traffic barrier interaction potentially leading to serious injuries or death. On the other side, a fundamental weakness of the road barriers in Europe is that they were designed before the approval of the technical specification CEN TS 1317-8 for motorcyclist protection in 2012 after which numerous protective systems were designed and tested. This paper presents the results of numerical simulations of the HYBRID III dummy impact into the C-beam post of a safety barrier with and without HDPE (High-Density Polyethylene) protection. For both models, the numerical tests were performed with different dummy positions with respect to the longitudinal axis of the barrier and different impact velocities. The results comparison showed that HDPE protection effectively decreases injury parameters at low impact velocities up to 30 km/h, whereas its efficiency at higher impact velocities is limited.

Keywords: Traffic safety; motorcyclist safety; numerical simulation; EN 1317-8; human injury

Full paper: http://kmtm.fs.uni-lj.si/datoteke/TRA2020_29042019_Trajkovski.pdf

365 Road Safety Modelling: Macroscopic and Microscopic Approach

George Yannis[a]*, Anastasios Dragomanovits[a], Alexandra Laiou[a], Ourania Basta[a], Xuesong Wang[b]

a National Technical University of Athens, 5 Heroon Polytechniou str., 15773, Athens, Greece
b Tongji University, 4800 Cao'an Road, 201804, Shanghai, China
** geyannis@central.ntua.gr*

Abstract

As budgets for road safety measures, policies and interventions are limited, road safety stakeholders worldwide have to decide about the most effective use of available funds. Policy makers need prediction tools and decision support systems, developed through the utilization of quantitative road safety modelling research, allowing them to analyze potential safety issues, identify appropriate safety improvements and estimate their potential effect in terms of crash reduction. Two distinct approaches can be defined in road safety modelling research, as far as the nature of the developed models and results is concerned: the microscopic (i.e. accident prediction at specific sites) and the macroscopic approach (accidents and casualty forecasts over larger geographic regions). The paper aims to present a systematic review of existing knowledge and international pertinent research on both microscopic and macroscopic road safety modelling, pointing out how they actually complement each other to the benefit of road safety practitioners.

Keywords: safety, injuries, fatalities

507 Human-centered measures to enhance safety at level crossings

Annika Dreßler[a]*, Anne Silla[b], Annie Kortsari[c], Grigore M. Havârneanu[d], Sarah Whalley[e], Jan Grippenkoven[a]

a German Aerospace Center, Institute of Transportation Systems, Lilienthalplatz 7, 38108 Braunschweig, Germany
b VTT Technical Research Centre of Finland Ltd, P.O. Box 1000, FI-02044 VTT, Finland
c Centre for Research and Technology Hellas – Hellenic Institute of Transport, 52 Egialias str., 15231, Athens, Greece
d International Union of Railways (UIC), 16 rue Jean Rey, F-75015 Paris, France
e Spanish Railways Foundation (FFE), Santa Isabel 44, 28012 Madrid, Spain
** annika.dressler@dlr.de*

Abstract

Road user behavior plays a major role in accidents at level crossings. Therefore, measures to improve safety at level crossings should be developed with a human factors perspective. Moreover, they should be affordable and applicable to a large number of crossings to achieve tangible safety effects. We report on work to collect and design human-centered low-cost measures to enhance the safety of level crossings that was part of the European project SAFER-LC. First, a pool of design ideas was collected from the research literature, models of road user behavior, and a design workshop with road and rail experts. Second, the measures collected were filtered, categorized and ranked in a three-step process including a classification of their application context and an assessment of their prospects to reduce accident risk. The resulting set comprises 89 measures and will be further developed into a web-based toolbox for road and rail safety practitioners.

Keywords: human factors, road users, errors, violations, rail safety, cost-effective

Full paper: https://elib.dlr.de/134335/

512 Identification of patterns in motorcycle riding dynamics at known accident sites

Klemens Schwieger[a]*, Horst Ecker[b], Andreas Hula[a], Manfred Neumann[b]

a Austrian Institute of Technology – Center for Mobility Systems, Giefinggasse 4, 1210 Vienna, Austria
b TU Wien - Institute of Mechanics and Mechatronics, Getreidemarkt 9, 1060 Vienna, Austria
** klemens.schwieger@ait.ac.at*

Abstract

The positive trend of declining accident numbers in Austria's traffic sector in general, is not seen for powered twowheelers (PTWs). Furthermore, fatality numbers of motorcycle-riders on Austria's road network is increasing and show for 2017 the highest number since 11 years. This negative trend was the reason for a research project, funded by the Austrian Road Safety fund. The scope of the project was a feasibility study on proactive, semi-automated risk assessment of roads especially designed for PTWs. For this study riding dynamics data have been gained by a motorcycle test vehicle. By analyzing measurement data collected by this highly instrumented PTW, road sections where identified, with a high probability that an accident may occur at some time in the future. The analysis results were obtained by an algorithmic methodology, based on clustering and statistical methods, for determining critical sections via similarities to known accident sites in riding dynamics data.

Keywords: motorcycle test vehicle; traffic accident research; accident investigation and analysis; traffic safety, machine learning; riding dynamics

Full paper:
https://www.ait.ac.at/fileadmin/mc/mobility/images/Projects/Verkehrssicherheit/viaMotorrad/TRA_2020_Schwieger_Ecker_Hula_Neumann.pdf

665 Road user safety attitudes towards driver fatigue

Dimitrios Nikolaou[a]*, Charles Goldenbeld[b], Apostolos Ziakopoulos[a], Alexandra Laiou[a], George Yannis[a]

a National Technical University of Athens, Department of Transportation Planning and Engineering, Iroon Polytechniou 5 str., GR-15773, Athens, Greece
b Institute for Road Safety Research SWOV, Bezuidenhoutseweg 62, 2509 AC The Hague, The Netherlands
** dnikolaou@mail.ntua.gr*

Abstract

Driver fatigue has been identified as a human factor causing major road safety problems in crash occurrence. The objective of this paper is to present the key findings on road user safety attitudes towards driver fatigue as identified by the second edition of the ESRA survey. Data from more than 35,000 road users in 32 countries were collected through an extensive online panel questionnaire survey concerning the opinion of participants on several aspects of road behaviour. The questions on fatigue concern the personal acceptability of fatigued driving, the perception of fatigued driving as crash cause and self-declared fatigued driving in the past 30 days. These variables and their interrelationships were further analysed via Random Forest analyses and binary logistic regression models. The results of this paper reveal the public attitudes and perceptions concerning driver fatigue; in addition, some solutions on preventing driver fatigue and mitigating its effects are discussed.

Keywords: driver fatigue; road safety; ESRA; attitudes; binary logistic regression; Random Forest Analysis

700 Reaction Time Variability Association with Unsafe Driving

M. G. Altarabichi[a]*, M. U. Ahmed[a], M. R. Ciceri[b], S. Balzarotti[b], F. Biassoni[b], D. Lombardi[b], P. Perego[b]

a School of Innovation Design and Engineering (IDT), Mälardalen University, Västerås, Sweden
b Università Cattolica del Sacro Cuore, L.go Gemelli, 1, 20123 Italy
** mohammed.ghaith.altarabichi@mdh.se*

Abstract

This paper investigates several human factors including visual field, reaction speed, driving behavior and personality traits based on results of a cognitive assessment test targeting drivers in a Naturalistic Driving Study (NDS). Frequency of being involved in Near Miss event (fnm) and Frequency of committing Traffic Violation (ftv) are defined as indexes of safe driving in this work. Inference of association shows statistically significant correlation between Standard Deviation of Reaction Time (σRT) and both safe driving indexes fnm and ftv. Causal relationship analysis excludes age as confounding factor as variations in behavioral responses is observed in both younger and older drivers of this study.

Keywords: Road Safety, Naturalistic Driving, Vienna Test, Cognitive Assessment, Reaction Time Variability

Full paper: http://mdh.diva-portal.org/smash/get/diva2:1366267/FULLTEXT03.pdf

743 Impact of socio-territorial disparities on road risk

Mohamed Mouloud Haddak[abc]*, Tadeg Ponnet[ab]

a University of Lyon, F-69622, Lyon, France
b University of Lyon 1, UCBL, F-69373, Lyon, France
c Epidemiological Research and Surveillance Unit in Transport, Occupation and Environment (UMRESTTE), French Institute of Science and Technology for Transport, Development and Networks (IFSTTAR), 25, av. François Mitterrand, F-69675, Bron, France
** Mouloud.haddak@ifsttar.fr*

Abstract

Since 2010, there has been a slowdown in the decline in the number of road deaths in France, and then, from 2013, there is even a deterioration in the situation. In road safety, road traffic risk factors are most often broken down into two groups: contextual or environmental risk factors and family or individual risk factors. In this study, we will focus on the risk factors related to the socio-economic characteristics of the victim, both personal and contextual. In this study, we use the national road safety data for the year 2018. We used this file to analyze the risk factors for serious or fatal injuries compared to minor injuries. We analyzed the road risk, taking into account the different characteristics of the territories, in order to better target the areas most exposed to road risk: regional division, size of municipalities, type of area (urban, peri-urban or rural). Indeed, socio-territorial disparities in road risk persists in France for many years. Although, overall, rural areas are the most affected by road safety, they remain very diverse. Finally, we will discuss these results in relation to the literature, as well as suggested preventive or corrective measures.

Keywords: Road Safety; Socio-territorial inequalities; Risk factors; Contextual risk factors

Full paper: https://hal.archives-ouvertes.fr/hal-02507149

815 Road safety capacity building actions in Africa. Results from the SaferAfrica project

Sandra Vieira Gomes[a]*, Ludo Kluppels[b], João Lourenço Cardoso[a]

a Laboratório Nacional de Engenharia Civil, Av. do Brasil, 101, 1700-066 Lisbon, Portugal
b VIAS Institute, Chaussée de Haecht 1405, 1130 Bruxelles, Belgium
** sandravieira@lnec.pt*

Abstract

SaferAfrica - Innovating dialogue and problems appraisal for a safer Africa is the designation of a research project funded by the European Commission under the Horizon2020 programme, than runs from October 2016 to October 2019. The project activities are anchored in the "Safe System" approach and are organized into four major technical Work packages: data and knowledge; assessment of road safety management capabilities; capacity building and training; and sharing of best practices in road safety interventions. This paper summarizes the work done within Work Package 6 which aims at identifying training needs and developing capacity building programs focused on road safety in African countries. To fulfil this goal, two main tools were developed: a series of road safety e-learning courses ready to use, and a train-the-trainer manual, which was validated by a trial session. In this presentation as description of these tools is provided.

Keywords: SaferAfrica; capacity building; Train-the-Trainer; e-learning courses; Africa

846 Differences in use of dynamic capacities between cars and motorcycles drivers

Claire Naude[a]*, Christophe Perrin[a], Romane Cornen[a], Thierry Serre[a]

a IFSTTAR TS2 Laboratory of Accident Mechanism Analysis, 304 chemin de la Croix Blanche, Salon de Provence, 13300, France
** claire.naude@ifsttar.fr*

Abstract

The higher risk of severe accident occurrence for motorcyclists and the lack of knowledge on their behavior and skills raise the need for collecting exposure data to complete accident reports. This paper explores differences between motorcyclists and car drivers in term of real use of vehicle dynamic capacities. It is based on three Naturalistic Studies with cars and/or motorcycles (55/57 in all) equipped with Event Data Recorders and collecting data during a few months to a year. The motorcyclists accelerate and brake more often and with a higher intensity. The PTWs endure medium or high yaw rate slightly more often than cars, and they sometimes reached very high levels never endured by cars. The comparison of speeds is more contrasted and does not confirm the common misconception that motorcyclists always ride faster than drivers do.

Keywords: car, motorcycle; vehicle dynamics; road safety; driver behaviour

860 State of the art on measuring driver state and technology-based risk prevention and mitigation Findings from the i-DREAMS project

Susanne Kaiser[a], Christos Katrakazas[b]*, Eva Aigner-Breuss[a], Fran Pilkington-Cheney[c], Apostolos Ziakopoulos[b], George Yannis[b], Tom Brijs[d]

a KFV, Austrian Road Safety Board, Schleiergasse 18, 1100 Wien, Austria
b National Technical University of Athens, Department of Transportation Planning and Engineering, 5 Heroon Polytechniou str., GR-15773, Athens, Greece
c Loughborough University, Transport Safety Research Centre, LE11 3TU Loughborough, United Kingdom
d UHasselt, Transportation Research Institute (IMOB), Science Park – Building 5, 3590 - Diepenbeek, Belgium
** ckatrakazas@mail.ntua.gr*

Abstract

Advanced vehicle automation and the incorporation of more digital technologies in the task of driving, bring about new challenges in terms of the operator/vehicle/environment framework, where human factors play a crucial role. This paper attempts to consolidate the state-of-the-art in driver state measuring, as well as the corresponding technologies for risk assessment and mitigation, as part of the i-DREAMS project. Initially, the critical indicators for driver profiling with regards to safety risk are identified and the most prominent task complexity indicators are established. This is followed by linking the aforementioned indicators with efficient technologies for real-time measuring and risk assessment and finally a brief overview of interventions modules is outlined in order to prevent and mitigate collision risk. The results of this review will provide an overall multimodal set of factors and technologies for driver monitoring and risk mitigation, essential for road safety researchers and practitioners worldwide.

Keywords: road safety; driver state measuring; driver state monitoring; literature review; risk prevention

1136 Crash risk of e-bike riders and riders of conventional bikes in Denmark

Mette Møller[a]*, Kira Hyldekær Janstrup[a], Luca Furlanetto[a]

a Technical University of Denmark, Kgs. Lyngby DK-2800, Denmark
** mette@dtu.dk*

Abstract

In recent years, there has been a dramatic increase in the use of e-bikes in a number of countries. However, knowledge about the crash risk associated with riding an e-bike remains sparse and contradictory. To reduce this knowledge gap, the purpose of this study is: 1) To map and compare crash involvement of conventional bikes and e-bikes in Denmark. 2) To estimate the overall risk of crash involvement of e-bike riders and conventional bike riders, and to estimate the risk of involvement in a fatal or serious injury crash for e-bike riders and conventional bike riders. The study regards the years 2015-2018. The analysis are based on police registered crash data and exposure data from the Danish National Travel Survey. Results show that the risk of serious injury and death is higher for e-bike riders.

Keywords: e-bike; cyclist; crash risk; age differences; road safety; accident analysis

1.14 Scientific and technical session 14: Travel behaviour and needs

222 Analysis of social media use for urban mobility and travel choices

Maria Karatsoli[a]*, Eftihia Nathanail[a]

a University of Thessaly, Pedion Areos, Volos 38334, Greece
** makarats@uth.gr*

Abstract

The explosive growth of social media has rendered them powerful communication channels. User generated content is an important source of inspiration and often affects the travel choices of a user. This content triggers new activities and affects mobility decisions of others, creating a circle of influence among web friends. A place visit, an event attendance, a change of transport mode or destination or a

cancellation of plans are actions that can be triggered through people's interactions on social media. The main objective of this paper is to investigate the impact of social media use on mobility decisions. A digital questionnaire was formulated to investigate the role of social media use on commuters' mobility and travel choices. The final sample size comprised 888 users and was grouped according to gender. In addition, statistical analysis results for women and men are included and further described in this paper.

Keywords: travel behavior; questionnaire survey; activity planning; big data; user generated content

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

500 Mapping everyday leisure travel in the effort of finding characteristics important for reducing car use

Emma Strömblad[a]*, Lena Winslott Hiselius[a], Lena Smidfelt Rosqvist[b]

a Lund University, Department of Technology and Society, Box 118, SE-221 00 Lund, Sweden
b Trivector Traffic, Vävaregatan 21, SE-222 36 Lund, Sweden
** emma.stromblad@tft.lth.se*

Abstract

Everyday trips to leisure activities account for a significant part of daily travel by car, and consequently need to be addressed when finding measures to mitigate climate change. In order to find appropriate measures there is a need for more knowledge about the anatomy of these trips. In this paper, trips by car for social and recreational purposes are mapped based on extensive national travel survey data from Sweden. The study shows that trips for everyday leisure purposes account for 33 percent of the total distance traveled by car. The results further reveal that the trip distance for social and recreational trips increases with the number of accompanying persons, that 25-35 percent of the leisure trips studied are shorter than 5 kilometers and that the overall pattern of men travelling longer distances than women by car also holds for everyday leisure trips.

Keywords: everyday leisure travel; travel behavior; passenger transport; car mileage; climate change

504 Co-creating people-focussed mobility solutions one neighbourhood at a time

Ralf Brand[a]*

a Rupprecht Consult Forschung und Beratung GmbH, Clever Str. 13-15, 50668 Köln, Germany
** r.brand@rupprecht-consult.eu*

Abstract

Two aspects characterize the Horizon 2020 project SUNRISE (2017-2021): One defines the neighbourhood as spatial dimension with its specific advantages and disadvantages in terms of size, social dynamics, communication structures, challenges etc. The other focus revolves around "co-creation" between the city administration and local citizens / stakeholders along all phases of the innovation chain. These SUNRISE principles are being deployed in "action neighbourhoods" within the six partner cities across Europe. SUNRISE uses the urban living lab approach to try out, concretely, what happens when co-creation principles are systematically deployed at the neighbourhood level. The processes and effects are

carefully documented and analysed and related lessons shared. SUNRISE is thus working towards robust answers to questions like: "Do participatory processes lead to more innovative solutions, to more widely accepted, to more efficient or more effective solutions, to more equitable or more affordable ones?" This paper articulates related empirical findings.

Keywords: Neighbourhood; Co-creation; Co-implementation; Sustainability; Mobility; SUMP

626 An assessment of digital travel information services serving persons with reduced mobility in Europe

Tharsis Teoh[a]*, Bryan Matthews[b], Daniela Carvalho[c]

a Panteia, Bredewater 26, 2715 CA Zoetermeer, The Netherlands
b Institute for Transport Studies, 34-40 University Road, LS2 9JT Leeds, United Kingdom
c Transportes, Inovação E Sistemas, Avenida Marquês de Tomar, Nº 35 - 3º Drt, 1050-153 Lisboa
** t.teoh@panteia.nl*

Abstract

Persons with Reduced Mobility (PRM) may face distinct barriers when accessing digital travel information services, such as the lack of specialized information that supports them in managing mobility challenges, as well as services that provide and present information in ways not entirely suitable to their cognitive and sensory impairments. The paper presents an inventory of 125 digital travel information services provided in Europe, a classification and an assessment from the perspective of PRM travellers. The classification framework was developed based on concepts derived from literature and discussed with user representatives in a workshop. The results provide several interesting trends, especially on how services present information on locations, wayfinding, and accessibility of vehicles and services within the station. Seven preliminary recommendations based on concrete examples of existing services are discussed. Overall, the level of PRM-relevant information was low, which indicates a need for the industry to be spurred and supported.

Keywords: accessibility, intelligent transport systems, travel information services, public transport, people with disabilities, persons with reduced mobility

739 The experience of travel time: worthwhile or wasted? Learnings from a large-scale smartphone-based data collection campaign and expected policy impacts (H2020 MoTiV project)

Yannick Cornet[a]*, Giuseppe Lugano[a], Dimitris Milakis[b]

a University of Žilina, Univerzitná 82115/1, Žilina, 010 26, Slovakia
b German Aerospace Center (DLR), Institute of Transport Research, Rutherfordstraße 2, 12489 Berlin, Germany
** yannick.cornet@uniza.sk*

Abstract

In conventional transport appraisal methods, travel time is considered a disutility. This view of the Value of Travel Time does not acknowledge the travel experience. The Horizon 2020 MoTiV project addresses this gap with an app that detects trips and prompts the traveller to qualify their travel experience as worthwhile, neutral or wasted. This approach offers insights into how travellers value their travel time in terms of work-related or personal productivity, fitness, or enjoyment, including the comfort factors contributing to this experience and the activities undertaken by travellers while on the move. This paper highlights the design challenges related to

the collection of data, describes the underlying conceptual framework, and offers initial insights from the data collected across Europe and their potential policy impacts. From a traveller's perspective, the travel experience matters: these results contribute to improving multimodal transport appraisal methods where travellers needs, preferences and expectations take centre stage.

Keywords: worthwhile travel time, value of travel time (VTT), travel experience, multimodal transport, door-to-door mobility, smartphone applications

756 An analysis of the potential adoption of Mobility as a Service across different age groups and lifestages: A mixed-methods approach

Valeria Caiati[a]*, Anna-Maria Feneri[a], Peraphan Jittrapirom[bc], Soora Rasouli[a], Harry Timmermans[a]

a Urban Planning and Transportation Group, Department of the Buil Environment, Eindhoven University of Technology, PO Box 513, Eindhoven 5600MB, The Netherlands
b Nijmegen School of Management, Radboud University, PO Box 9108, Nijmegen 6500HK, The Netherlands
c Center for Global Environment Research, National Institute for Environmental Studies, Tsukuba, Japan
** V.Caiati@tue.nl*

Abstract

An important issue for policy makers and transport planners who wish to promote Mobility as a Service (MaaS) initiatives is to find out whether and to what extent citizens are willing to adopt this new mobility concept. In general, young people are supposed to be the early adopters of new technologies and innovative services, but are they among the early adopters of MaaS? This study aims to explore potential MaaS adoption considering age groups and lifestages of potential users. We employ two methods: i) a Delphi study with international transport experts, with the respondents of n=89, 46 and over the three rounds; ii) a discrete choice modelling approach based on stated choice data related to 1078 respondents. Overall, the findings of the study suggest that younger age groups are more likely to subscribe to MaaS and that lifestage is a critical determinant of MaaS adoption.

Keywords: Mobility as a Service; MaaS users; Lifestage; Delphi study; Stated Choice Experiment

Full paper:
https://www.researchgate.net/publication/339875819_An_analysis_of_the_potential_adoption_of_Mobility_as_a_Service_across_different_age_groups_and_lifestages_A_mixed-methods_approach

804 Mobility as a Service – an opportunity for the urban poor? GIS-based investigation of four ride-pooling schemes in Hamburg/Germany

Christoph Aberle[a]*

a Hamburg University of Technology, Institute for Transport Planning and Logistics, Am Schwarzenberg-Campus 3 D-21073 Hamburg
**christoph.aberle@tuhh.de*

Abstract

The emergence of Mobility as a Service (MaaS) holds the potential to more flexibly satisfy passengers' needs than conventional public transport can, while being more

affordable than traditional taxi services are. This paper examines the potential benefits of ride-pooling schemes for low-income urbanites. Using a GIS-based method, I examine four schemes in Hamburg regarding their coverage of public welfare recipients. Three out of four schemes potentially serve a population that has a lower share of public welfare recipients compared to Hamburg average. Furthermore, the populations in their catchment areas have a lower share of elderly people. One scheme stands out both regarding welfare recipient share and elderly resident share. Its fare is 1 EUR per journey due to municipal requirement, whereas the other schemes charge 5-12 EUR for a 5km journey. From a low-income population's perspective, only this scheme holds the potential to enable the urban poor to partake in MaaS.

Keywords: Mobility as a Service; Urban Poverty; Ride-Pooling; Digitalisation; Europe; Hamburg; Spatial analysis

895 Travel satisfaction, travel environment and satisfaction with transport modes

Hanne Tiikkaja[a]*, Heikki Liimatainen[a], Markus Pöllänen[a]

a Transport Research Centre Verne, Tampere University, P.O. Box 600, FI-33014 Tampere University, Finland
** hanne.tiikkaja@tuni.fi*

Abstract

The objective of this paper is to study if people living in certain travel environments express more dissatisfaction with daily travel and if dissatisfaction with daily travel is related to dissatisfaction with certain transport modes. The analyses are based on a Finnish survey on citizen satisfaction with the transport system and travel chains. Two groups, the satisfied and the dissatisfied, are analysed according to their residential area's travel environment and satisfaction with different modes. The results indicate that travel environment and travel satisfaction are related. Results suggest that satisfaction with different modes is partly related to lower options offered by the travel environment and higher expectations towards the travel environment. However, general satisfaction with the transport system does not relate to higher expectations in a similar way. Findings from this study indicate that general satisfaction is a phenomenon related to real travel options offered by the travel environment.

Keywords: Travel satisfaction; travel behaviour; travel environment; transport mode

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

903 Shaping Mobility Value Chain in Madeira - The challenges of tourist mobility

Claudio Mantero[a], Joana Gaudêncio[a]

a Horários do Funchal, Transportes Públicos S.A., Funchal, Portugal
**claudiomantero@horariosdofunchal.pt*

Abstract

On highly touristic destinations as Madeira, it is of paramount importance to have in-depth knowledge of the mobility pattern of tourists. This information is relevant to define the mobility management strategy at Regional level, but also essential to

map the Tourism Value Chain. It also allows to address the touristic needs, to adapt the mobility offer and to grant a sustainable development. Although, the tourism sector is unknown in what regards tourists' mobility patterns. A baseline scenario was built to support mobility operators towards mobility solutions tailored to non-residents, through surveys about mobility and tourism applied at the main gateways. The results from the surveys shown the many opportunities for improvements. In line with the findings and with the support of several EU projects, Horários do Funchal over the years has been capable of tackling the severe decrease of public transport users, through systematic commercial strategies and innovative solutions.

Keywords: Tourism Value Chain, Mobility Value Chain, commercial strategies, public transport (PT), transport modal share rebalance

Full paper: https://doi.org/10.26226/morressier.5e4fe9c16bc493207536f870

1019 Travel-based multitasking on public transport: a case study from Hungary

András Munkácsy[a]*, Imre Keserű[b], Miklós Siska[a]

a KTI Institute for Transport Sciences, Than Károly utca 3–5, Budapest 1119, Hungary
b Vrije Universiteit Brussel, MOBI Research Centre, Department BUTO, Pleinlaan 2, Brussels 1050, Belgium
** munkacsy.andras@kti.hu*

Abstract

On the basis of a survey addressing travel behaviour in 4707 households in Hungary, activities of passengers (especially on-board non-local public transport services) are analysed in this short paper. Descriptive statistics is applied to provide a general view of household survey results about activities while travelling. Advanced statistics, namely K-means clustering is used for the analysis of travel-based multitasking on-board public transport and chartered commuter bus services. On the basis of one of the very first travel-based multitasking studies in Hungary, we concluded that the prevailing activity is talking to others, followed by relaxing or daydreaming, and listening to music/radio. Based on the outcomes of the clustering of public transport journeys by the age of passengers, the main finding is that the use of electronic devices decreases by the age. Characteristics of clusters in terms of other activities are diverse.

Keywords: travel-based multitasking; travel behaviour; public transport; household survey; Hungary

1134 Towards a smart tourism destination: Transport digitalization and mobility as a service concept in rural destinations

Jouko Nuottila[a]*, Maria Hakkarainen[a], Tuomo Kinnunen[b], Olli Pihlajamaa[c]

a University of Lapland, Rovaniemi, Finland
b Matkahuolto, Helsinki, Finland
c VTT Technical Research Centre of Finland, Espoo, Finland
** jouko.nuottila@ulapland.fi*

Abstract

Fast increase of international individual travelers in Finnish Lapland has emphasized the need for easy-to-adapt digital information services of local public transportation. Synergies for the overall development of digital mobility services are clear to both local and tourist users. The case study project demonstrates

digitalization efforts by a coalition of local destination management organizations and municipalities. Research concludes that there are operational challenges DMOs and municipalities face while taking ownership over the digital service offering of transportation information. The challenges relate to the organizational capabilities of developing and implementing the digital services, ensuring continuity of up-to-date content of these services, and capabilities of managing technical maintenance of these services. Also, funding and investing in capability building and development of digital services is problematic for DMOs and municipalities. Larger coalitions collecting local actors together as well as open source initiatives could provide solutions to these challenges.

Keywords: smart tourism destination; tourism; digitalization; rural destination; transport digitalization

1.15 Scientific and technical session 15: Vehicles, vehicle systems and technologies

179 Affordable Multi-Material Lightweight Design - Selected Results of the H2020 Project ALLIANCE

Thilo Bein[a]*, Sama Mbang[b], Dinesh Thirinavukkarasu[c], Martin Kerschbaum[d], Daniele Bassan[e], Thorsten Michler[f], Jens Meschke[g], Paul Jonasson[h], Marcos Ierides[i]

a Fraunhofer LBF, Bartningstr. 47, 64289 Darmstadt, Germany
b Daimler AG, 71059 Sindelfingen, Germany
c RWTH Aachen – ika, Steinbachstr. 7, 52074 Aachen
d Toyota Motor Europe, Hoge Wei 33, 1930 Zaventem, Belgium
e C.R.F. S.C.p.A, Strada Torino 50, 10043 Orbassano (TO), Italy
f Opel Automobile GmbH, Bahnhofstrasse 1, 65423 Ruesselsheim, Germany
g Volkswagen AG, Letterbox 011/1777, 38436 Wolfsburg, Germany
h Volvo Cars, Assar Gabrielssons väg, 40531 Göteborg, Sweden
i Bax & Company, C/ Casp 118-120, 08013 Barcelona, Spain
** thilo.bein@lbf.fraunhofer.de*

Abstract

In the last years, the research activities in the field of lightweighting have been advancing rapidly. The introduction of innovative materials and manufacturing technologies have allowed significant weight reduction. Despite this, novel technologies and materials have not reached a wide distribution. The reasons for this are mainly high production costs and environmental impacts of manufacturing that do not compensate benefits during operation. The paper will discuss selected final results of the H2020 project AffordabLe LIghtweight Automobiles AlliaNCE (ALLIANCE, www.lightweight-alliance.eu) which has the goal of developing novel advanced automotive materials and production technologies, aiming at an average 30% weight reduction over 100k units/year, at costs of < 3 €/kg-saved. An overlook of the realized demonstrators will be given and the applied new materials and manufacturing technologies discussed. A special focus will be put on how the different concepts, materials and manufacturing technologies have been evaluated regarding GWP and costs.

Keywords: lightweighting, multi-material, manufacturing, LCA, full vehicle modelling, conceptual design

Full paper: http://publica.fraunhofer.de/documents/N-577905.html

210 Enabling green mobility by making highly efficient WBG semiconductors available for automotive industry

Christoph Abart[a]*, Kunal Goray[b], Mohamed Abdel-Monem[c], Omar Hegazy[d], Omar Vanegas[e]

a AVL List GmbH, Hans List Platz 1, 8020 Graz, Austria
b AVL Software and Functions GmbH, Im Gewerbepark B29, 93059 Regensburg, Germany
c POWERDALE , Rue des Pères Blancs 4, 1040 Bruxelles, Belgium
d Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussel, Belgium
e Infineon Technologies AG, Am Campeon 1-15, 85579 Neubiberg, Germany
** christoph.abart@avl.com*

Abstract

Electric mobility is widely discussed as an enabler for green mobility and the reduction of CO2 emissions in the transport sector. However, today's technology limits driving ranges and prices of electric cars are higher than those of conventional vehicles. Research is therefore focusing on innovative technologies to remove the limitations and enable electric mobility for a wide range of customers. A promising approach is the application of wide-bandgap semiconductors in automotive applications. They help to enable highly efficient power electronics for electric cars and thus increase the range. The HiPERFORM project develops wide-bandgap semiconductors for use in automotive applications such as inverters and charging solutions for cars. The paper focuses on the applications and the benefits for the end user through these new technologies and also gives an overview of the technical developments.

Keywords: electromobility; research project; wide-bandgap semiconductors; inverter; charging

223 Potentials and Challenges in the Harmonization of Approaches for agile Product Development and Automotive SPICE

Jonas Heimicke[a]*, Markus Spadinger[a], Xiang Li[a], Albert Albers[a]

a Karlsruhe Institute of Technology, Kaiserstrasse 12, Karlsruhe 76131, Germany
** Jonas.Heimicke@kit.edu*

Abstract

In this contribution the potentials and challenges in the harmonization of Automotive SPICE and agile product development methods, e.g., Scrum, Design Thinking, Lean Management and Kanban are discussed. Automotive SPICE is known as a standard of product development and production in automotive industry. It is a domainspecific variant of the international standard ISO/IEC 15504 (SPICE). The purpose of Automotive SPICE is to evaluate the performance of the development processes of ECU suppliers in the automotive industry. Agile methods have been noted to be effective in product development projects which are faced to a high degree of uncertainty. With the ability to quickly react to changing demands agile methods have great success in Automotive industry. Therefore, if ASPICE and agile methods can support and improve each other, there will be a huge step forward in product development. This paper will explore the possibility of harmonization.

Keywords: agile development; Automotive SPICE; Scrum; Design Thinking; ASD – Agile Systems Design; Functional Safety

Full paper:
https://www.researchgate.net/publication/339944071_Potentials_and_Challenges_in_the_Harmonization_of_Approaches_for_agile_Product_Development_and_Automotive_SPICE

247 State of the art of the regulatory framework through the analysis of the technologies developed within the AEROFLEX project

Ignacio Lafuente[a], Carlos Luján[a]*, Marta Tobar[a], Estrella Martínez[a]

a IDIADA Automotive Technology S.A, L'Albornar S/N PO Box 20, Santa Oliva 43710, Spain
* carlos.lujan@idiada.com

Abstract

AEROFLEX project, started in October 2017 with the objective of developing and demonstrating new technologies, concepts and architectures for complete vehicles that are energy efficient, safe, comfortable, configurable and cost-effective. Example of the developments of AEROFLEX project are a distributed hybrid powertrain, aerodynamics devices for truck and trailer to improve the air drag performance, optimized loading units for the trailer and a new concept for the cabin of the truck. One of the main pillars of the AEROFLEX project is the drafting of coherent recommendations for revising standards and legislative frameworks to be compiled in a handbook, which will be submitted to the European Commission. This paper summarizes the results and outputs obtained so far regarding this regulatory analysis. It comprises the state of the art of the regulatory framework and a deep analysis of the current boundaries and constraints within the European transport and logistics industry identified so far.

Keywords: regulatory framework; heavy-duty vehicles, AEROFLEX

259 HiFi-ELEMENTS: An Interface Model Standard and Workflow for High Fidelity Electric Vehicle Modelling and Testing

Jens Ewald[a]*, Thorsten Schnorbus[a], Markus Deppe[b], Hassen Hadj-Amor[c], Christian Granrath[d], Jakob Andert[d]

a FEV Europe GmbH, Neuenhofstraße 181, 52078 Aachen, Germany
b dSPACE GmbH, Rathenaustr. 26, 33102 Paderborn, Germany
c FEV STS SA, 11 rue Denis Papin, CS 70533 - Trappes, France
d RWTH Aachen University, Templergraben 55, 52056 Aachen
** ewald_j@fev.com*

Abstract

The HORIZON 2020 project "HIFI-ELEMENTS" contributes to a more efficient development process for e-vehicles. Goal is to reduce development and testing efforts by over 50%, vehicle energy consumption by up to 20% and increase validation test coverage up to 10-fold. HiFi-ELEMENTS implements and investigates a streamlined workflow that makes the use of diverse modelling tools for vehicle development inter-operable. The proposal for standardisation of functional model interfaces related to the specific sub-components of an E-drivetrain vehicle, including: E-machine, inverter, DC/DC-converter, and battery system is included. Functional Mockup Interfaces (FMI) are incorporated. A scalable interface structure will be shown which implements a number of models using different levels of detail. It allows seamless transition from Real-Time low fidelity black-box models, suited for Hardware-in-the-Loop setups, to high fidelity models with detailed physical modelling. HiFi-ELEMENTS investigates how a workflow with a linked co-simulation environment and data-management application can speed up product development.

Keywords: development process, e-vehicles, co-simulation, system modelling, component interface standard, systems engineering

Full paper: http://publications.rwth-aachen.de/record/785203

372 The H2020 project FITGEN: preliminary results and design guidelines of an integrated e-axle for the third-generation electric vehicles

Michele De Gennaro[a]*, Peter Scheuermann[a], Tobias Wellerdieck[b], Vittorio Ravello[c], Gianmario Pellegrino[d], Elena Trancho[e]

a AIT Austrian Institute of Technology GmbH, Giefinggasse 4, Vienna, 1210, Austria
b BRUSA Elektronik AG, 9466 Sennwald, Switzerland
c Centro Ricerche FIAT SCpA, Strada Torino 50, 10043 Orbassano, Italy
d Department of Energy "Galileo Ferraris", Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129, Torino, Italy
e TECNALIA, Parque Tecnológico de Bizkaia, E-48160 Derio, Bizkaia, Spain
** michele.degennaro@ait.ac.at; michele.degennaro.phd@gmail.com*

Abstract

The electrification of light-duty vehicles is key to reducing emissions in urban areas. This paper aims at presenting the interim results of the European project FITGEN, granted under the H2020 LC-GV-01-2018 call and kicked-off in January 2019. The project will deliver an e-axle natively designed to fit a brand-independent A-segment fully electric vehicle architecture, enabling the following progresses beyond the state-of-the-art 2018: (1) 40% increase of power density of the motor from an innovative 6-phase permanent magnet e-machine design with operation at 20,000 rpm, (2) 50% increase of power density of the inverter from the adoption of SiC power switches and (3) affordable, in-built fast charge capability up to 120 kW peak power. This manuscript includes the design guidelines adopted in the areas of electric motor, transmission, power electronics and control, providing an interim overview of the advancements of the project.

Keywords: H2020 FITGEN, e-axle, third generation electric vehicles, electric motor, SiC inverter, fast charging

Full paper:
https://www.researchgate.net/publication/339883058_The_H2020_project_FITGEN_preliminary_results_and_design_guidelines_of_an_integrated_e-axle_for_the_third-generation_electric_vehicles

375 AEROFLEX – AEROdynamic and FLEXible Trucks, Rethinking Long Distance Road Transport

Ben Kraaijenhagen[a]*, Cor van der Zweep[b], Andreas Lischke[c], Julius Engasser[a], Dr Per Elofsson[d], Magnus Olbäck[e], Alessio Sarcoli[f], Alex Freixas[g], Marta Tobar[g], Estrella Martínez Rami[g], Gertjan Koornneef[h], Jaap van Muijden[i], Paul Mentink[h], Henning Wittig[j]

a MAN Truck & Bus SE, Dachauerstraße 667, Munich , Germany
b Uniresearch BV, Elektronicaweg 16-C, Delf 2628 XG, The Netherlands
c Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR), Linder Höhe, 51147 Cologne, Germany
d Scania CV AB, Granparksvägen 10, 151 87 Södertälje, Sweden
e Volvo Technology AB, SE-405 08, Gothenburg, Sweden
f IVECO S.p.A., Via Puglia 35, 10156 Turin, Italy
g IDIADA Automotive Technology S.A, L'Albornar S/N PO Box 20, Santa Oliva 43710, Spain
h TNO – Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Radarweg 60, 1043 NT, Amsterdam, The Netherlands
i NLR - Royal Netherlands Aerospace Centre, P.O. Box 90502, 1006 BM, Amsterdam, The Netherlands
j Fraunhofer Institute for Transportation and Infrastructure Systemsm, Zeunerstraße 38, 01069 Dresden, Germany
** Ben.Kraaijenhagen@man.eu*

Abstract

THE VISION OF THE AEROFLEX PROJECT IS TO SUPPORT VEHICLE MANUFACTURERS TO ACHIEVE THE COMING CHALLENGES FOR ROAD FREIGHT

TRANSPORT. A new vision of future logistics for physical goods is required to achieve a sustainable logistics and transport system, a paradigm shift described as "The Physical Internet"1; rethinking future freight transport by the optimisation of multi-modal transport chains by drawing on the advantages of the different modes. Thus, it is essential to develop flexible and adaptable vehicles and loading units with optimised aerodynamics, powertrain for low emission and highly efficiency. The optimal matching of novel vehicle concepts and infrastructures is crucial, requiring intelligent access policies for trucks, load carriers and road infrastructures. This paper summarises its overall preliminary results. It covers boundaries and constraints from a market perspective, hybrid distributed powertrain and aerodynamic features for the complete vehicle, smart loading units, front-end design and finally consequences regarding the regulatory framework.

Keywords: multi-modality; aerodynamics; energy management systems; distributed drive trains, regulatory framework; heavy duty vehicles

Full paper: https://aeroflex-project.eu/

381 Development of a pre-chamber for ultra-lean operation of gasoline engines

Knut Habermann[a]*, Bastian Morcinkowski[a], Christoph Müller[b], Christof Schernus[a], Tolga Uhlmann[a]

a FEV Europe GmbH, Neuenhofstrasse 181, 52078 Aachen, Germany
b VKA at Aachen University, Forckenbeckstraße 4, 52074 Aachen, Germany
** habermann@fev.com*

Abstract

Combustion engines in hybridized powertrains continue to require further reductions in fuel consumption and emissions. Lean operation represents a major step towards increasing gasoline engine efficiency. Here, pre-chamber jet ignition offers the potential to assure a reliable ignition and combustion process. This paper describes the development of such a system. Numerical approaches allow for an efficient development process of the pre-chamber layout. Thus, the pre-chamber geometry is thoroughly optimized with respect to the combustion quality. Based thereupon, different pre-chamber layouts were experimentally evaluated. Optical investigations serve to conclude on burn rate and particulate emissions. Having found a specific layout to achieve stable combustion (COV<1.5%) for lean (λ > 3) operation and specific NOx emissions below 0.1 g/kWh a synthesis of all findings serves to define the final concept. The resulting combustion system offers high efficiencies in the entire engine map and thus excellent conditions for further improving the fuel consumption.

Keywords: Gasoline engine; Pre-chamber ignition; Lean burn; Efficiency

Full paper: https://hal.archives-ouvertes.fr/view/index/docid/2504571

533 Particle Reduced, Efficient Gasoline Engines: A final report on the PaREGEn project

Simon Edwards[a]*, Andreas Manz[b], Jeremy Gidney[c], Normann Freisinger[d], Niall Turner[e], Antonio Perez[f], Cor van der Zweep[g]

a Ricardo GmbH, Schwäbisch Gmünd, Germany
b Bosch, Stuttgart, Germany
c Johnson Mattey, Royston, UK
d Daimler, Stuttgart, Germany

e Jaguar Land Rover, Coventry, UK
f IDIADA, Barcelona, Spain
g Uniresearch, Delft, Netherlands
** simon.edwards@ricardo.com*

Abstract

The PaREGEn project (supported by EC Grant No. 723954) is addressing the topic, "Technologies for low emission light duty powertrains", GV-02-2016 of Horizon 2020 programme; specifically, the further development of gasoline engines used in mid to premium sized passenger cars. The innovations therein are to be realized during the critical transition period (2020-2030) for transport, when the mitigation of climate change must be enacted. The project has committed to show a 15% reduction in CO2 emissions. If successful and adopted, these developments have been projected to reduce the European vehicle parc CO2 emissions by ~2.0 Mtonnes in 2025 and up to 10 Mtonnes, together with a ~10% reduction in PN >10 nm, in 2030. The project is being realized by a seventeen-partner consortium representing all parts of the automotive industry. At the time of the TRA2020, the project will have recently completed: the final results and potential impact will be presented.

Keywords: climate change; mitigation; hybrid technologies; emission reduction; air quality; technology

649 Power Advanced N-level Digital Architecture for models of electrified vehicles and their components

Alain Bouscayrol[a]*, Amandine Lepoutre[a], Cristi Irimia[b], Calin Husar[b], Joris Jaguemont[c], Aurélien Lievre[d], Claudia Martis[e], Dragan Zuber[f], Volker Blandow[c], Fei Gao[h], Willem F. van Dorp[i], Gabriel Mihai Sirbu[j], Johan Lecoutere[k]

a Univ. Lille, Arts et Metiers Paris Tech, Centrale Lille, HEI, EA 2697- L2EP, F-59000 Lille, France,
b Siemens Industry Software SRL, Brasov 500203, Romania
c Vrije University of Brussel, Mobi-group, Brussel 1050, Belgium
d Valeo Equipements Electriques Moteurs SAS, Créteil 94000, France
e University of Technology of Cluj Napoca, Cluj-Napoca 400114, Romania
f Typhoon HIL, Novi Sad 21000, Serbia
g TUEV SUED AG, Munchen 80686, Germany
h Université de Bourgogne Franche-Comté, FEMTO-ST, Besançon 25000, France
I Uniresearch BV, Delft 2628XG, Netherlands
j Renault Technologie Roumanie SRL, Bucarest, Romania
k Blueways International BVBA, Leuven 3001, Belgium
** Alain.Bouscayrol@univ-lille.fr*

Abstract

The PANDA project is a Research Innovation Action from the European H2020 programme. PANDA will enable the automotive industry to speed up design and testing of innovative electrified vehicles. In the PANDA project, multi-scale and multi-domain simulation packages are developed to interconnect all components of electrified vehicles. The EMR (Energetic Macroscopic Representation) formalism is used to unify the model organization. Moreover, all the models will be shared in a cloud for both stand-alone simulation and cloud computing. On the contrary to existing solutions which are based on a structural philosophy, PANDA is focused on functional-based approach. First results are provided to compare both approaches for the simulation of an electric vehicle. The EMR-based functional library leads to a reduced computation time of 15% in comparison with a structural-based simulation. This results confirms the ability of the PANDA solution for real-time simulation in particular for Hardware-In-the-Loop testing.

Keywords: Electrified Vehicle, simulation, virtual testing, real testing, unified model organization

Full paper:
https://www.researchgate.net/publication/339781398_Power_Advanced_N-level_Digital_Architecture_for_models_of_electrified_vehicles_and_their_components_Transport_Reserach_Arena_Helsinki_April_2020

680 Hair-pin winding in high-speed permanent-magnet machine

Mario Vukotić[a]*, Jutta Kinder[b], Katrin Wand[c], Michael Burghardt[c], Janne Sami Keränen[d], Damijan Miljavec[a]

a University of Ljubljana, Tržaška 25, Ljubljana 1000, Slovenia
b THIEN eDrives, Millennium Park 11, Lustenau 6890, Austria
c AVL Trimerics GmbH, Im Gewerbepark B2, Regensburg 93059,Germany
d VTT, P.O. Box 1000, FI-02044 VTT, Finland
** mario.vukotic@fe.uni-lj.si*

Abstract

Using a hair-pin winding instead of a stranded-wire winding in electrical machines might increase the slot fill factor for as much as the factor of two. The DC copper losses are inversely proportional to the increase of the slot fill factor. This means that the efficiency in the low-speed area is significantly increased. However, as the supply frequency of the current increases, the AC effects cause additional eddy-current losses in the slot conductors. These losses grow exponentially with the frequency. An analysis of different hair-pin winding configuration has been made using the analytical approach and 2D finite-element-method software. The goal of the analysis was to establish, whether the hair-pin winding might be used in a high-speed permanent-magnet electric machine.

Keywords: hair-pin windings; high-speed permanent-magnet machine; skin effect; proximity effect; eddy currents

Full paper: https://www.researchgate.net/

724 aColor: Mechatronics, Machine Learning, and Communications in an Unmanned Surface Vehicle

Jose Villa[a]*, Jussi Taipalmaa[b], Mikhail Gerasimenko[c], Alexander Pyattaev[c], Mikko Ukonaho[d], Honglei Zhang[b], Jenni Raitoharju[b], Nikolaos Passalis[b], Antti Perttula[d], Jussi Aaltonen[a], Sergey Andreev[c], Markus Aho[d], Sauli Virta[e], Moncef Gabbouj[b], Mikko Valkama[c], Kari T. Koskinen[a]

a Unit of Automation Technology and Mechanical Engineering, Tampere University (TAU), Korkeakoulunkatu 1, Tampere, 33720, Finland
b Unit of Computing Sciences, Tampere University (TAU), Korkeakoulunkatu 1, Tampere, 33720, Finland
c Unit of Electrical Engineering, Tampere University (TAU), Korkeakoulunkatu 1, Tampere, 33720, Finland
d School of Industrial Engineering, Tampere University of Applied Science (TAMK), Kuntokatu 3, Tampere, 33520, Finland
e R&D Department, Alamarin-Jet Oy, Tuomisentie 16, Härmä, 62300, Finland
** jose.villaescusol@tuni.fi*

Abstract

The aim of this work is to offer an overview of the research questions, solutions, and challenges faced by the project aColor ("Autonomous and Collaborative Offshore Robotics"). This initiative incorporates three different research areas, namely, mechatronics, machine learning, and communications. It is implemented in an autonomous offshore multicomponent robotic system having an Unmanned Surface Vehicle (USV) as its main subsystem. Our results across the three areas of

work are systematically outlined in this paper by demonstrating the advantages and capabilities of the proposed system for different Guidance, Navigation, and Control missions, as well as for the high-speed and long-range bidirectional connectivity purposes across all autonomous subsystems. Challenges for the future are also identified by this study, thus offering an outline for the next steps of the aColor project.

Keywords: mechatronics; machine learning; communications; autonomous system; USV

Full paper: https://arxiv.org/abs/2003.00745

953 Next generation of vehicle diagnostics based on advanced on-board monitoring and cloud-based diagnostics

Savas Geivanidis[ab], Zissis Samaras[a]*, Markus Willimowski[c], Ian Faye[c], Obaid Ur-Rehman[d], Christof Schernus[d], Robin Vermeulen[e]

a Lab. of Applied Thermodynamics, PO Box 458, Thessaloniki, 54124, Greece
b International Hellenic University, 14th km Thessaloniki - Moudania, Thermi (Thessaloniki) 57001 , Greece
c Robert Bosch GmbH, Postfach 30 02 40, Stuttgart 70442, Germany
d FEV Europe GmbH, Neuenhofstr. 181, Aachen 52078, Germany
e TNO, Anna van Buerenplein 1, The Hague 2595 DA, The Netherlands
** zisis@auth.gr*

Abstract

This paper presents the architecture and elements of an advanced diagnostic and emission monitoring system to eliminate the risk of interventions to the vehicle that would lead to emission increase. The designed system will be implemented on a demonstrator vehicle within the framework of the Horizon 2020 project with acronym DIAS funded the European Commission. Firstly, all possible improvements to the existing on-board detection logic (Level 1 measures) are implemented, to demonstrate on one hand demonstrate the feasibility of having more robust conventional systems in a framework for intermediate regulatory steps. On the other hand, it will demonstrate that there will still be weaknesses not possible to be addressed by this conventional approach. This system will include advanced models, virtual and hardware sensors etc. The advanced diagnostic system (Level 2 measures) to enable very robust monitoring will be built using advanced remote cloud-based architectures for data collection and processing.

Keywords: tampering; emission reduction systems; on-boarding diagnostics; on-board monitoring; cloud-based diagnostics; anomaly detection

Full paper:
http://lat.eng.auth.gr/share/publications/TRA2020_953_Geivanidis.pdf

954 An environmentally-friendly LED lighting system for truck applications

Dimitris Baros[a], Nena Apostolidou[a], Fotis Valsamas[a], Michael Loupis[a,c], Vasilios Dasteridis[b]

a Innovative Technologies Center S.A., Alketou 25, Athens 11633, Greece

b Dasteri, 1st km Alexandroupolis-Ferron, Alexandroupolis 68133, Greece
c National & Kapodistrian University of Athens, Evripou Campus, Psachna 34400, Greece
** dbaros@ee.duth.gr*

Abstract

The main scope of this paper is to propose the incorporation of a new product which allows for the prompt use of LED lights on trucks with the adoption of modern power electronics technologies in an energy-conscious way. In particular, the proposed product can virtually increase the consumption of LED lights at appropriate levels so that the conventional central control of the majority of lorries recognizes them and does not sense that there is damage to lighting. The novelty of the proposed product lies in the fact that the power consumption of the virtual consumption is not consumed in pseudo-loads (e.g. resistors) but is returned (recycled) to the vehicle's batteries via a suitable electronic power converter. PSPICE simulation results have validated the proposed energy saving scheme for track applications.

Keywords: Energy saving, environmentally-friendly LED lighting for conventional trucks, power electronics technology, transport safety

1059 Analysis of electric vehicle design and travel based on long trip capabilities

Henrick Brandes[a], Ian Faye[a]*, Volker Döge[a]

a Robert Bosch GmbH, Postfach 300240, Stuttgart 70442, Germany
** ian.faye@de.bosch.com*

Abstract

Rethinking electric mobility in terms of pure driving range versus long-trip capabilities is the motivation for this paper. An analysis of battery sizing compared to charging power is carried out in terms of additional time needed to execute a long distance trip with an electric vehicle based on standard consumption, battery size, charging power and limitations due the battery C-rate. The goal is to identify the smallest suitable battery and the "sweet-spot" concerning charging power that will still satisfy the user's need to complete long distance trips by specific charging stops and fast charging with sufficient power to continue the trip. At the same time, some of the limitations of battery technology especially regarding fast charging and durability are taken into consideration. Long-trip capability can be concluded, but also the imperative need for further research to improve fast charging capabilities (up to 100 – 150 kW) of batteries becomes clear.

Keywords: Electric vehicle; fast charging; driving range; trip time; battery capacity; C-rate

Full paper: \\si-z0zev\C$_Ablage_Hausaufgabe_2020_2020_03_02_2020_03_13_TRA_presentation\191102___TRA2020_Paper_BOSCH_Long_Trip_REVIEWED___final.pdf

1106 Hyperloop in Europe: State of play and challenges

Konstantinos Gkoumas[a]*, Michalis Christou[a]

a European Commission, Joint Research Centre (JRC), Via Enrico Fermi 2749, 21027, Ispra (VA), Italy
** konstantinos.gkoumas@ec.europa.eu*

Abstract

Since the introduction of hyperloop in modern form in 2013, progress has been thriving, with several companies involved in research and development of hyperloop

systems and sub-systems. Many of them have planned testing tracks in Europe, anticipating what could be the start of commercial routes for passenger and freight transport. Nevertheless, many issues remain to be solved for what regards safety and serviceability performance. This study leverages the state of play of hyperloop development, identifies issues and challenges from a European perspective, and provides policy insights towards testing and commercialization. To this end, it follows a two-tier approach, that, (i) looks in depth into possible legislative, technological and other challenges and enablers for the introduction of hyperloop, and, (ii) analyses hyperloop technology developments, identifying possible R&I spill overs from and to other sectors using the methodology developed for the European Commission's Transport Research and Innovation Monitoring and Information System (TRIMIS).

Keywords: hyperloop; disruptive technologies; research; innovation; knowledge management; policy support

1.16 Scientific and technical session 16: Acceptance of automated transport

108 People perceptions and public acceptance of autonomous vehicles: A literature review

Ghada Tay[a]*, Cristina Pronello[ab]

a EA 7284 AVENUES, Université de Technologie de Compiègne, Compiègne 60200, France
b Interuniversity Department of Regional and Urban Studies and Planning, Politecnico di Torino, Torino 10125, Italy
** ghada.tay@utc.fr*

Abstract

Nowadays, autonomous vehicles (AVs) are considered as a key factor for the future mobility, they are proposed as promising solutions for the different transport problems. However, before their implementation, testing AVs' effects on roads and analysing people acceptance is of utmost importance. This paper aims to review and critically analyse the surveys conducted on AVs, in order to investigate the factors influencing people perception and public acceptance of AVs to address the research gaps before their implementation. In literature, socio-demographic variables, experience, affect towards use, perceived usefulness, compatibility, trust, willingness to pay and attitudes towards AV appeared to be the most significant factors. After investigating such factors, it was found that the majority of people would accept AVs if they have the option to take over control. Another important outcome is that reliability of AVs as well as regulations on their use are not properly addressed in the past research.

Keywords: autonomous vehicles; driverless vehicles; public acceptance; surveys; people perception

221 On the road to automated vehicles: From perception to use

António Lobo[a]*, Sara Ferreira[a], Daniel Silva[b], Liliana Cunha[b], Anabela Simões[c], António Couto[a]

a Faculty of Engineering of the University of Porto, Research Centre for Territory, Transports and Environment, Rua Dr. Roberto Frias, s/n, 4200-465 Porto, Portugal
b Faculty of Psychology and Educational Sciences of the University of Porto, Center for Psychology at University of Porto, Rua Alfredo Allen, s/n, 4200-135 Porto, Portugal
c Lusófona University, Centre for Interdisciplinary Development and Research on Environment, Applied Management and Space, Campo Grande, 376, 1749-024 Lisbon, Portugal
** lobo@fe.up.pt*

Abstract

A safe and highly acceptable automated driving experience depends on how drivers, as the primary users of automated vehicles, understand and interact with technology. This study presents a literature review about the main driver-related challenges associated with different levels of automation, as well as an incremental approach to tackle these challenges, proposed under the AUTODRIVING project. AUTODRIVING combines an extensive survey on the perceptions of representative groups of drivers about the safety and usability of automated vehicles with a driving simulator study to evaluate driver-vehicle interaction under regular and critical automated driving scenarios. The project will deliver relevant decision-supporting and driving behaviour modelling tools for the development of technology and driving modes that mimic human behaviour and effectively address the needs and requirements of different users. These instruments will increase the capacity of industrial stakeholders and regulatory bodies to ensure a smooth transition to automated driving and promote societal acceptance.

Keywords: road safety; automated vehicles; driver behaviour; user acceptance; collaborative technology

421 Drive2theFuture: Concepts and methodology towards accepting our automated future

Evangelia Gaitanidou[a]*, Evangelos Bekiaris[a]

a Centre for Research and Technology Hellas/Hellenic Institute of Transport, 6th Km Charilaou-Thermi Rd, 57001, Thermi, Thessaloniki, Greece
** lgait@certh.gr*

Abstract

Following the emerging invasion of automation in the transport sector, what rises as a primary concern is whether the users of the transportation system are ready to accept and include the technological innovations in their lives and how this transition can occur in a safe, sustainable and user-friendly manner. Accepting this challenge, Drive2theFuture project aims to develop training, HMI concepts, incentives policies and other cost efficient measures to promote and then to comparatively assess several alternative connected, shared and automated transport Use Cases for all transport modes and with all types of users (drivers, travellers, pilots, VRUs, fleet operators and other key stakeholders), in order to understand, simulate, regulate and optimize their sustainable market introduction; including societal awareness creation, acceptance enhancement and training on use. This initiative is undertaken by 31 Partners from 13 European countries. This paper presents the project aims, its plans and some preliminary findings.

Keywords: automation; user acceptance; training; HMI; transport modes

Full paper:
https://www.researchgate.net/publication/339791475_Drive2theFuture_Concepts_and_methodology_towards_accepting_our_automated_future

530 Towards full vehicle automation: mediating between human and technological strengths

Nicole van Nes[a]*, Ingrid van Schagen[a], Diane Cleij[a], Michiel Christoph[a], Bram Bakker[b]

a SWOV Institute for Road Safety Research, PO Box 93113, 2509 AC The Hague, Netherlands
b Cygnify BV, Bargelaan 200, 2333 CW Leiden, Netherlands
** nicole.van.nes@swov.nl*

Abstract

Vehicle automation is developing rapidly, with huge potential for road safety, environment and traffic flow. However, with increasing vehicle automation, the role of the car driver changes from constant and active control to more passive monitoring with infrequent need for action. Unfortunately, humans are not very good in these monitoring tasks. Hence, the path towards automation is likely to bring new risks, such as reduced attention, increased response times, reduced situational awareness, overreliance and mode confusion. The H2020 project MEDIATOR aims to develop an intelligent 'mediating' support system, enabling safe, real-time switching between the human driver and automation system. The project will produce several lab and in-vehicle prototypes of this mediator system for evaluation in simulation, simulator and on-road studies, as well as several tools for further exploitation. The current paper sets out MEDIATOR's theoretical framework, its approach as well as its first elaborations.

Keywords: vehicle automation; transition phase; support system; driver state; human-machine interface

561 Change of acceptance with repeated usage of a L3-motorway chauffeur

Barbara Metz[a]*, Johanna Wörle[a], Michael Hanig[a], Marcus Schmitt[a], Aaron Lutz[a]

a WIVW, Robert-Bosch-Str. 4, 97209 Veitshöchheim, Germany
** metz@wivw.de*

Abstract

In the H2020 EU-funded project L3Pilot, the impact of repeated use of vehicle automation on usage and acceptance is studied. A simulator study is presented in which N=31 drivers used a L3-motorway-chauffeur during six drives. The drives took place at six different days. The drivers were allowed to use the L3-system as they pleased. The system is designed in a way that its operational design domain (ODD) resembles real L3-motorway systems tested in on-road tests in L3Pilot. Evaluation and acceptance of the system was assessed with questionnaires after every experimental session. Results show an overall positive evaluation after the first drive already. With growing experience drivers stated growing trust in the system going together with an increasing willingness to spend the driving time on other activities. Willingness to use and willingness to buy the system are analysed and set in relation to system usage.

Keywords: L3-motorway chauffeur, acceptance, trust, willingness to use, willingness to buy

686 Creating informed public acceptance by a user-centered human-machine interface for all automated transport modes

Lesley-Ann Mathis[a]*, Frederik Diederichs[b], Harald Widlroither[b], Daniele Ruscio[c], Linda Napoletano[c], Marc René Zofka[d], Alexander Viehl[d], Peter Fröhlich[e], Johannes Friedrich[f], Anders Lindström[g], Birgitta Thorslund[h], Antonis Litke[i], Nikolaos Papadakis[i], Nikolaos Bakalos[i], Unai Hernandez-Jayo[j], Stéphane Espié[k], Viola Cavallo[l], Maria Panou[m], Evangelia Gaitanidou[n], Evangelos Bekiaris[n]

a University of Stuttgart IAT, Nobelstraße 12, 70569 Stuttgart, Germany
b Fraunhofer IAO, Nobelstraße 12, 70569 Stuttgart, Germany
c Deep Blue, Piazza Buenos Aires 20, 00198 Rome, Italy
d FZI Research Center for Information Technology, Haid-und-Neu-Straße 10-14, 76131 Karlsruhe, Germany
e AIT Austrian Institute of Technology, Giefinggasse 2, 1210 Wien, Austria
f Technical University Berlin, Salzufer 17-19, 10587 Berlin, Germany
g VTI, Malvinas väg 6 P.O. Box 55685, 102 15 Stockholm, Sweden
h VTI, Olaus Magnus väg 35, 581 95 Linköping, Sweden
i Infili Technologies PC, 62 Kousidi str. Zografou, 15772 Athens, Greece
j University of Deusto - Deusto Institute of Technology, Av Universidades 24, 48007 Bilbao, Spain
k Ifsttar/TS2/SIMU&MOTO, Cité Descartes 14-20, Boulevard Newton Champs sur Marne, 77447 Marne la Vallée Cedex 2, France
l Ifsttar/COSYS/LEPSiS, Cité Descartes 14-20, Boulevard Newton Champs sur Marne, 77447 Marne la Vallée Cedex 2, France
m Centre for Research and Technology Hellas/Hellenic Institute of Transport, Egialias 52, 15121 Athens, Greece
n Centre for Research and Technology Hellas/Hellenic Institute of Transport, 6th Km Charilaou-Thermi Rd., 57001 Thessaloniki, Greece
** lesley-ann.mathis@iat.uni-stuttgart.de*

Abstract

Increasing automation is ongoing in all areas of transport. This raises new challenges for the design and training of Human-Machine Interfaces (HMI) for different user groups. The EU-project Drive2theFuture investigates the needs and wants of transportation users, operators, passengers and passersby to gain their acceptance and to set the ground for a sustainable market introduction of automated transport. This paper describes how HMI concepts for the transport modes road, rail, maritime and aviation in Drive2theFuture are developed and comparatively assessed in order to be able to support an educated use of automated transport. By relying on a stepwise process, adaptable HMI strategies for different user clusters and levels of automation are defined. As a universal method, a comprehensive HMI development toolkit is developed, which can be adopted as training tool to create realistic expectations and enhance acceptance among users, operators and drivers in light of the deployment of automated vehicles.

Keywords: HMI; automated transport; automated vehicles; acceptance; user-centered; training

Full paper: http://publica.fraunhofer.de/dokumente/N-578610.html

697 Ethically Aligned Design of Autonomous Systems: Industry viewpoint and an empirical study

Ville Vakkuri[a]*, Kai-Kristian Kemell[a], Joni Kultanen[a], Mikko Siponen[a], Pekka Abrahamsson[a]

a University of Jyväskylä, P.O. Box 35, Jyväskylä FI-40014, Finland
** ville.vakkuri@jyu.fi*

Abstract

Progress in the field of artificial intelligence has been accelerating rapidly in the past two decades. Various autonomous systems from purely digital ones to autonomous vehicles are being developed and deployed out on the field. As these systems exert a growing impact on society, ethics in relation to artificial intelligence and autonomous systems have recently seen growing attention among the academia.

However, the current literature on the topic has focused almost exclusively on theory and more specifically on conceptualization in the area. To widen the body of knowledge in the area, we conduct an empirical study on the current state of practice in artificial intelligence ethics. We do so by means of a multiple case study of five case companies, the results of which indicate a gap between research and practice in the area. Based on our findings we propose ways to tackle the gap.

Keywords: AI ethics, Artificial intelligence, Autonomous systems, Autonomous vehicle, Ethically Aligned Design, Software development

718 Towards behavioral models for autonomous driving acceptance

Foteini Orfanou[a]*, Truls Vaa[b], Eleni I. Vlahogianni[a], George Yannis[a]

a National Technical University of Athens, 5, Iroon Polytechniou, Athens GR-15773 Athens Greece
b Transportokonomisk Institutt, Gaustadalleen 21, Oslo 0349, Norway
** forfanou@central.ntua.gr*

Abstract

The advent of autonomous vehicles (AVs) is a breakthrough innovation in the field of transportation. At the cornerstone of autonomous vehicles (AVs) research lies the challenge of ensuring that the future vehicles can react properly and efficiently in all situations and especially in emergencies. The present work analyzes autonomous vehicle's "driver"/operator behavior and conceptualizes the changes that should be introduced to the existing behavioral driving models in order to address the requirements of autonomous vehicles and increase the acceptance of autonomous driving. For this purpose, empirical evidence and qualitative experience from over 20 relevant projects and pilots are critically reviewed. Moreover, the conceptualization and potential parameterization of AV behavioral models are analyzed based on three popular modeling alternatives: Summala's Multiple Comfort Zone Model, Fuller's Risk Allostasis Model (RAT), Vaa's Risk Monitor Model (RMM). The findings are critically discussed to reveal future research directions.

Keywords: autonomous vehicle; behavioral models; comfort zone; RAT; RMM

803 Developing a Policy Support Tool for Connected and Automated Transport Systems

Anastasios Dragomanovits[a], George Yannis[a], Julia Roussou[a]*, Rune Elvik[b], Bin Hu[c], Alexandra Milloning[c], Ashleigh Filtness[d], Pete Thomas[d]

a Department of Transportation Planning and Engineering – National Technical University of Athens, 5 Iroon Polytechniou Str., GR-15773 Athens, Greece
b Departement of Safety and Security – Institute of Transport Economics Norwegian Centre for Transport Research, Gaustadalléen 21, 0349 Oslo, Norway
c AIT Austrian Institute of Technology, Center for Mobility Systems, Giefinggasse 2, 1210 Vienna, Austria
d Loughborough University, Loughborough, LE11 3TU, United Kingdom
** jroussou@mail.ntua.gr*

Abstract

Connected and automated transport systems (CATS) are expected to be introduced in increasing numbers over the next decade based on the rapidly developing capability of modern technologies. The need for policies around the introduction of CATS is starting to arise, based on the evaluation of the likely impact of different technologies, with the aim to capture the benefits of automation and ensure that new technologies contribute to wider policy objectives. The Horizon 2020 Levitate project aims to investigate the potential short, medium and long term impacts of

CATS, through an innovative multi-disciplinary impact assessment methodology, which will be incorporated within a new web-based policy support tool to enable city and other authorities to forecast impacts of CATS on urban areas. This policy support tool will comprise a knowledge and an estimator module and will include forecasting and backcasting systems providing estimates for different types of impacts and allowing comparative analyses.

Keywords: connected and automated transport systems; policy support tool; impact assessment; forecasting; backcasting

806 Assessing user behaviour and acceptance in real-world automated driving: the L3Pilot project approach

Tyron Louw[a]*, Natasha Merat[a], Barbara Metz[b], Johanna Wörle[b], Guilhermina Torrao[a], Satu Innamaa[c]

a Institute for Transport Studies, University of Leeds, University Road, Leeds and LS2 9JT, UK
b WIVW Würzburg Institute for Traffic Sciences GmbH, Robert-Bosch-Straße 4, 97209 Veitshöchheim, Germany
c VTT Technical Research Centre of Finland Ltd., P.O. Box 1000, FI-02044 VTT, Finland
** t.l.louw@its.leeds.ac.uk*

Abstract

The L3Pilot project, funded by H2020, is conducting the first large-scale piloting of SAE Level 3 automated driving in Europe. The main aim of the project is to address a number of key questions in a step towards introducing automated vehicles on European roads. This paper discusses the approach taken by the L3Pilot project, to evaluate user behaviour in, and acceptance of, automated driving in real-world pilots. Although some technical challenges associated with the development and demonstration of such technologies are well-documented, current methodologies, such as those used to evaluate Field Operational Tests (FOTs), offer little guidance about assessing the impact of automated driving on users' behaviour and acceptance. This paper outlines the methods used and developed for assessing user behaviour and acceptance within the project, summarises some of the methodological challenges involved in collecting data during an automated driving pilot, and discusses some approaches we have developed to solve these multifaceted challenges.

Keywords: Real-world study, automated driving pilot, methodology, human factors, user acceptance, user behaviour

885 User rating and acceptance of attention-adaptive driver safety systems

Betina Weber[a], Manfred Dangelmaier[b]*, Frederik Diederichs[b], Dieter Spath[a]

a Universität Stuttgart, Institut für Arbeitswissenschaft und Technologiemanagement, Nobelstraße 12, 70569 Stuttgart, Germanyy
b Fraunhofer Institut für Arbeitswirtschaft und Organisation, Nobelstraße 12, 70569 Stuttgart, Germany
** manfred.dangelmaier@iao.fraunhofer.de*

Abstract

Current statistics show that distraction is a central cause of traffic accidents. Safety systems with distance control currently available on the market have great potential for preventing accidents and significantly reducing their severity. However, depending on the driver's level of attention, the systems warn too early or too late, which impairs use acceptance. Adaptive systems allow for personalization according

to driver's attention level. Studies were carried out in the driving simulator in order to compare the system adaptations with regard to acceptance for attentive and distracted driving phases. 72 participants took part in the study, with a »between-subjects test design«. Acceptance ratings shows highest acceptability for the adaptive systems in distractive situations. We conclude that personalization of attention-adaptive systems shall be implemented in case safety benefits are proven.

Keywords: System adaptation, attention level, safety, acceptance

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

950 Investigation of acceptance of driverless buses in the city of Trikala and optimization of the service using Conjoint Analysis

Georgia Papadima[a], Evangelos Genitsaris[a], Ioannis Karagiotas[a], Aristotelis Naniopoulos[a], Dimitrios Nalmpantis[a]*

a School of Civil Engineering, Faculty of Engineering, Aristotle University of Thessaloniki, PO Box 452, 541 24 Thessaloniki, Greece
** dnalba@civil.auth.gr*

Abstract

After the completion of the pilot application of the European research project CityMobil2 with driverless buses in the city of Trikala, Greece, which took place from June 2015 to February 2016, and the problems and reactions that arose, there was a need to investigate their acceptance by the passengers. The present paper is an independent from the project research effort that focused on this investigation. The results of the relevant questionnaire survey show that the residents and the visitors of the area were positive towards the automated vehicles, while a number of other factors, such as the reduction of parking spaces were an inhibiting factor of acceptance. Moreover, the fact of the positive attitude of the residents and the passengers was confirmed by the complementary questionnaire survey conducted using the Conjoint Analysis method regarding the potential optimization of the service by choosing appropriate levels for specific attributes.

Keywords: Conjoint Analysis (CA); driverless buses; automated vehicles; acceptability; optimization; Trikala

This paper is a part of the Utilities Policy Special Issue:
https://www.sciencedirect.com/journal/utilities-policy/special-issue/10D8V459F11

Full paper: https://doi.org/10.5281/zenodo.3708352

1015 Acceptance of autonomous delivery vehicles – Applying UTAUT in the context of last-mile logistics

Sebastian Kapser[a]*, Mahmoud Abdelrahman[b]

a Northumrbia University Newcastle Business School, City Campus East, Newcastle, NE1 8ST, United Kingdom
b Northumrbia University Newcastle Business School, City Campus East, Newcastle, NE1 8ST, United Kingdom
** sebastian.kapser@northumbria.ac.uk*

Abstract

Nowadays, last-mile delivery receives a great deal of attention, due to the increasing e-commerce market. The current delivery concepts do not seem suitable to cope with the simultaneously growing transportation volume efficiently. Autonomous delivery vehicles (ADVs) have the potential to revolutionize last-mile delivery. Despite its importance, little research exists on the acceptance of such delivery alternatives. Hence, it is imperative to identify the variables that determine user acceptance of ADVs. Within this study the unified theory of acceptance and use of technology (UTAUT) was applied to the underlying context. Quantitative data was collected via an online survey approach (n=501) and structural equation modelling was undertaken. Performance expectancy has been found to be the most important variable, followed by social influence; whereas no effect could be found for effort expectancy. The results of this study have important practical implications and theoretical contributions in the areas of technology acceptance and last-mile logistics.

Keywords: autonomous delivery vehicles; acceptance; last-mile delivery; UTAUT; unified theory of acceptance and use of technology

Full paper:
https://www.researchgate.net/publication/336085159_Acceptance_of_autonomous_delivery_vehicles_-Applying_UTAUT_in_the_context_of_last-mile_logistics

1087 Risk Assessment on Public Acceptance of Autonomous Vehicles – The Drive2TheFuture project

Matina Loukea[a]*, Evangelia Gaitanidou[a], Evangelos Bekiaris[a], Eleni Vlachogianni[b], Davide Shingo Usami[c], Nikos Bakalos[d]

a Center for Research and Technology Hellas – Hellenic Institute of Transport (CERTH/HIT), 6th Km Charilaou - Thermi Rd., 57001 Thessaloniki, Greece
b National Technical University of Athens, Zografou Campus 9, Iroon Polytechniou str 15780, Athens, Greece
c Research Centre for Transport and Logistics of Sapienza University, Piazzale Aldo Moro, 5, 00185 Roma RM, Italy
d INFILI Technologies, 62, Kousidi str, Zografou 15772, Athens, Greece
** mloukea@certh.gr*

Abstract

Automation is already a reality in public transport vehicles; it is not anymore an "if" but a "when" and "how" issue with user awareness, acceptance and training formulating the first priority challenge. Questions related to vehicle taking over control from humans, change of mobility habits and experience, cost of travelling in the future, ethical decisions of a machine vs. a human, as well as the need of new driver training incentives for adapting to this technological evolution, are some of the key issues that are yet to be investigated. Within the Drive2theFuture project, the risks related to the user acceptance of autonomous vehicles are being explored and recognised with the use of the extended FMEA methodology, together with the key features and factors responsible for such risks, while also specific recommendations for their elimination are being suggested.

Keywords: autonomous vehicles; user acceptance; risk assessment; mitigation strategies; FMEA methodology

1.17 Scientific and technical session 17: Modelling of traffic flow

230 An Error Analysis by Fluctuation of Vehicle Detection Result for Traffic State Estimation Using Opposite Observation Probe

Katsuya Kawai[a]*, Atsushi Takenouchi[b], Masahiko Ikawa[a], Masao Kuwahara[b]

a Advanced Technology R&D Center, Mitsubishi Electric Corporation, 8-1-1, Tsukaguchi-hommachi, Amagasaki City, 661-8661, Japan
b Graduate School of Information Sciences, Tohoku University, 6-6-06, Aoba, Aramaki, Aoba-ku, Sendai City, 980-8579, Japan
** Kawai.Katsuya@dn.MitsubishiElectric.co.jp*

Abstract

In this study, instead of using vehicle detector data, we propose a method of estimating the traffic state by using the data obtained by measuring the opposite lane of traffic flow, such as by mounting a camera or a millimeterwavelength radar to the vehicle or the like. In this paper, we describe the application result of vehicle detection function from vehicle-mounted camera image and analysed estimation error of the proposing method by fluctuation of detection result.

Keywords: Vehicle trajectory; Data assimilation; Variational theory

262 Estimation of carpooling potential by trip modelling

Wilfried Raballand[a]*, Pierre-Antoine Laharotte[a]

a Cerema Centre-Est, 25 avenue François Mitterand, CS92803, 69674 Bron Cedex, France
** wilfried.raballand@cerema.fr*

Abstract

The development of carpooling meets the challenges of sustainable development and energy transition. But prior assessment of the success of this transport service is complex. We propose a tool to estimate supply and demand potentials from a multimodal static agglomeration model. This is based on systematic exploitation of the model data. Indicators are created in order to quantify the attractiveness of a carpooling service, and the impact on the user in terms of cost and time. The tool is tested with the model of a large French urban area and a fictitious carpooling service. The results are presented with representations adapted to the qualification of the service. The method developed is a promising solution for the study of carpooling projects. Future work will deal mainly with modal shift and service reliability.

Keywords: transport planning; trip modelling; urban mobility; Mobility-as-a-Service

Full paper: https://hal.archives-ouvertes.fr/hal-02503684

285 User Powertrain Type Choice Model and Analysis Using Neural Networks

Fabio Marques dos Santos[a]*, Paolo Tecchio[a], Fulvio Ardente[a], Ferenc Pekar[a]

a European Commission, Joint Research Centre (JRC), Italy
** fabio.marques-dos-santos@ec.europa.eu*

Abstract

This paper presents an Artificial Neural Network (ANN) model that simulates user's choice of electric or internal combustion engine vehicles based on basic vehicle attributes (purchase price, range, operating cost, taxes due to emissions, time to refuel/recharge and vehicle price deprecation), with the objective of analyzing user behavior and creating a model that can be used to support policymaking. The ANN is trained using stated preference data from a survey carried out in six European countries, taking into account petrol, diesel and battery electric vehicle attributes. Model results show that the electric vehicle parameters (especially purchase cost,

range and recharge times), as well as the purchase cost of internal combustion engine vehicles are the most influencing on consumer's vehicle choice. A graphical interface is created for the model, to make it easier to understand the interactions between different attributes and their impacts on consumer choices and thus help policy decisions.

Keywords: Artificial neural networks; electric vehicles; consumer choice

332 The Disruption Transport Model: Computing user delays resulting from infrastructure failures for multi-modal passenger & freight traffic

Marieke S. van der Tuin[a]*, Adam J. Pel[a]

a Department of Transport and Planning, Faculty of Civil Engineering and Geosciences, Delft University of Technology, P.O. Box 5048, 2600 GA Delft, The Netherlands
** m.s.vandertuin@tudelft.nl*

Abstract

Transport infrastructure owners are moving from reactive toward proactive infrastructure management. This involves computation of costs associated with failure or maintenance, including expected transport delays. These delays are often computed by multiplying additional travel time by the number of travellers. However, this does not reflect the process of decision-making by travellers using the infrastructure asset, such as mode choices, departure time changes and trip cancellations to reduce time wasted in a traffic jam. Therefore, we introduce a multi-modal transport model that simulates travellers' behaviour after a large-scale infrastructure failure at a critical node in the European TEN-T network. We use a novel approach of modelling the region around the infrastructure disruption in a very detailed manner, whereas the rest of Europe is modelled in a more basic way. This enables us to model impacts of disruptions in high detail, whereas also effects throughout Europe are considered, within reasonable computation time.

Keywords: transport model; disruptions; critical infrastructure; traveller behaviour; traffic assignment; TEN-T network

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

387 Building feedback into modelling impacts of automated vehicles: Developing a consensus model and quantitative tool

Hannah E. Rakoff[a]*, Scott Smith[a], Satu Innamaa[b], Yvonne Barnard[c], Gillian Harrison[c], Jingsi Shaw[a]

a U.S. Department of Transportation, Volpe National Transportation Systems Center, 55 Broadway, Cambridge, MA 02142, USA
b VTT Technical Research Centre of Finland Ltd, P.O. Box 1000, FI-02044 VTT, Finland
c Institute for Transport Studies, University of Leeds, 34-40 University Road, Leeds, UK LS2 9JT
** hannah.rakoff@dot.gov*

Abstract

System dynamics offers a rigorous approach to modelling the sometimes-surprising dynamics endogenous in complex systems and is ideal for gaining insight into potential impacts of automation in transport. Researchers from Europe and the U.S. are developing a consensus model, starting from an impact assessment framework presented at TRA 2018 and published shortly thereafter. This paper reports on a 2019 group model building workshop, which collated the intelligence of a diverse

international group of modelling, transport and liveability/equity experts, focusing on socioeconomic impacts ofhighly automated vehicles, from household and public authority standpoints. Subsequent work developed a general framework from which detailed system dynamics models canbe created for specific research questions. The ultimate goal is to develop a quantitative tool that can help planners and policy-makers understand howhighly automated vehicles may fit within the transport system, and to begin to explore consequences of potential actions under various scenarios.

Keywords: system dynamics; automated vehicles; impact assessment; scenario planning; causal loop structures; feedback

483 Impact of conflict resolution parameters on combined alternate-directions lane assignment and reservation-based intersection control

Nikola Mitrovic[a], Aleksandar Stevanovic[a]*

a Florida Atlantic University, 777 Glades Rd, Boca Raton, FL 33431
** astevano@fau.edu*

Abstract

We recently proposed a concept, called Combined Alternate-Direction Lane Assignment and Reservation-based Intersection Control (CADLARIC), for organizing directionally unrestricted traffic flows in automated vehicle environment. The conflicts between through movements are handled by a reservation-based algorithm while the turning conflicts at the intersections are avoided altogether. This paper extends this research by analyzing the impacts that CADLARIC's parameters, used to control the conflict-resolution processes, have on the efficiency and safety. The investigated parameters include: (i) buffer time in cell's reservation schedule; (ii) allowed speed to cross the reserved cell; (iii) distance from intersection from which a vehicle can make reservation, and (iv) duration of the lane-change process. For most of the investigated parameters, the numerical results show that less efficient operations lead not just to an increase in delay time and number of stops but also increase number of conflicting situations, as a consequence of vehicular queues formed within the intersection zone.

Keywords: Automated intersection control; Autonomous and Connected Vehicles; Reservation-Based Intersection Control

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

558 Recommendations for a methodological enhancement of the national German accessibility model

Stefan Schönfelder[a]*, Thomas Pütz[b], Björn Schwarze[c], Klaus Spiekermann[c]

a University of Economics and Business, Institute for Transport and Logistics Management, Welthandelsplatz 1, 1020 Wien, Austria
b Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR), Deichmanns Aue 31-37, 53179 Bonn, Germany
c Spiekermann & Wegener, Urban and Regional Research (S&W), Lindemannstraße 10, 44137 Dortmund, Germany
** stefan.schoenfelder@wu.ac.at*

Abstract

The Federal Institute for Research on Building, Urban Affairs and Spatial Development, BBSR, has analysed regional accessibility for Germany since the 1980s. Its multimodal and GIS-based analytical system is applied for monitoring the performance, efficiency and quality of transport infrastructure, the settlement system and access to services of general interest. It also acts as decision support tool for national transport and regional policy. Given new challenges for the accessibility model through the availability of new data, methods and political objectives, the BBSR commissioned a study to develop scientific recommendations for an update and expansion of its analyses. This paper presents selected results focusing on a more realistic representation of car travel times and the way of modelling central places as destinations.

Keywords: transport; accessibility; modelling; travel times; temporal dynamics; passenger transport

Full paper:
https://www.bbsr.bund.de/BBSR/DE/FP/MORO/Studien/2017/erreichbarkeitsmodell/Accessibility_model.html

592 Is the car-following model appropriate for the simulation of mixed traffic considering e-scooters?

Zoi Christoforou[a]*, Nadir Farhi[a], Yeltsin Valero[a]

a IFSTTAR/GRETTIA, 14-20 Boulevard Newton, 77420 Champs-sur-Marne, France
** zoi.christoforou@ifsttar.fr*

Abstract

This paper explores the pertinence of the car-following models for the simulation of mixed traffic considering e-scooters. The car-following model that have been analyzed was the Krauss model. This model is implemented in the open source Simulation of Urban Mobility – SUMO. The data collection has been realized with video data analysis that allows an automated extraction of the position and speed of the vehicle by typology. The calibration process of the parameters of the car-following models for the simulation of e-scooters consists in generating random input parameters, which are subsequently simulated in SUMO, to obtain as a result, the different trajectories. These modeled trajectories are compared with the trajectories collected by the cameras and by means of an error minimization function between the real and modeled trajectory, which allows determining the optimal parameters for the car-following model for e-scooters.

Keywords: Car-Following Model, SUMO, E-Scooters, Mixed Traffic Simulation

661 Robust methods and conditional expectations for vehicular traffic count analysis

Jorma Kilpi[a]*, Ilkka Norros[b], Pirkko Kuusela[a], Fanny Malin[a], Tomi Räty[a]

a VTT Technical Research Centre of Finland Ltd, Tekniikantie 1, Espoo, FI-02044 VTT, Finland
b University of Helsinki, Fredrikinkatu 73 B 19, Helsinki 00100, Finland
** jorma.kilpi@vtt.fi*

Abstract

We study the problem of making algorithmic statistical inferences about the dynamics of city traffic. Our data is based on loop detector counts of observed vehicles in various roads in the city of Tampere, Finland. We show that meaningful correlations can be found between traffic asymmetries at different measurement

locations. The traffic asymmetry is the difference of the traffic counts of the opposite directions of a road. The correlations can be further quantified by estimating how much they effect on the average values of the traffic asymmetries at the neighbouring locations. Conditional expectations, both sample and binormal model-based versions are useful tools for quantifying this effect. The uncertainty bounds of conditional expectations of the binormal model distribution are extremely useful for outlier detection. Furthermore, conditional expectations of the multinormal distribution model can be used to recover missing data with bounds to uncertainty.

Keywords: loop detector; traffic count data; robust statistics; truncated distribution; multinormal distribution

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

982 A Departure Delay Estimation Model for Freight Trains

Niloofar Minbashi[a]*, Markus Bohlin[a], Behzad Kordnejad[a]

a Division of Transport Planning, KTH Royal Institute of Technology, Stockholm 10044, Sweden
** minbashi@kth.se*

Abstract

The main objective of this paper is to develop a macroscopic delay estimation model for freight trains departing from a marshalling yard. Freight trains are made up in large marshalling yards comprising three yards (arrival, classification, departure). On time operations in marshalling yards enhances reliability of rail freight services compared to other modes of freight transport. Currently, freight trains encounter most of their delays in marshalling yards even before entering the railway network. Therefore, there is a need to estimate the departure delay of freight trains from the marshalling yard. So far, studies have mainly focused on classification yard operations to estimate departure delay, whereas a proper delay estimation model should be able to consider processes of all three yards. We have developed our model considering main factors (yard congestion, wagon availability and locomotive availability) from all three yards. Hallsberg and Malmö Marshalling yards in Sweden were used as case study.

Keywords: Delay Estimation; Marshalling Yards; Rail Freight; Swedish Railways; Shift2Rail

Full paper:
https://www.researchgate.net/publication/339900221_A_Departure_Delay_Estimation_Model_for_Freight_Trains

1028 A GIS-based accessibility model for predicting the demand for residential parking

Johanna Mäkinen[a]*, Heikki Liimatainen[a]

a Transport Research Centre Verne, Tampere University, P.O. Box 600, 33014 Tampere, Finland
** johanna.m.makinen@tuni.fi*

Abstract

Many cities have abandoned minimum parking requirements, since these requirements do not meet the individual needs of different areas and have led to over- and undersupply of parking. The focus of this research was to develop a GIS-based model for predicting residential parking demand in Kerava, Finland. Factors

affecting vehicle ownership were studied by analysing GIS-based sociodemographic and built environment data. Moreover, a GIS-based tool was created to analyse accessibility of everyday services. Linear regression analysis was used to create a predictive model. The variables included in the model were number of inhabitants, number of owner-occupied dwellings, average floor area per person and accessibility. The explanatory power of the model is high (R2=0.928). Vehicle ownership is affected by many more factors than the parking requirements are taking into consideration. With GIS-based methods, differences in vehicle ownership can be considered, and over- and under-supply of residential parking can be minimised.

Keywords: Residential parking; Accessibility; Car ownership; Parking policy; GIS; Parking requirements

1036 Micro and macro: Development of a hybrid travel demand model with aggregate gravity and individual-level activity-based approaches

M.L. Hollestelle[a]*, H.B. Rijksen[b], L.J.N. Brederode[b,c], R.J. Koopal[d], P.T. Moilanen[a,e]

a Digital Mobility Lab, Ramboll Finland Oy, PL 25 Itsehallintokuja 3, FI-02601 Espoo, Finland
b DAT.Mobility, Snipperlingsdijk 4, 7417 BJ Deventer, The Netherlands
c Department of Transport and Planning, Faculty of Civil Engineering, Delft University of Technology, Stevinweg 1, 2628 CN Delft, The Netherlands
d Goudappel & Coffeng, Snipperlingsdijk 4, 7417 BJ Deventer, The Netherlands
e Kyyti group, Fredrikinkatu 47, 00100 Helsinki, Finand
** martijn.hollestelle@ramboll.fi*

Abstract

This paper describes the development of a hybrid travel demand model that combines aggregated gravity-modelling with the individual-level travel demand model called Brutus. Aim of this model development is to combine the favorable properties from both approaches: individual-based approach can use discrete tours as their units of travel and offer rich heterogeneity in behavioral models among different agents. Aggregate models do not have such advantages but offer stable results and are, at least with higher abstraction level, more calculation time efficient. Both models are developed in parallel based on the same input data. The two different modelling approaches and their integration are explained and compared, as well as the challenges faced, focusing on practicalities and theoretical questions raised within the process.

Keywords: Travel demand modelling; agent-based model; gravity model; hybrid model

1109 Intelligent Intersection Management using Fuzzy Logic control and PI control

Ilhan Tunc[a], Mehmet Turan Söylemez[a]*

a Control and Automation Engineering Department, Istanbul Technical University,Istanbul,Turkey
**soylemezm@itu.edu.tr*

Abstract

Traffic congestion is one of the leading causes of loss of productivity and low living standards in urban areas. The effectiveness of transport systems is a priority for modern society. The regions with the highest traffic density in cities are those with traffic intersections. Intelligent traffic light applications reduce waiting time in traffic. Therefore, as these practices become widespread in big cities, quality of life

increases. Therefore, control of traffic lights in these areas is a crucial factor in reducing traffic congestion. In this study, a single intersection simulation environment is made by using Simulation of Urban MObility (SUMO) program. Fuzzy logic control based and Proportional Integral (PI) type control based traffic light controllers are designed for controlling a basic road junction. Simulations for the designed controllers and conventional traffic light controllers are performed and the results are compared.

Keywords: Fuzzy Logic, Intelligent Intersection Management, Intelligent Transportation Systems, Traffic Light Controller (TLC)

Full paper: https://web.itu.edu.tr/soylemezm/tra2020/tunc_soylemez.pdf

1110 Impact of Automated Highway Autopilot on the Average Network Travel Times and Total Distance Travelled

Marieke S. van der Tuin[a]*, Gonçalo H. A. Correia[a], Haneen Farah[a]

a Department of Transport and Planning, Faculty of Civil Engineering and Geosciences, Delft University of Technology, P.O. Box 5048, 2600 GA Delft, The Netherlands
** m.s.vandertuin@tudelft.nl*

Abstract

Allowing Level 4 Automated Vehicles (AVs) to drive on highways could potentially have an impact on the road network performance. Although it might probably take a while before AVs are on the road, National Road Authorities (NRAs) are already concerned about understanding what changes would be required on their current infrastructure to make it ready for AVs. In this study, we simulate part of the highway network in the Netherlands, the region of Rotterdam The Hague, to investigate the impact of AVs on the network performance in terms of network travel times and distances travelled. Results allow us to conclude that 50% AVs (Level 4) result in an increase in distance travelled on highways but a decrease in the total network travel times and corresponding delays.

Keywords: autonomous vehicles; highway autopilot; OmniTRANS; NRA

Full paper: http://resolver.tudelft.nl/uuid:d142526e-3f1d-4d10-8bbc-c08a52857ec6

1.18 Scientific and technical session 18: Collaborative urban planning and stakeholder engagement

153 SPADE – Assessment method for the collaborative planning of infrastructure and spatial development

Jan Kiel[a]*, Benjamin Biesinger[b], Rasmus Bøgh Holmen[c], Wiljar Hansen[c], Ivo Hindriks[a], Niklas Galonske[d], Arianna Zanardelli[d]

a Panteia, Bredewater 26, 2715 CA Zoetermeer, The Netherlands
b AIT Austrian Institute of Technology, Giefinggasse 4, 1210 Vienna, Austria
c TØI Institute of Transport Economics, Gaustadalléen 21 NOR 0349, Norway
d HaCon Ingenieurgesell9schaft, Lister Straße 15, DEU 30163 Hannover, Germany
** j.kiel@panteia.nl*

Abstract

The development of infrastructure takes place at different spatial levels, spatial functions, time horizons and involves many stakeholders. The consequence is that planning may become complex. The SPADE project – funded by CEDR – developed

a method to keep the planning process efficient. The method addresses different planning challenges, thereby going beyond the traditional assessment package of cost-benefit analysis and multi-criteria assessment methods. First, it exploits the information of the different stakeholders to achieve a better outcome from a social point of view. Second, it supports the decision-making process. The method comprises a process and an instrument. The process is embedded in collaborative planning. The instrument consists of a digital workshop or e-participation with a Delphi method and a tool to assess policy measures or packages based upon their impacts. The method allows a cost-efficient and fast exchange of information and a better understanding amongst stakeholders on the different impacts, which include qualitative aspects.

Keywords: collaborative planning; infrastructure planning; spatial development; assessment method; impact assessment; stakeholder involvement

Full paper: http://www.spade-project.eu/wp-content/uploads/2020/03/SPADE_TRA2020_Paper.pdf

154 Impact assessment and participation in the Helsinki region land use, housing and transport plan – Success stories and lessons learnt

Mette Granberg[a]*

a Helsinki Region Transport Authority HSL, Opastinsilta 6A, Helsinki 00077 HSL, Filand
** mette.granberg@hsl.fi*

Abstract

The Helsinki region land use, housing, and transport plan defines how to develop the region in the coming decades. It is essentially a sustainable urban mobility plan (SUMP) for the region and includes all the main steps of the SUMP plan from setting up working structures to reviewing and learning lessons. This paper is based on the review and evaluation process of the plan, and success stories and lessons learnt identified in it. The making of the plan consisted of an extensive impact assessment, including modelling. With many stakeholders, participation has also been a key factor in the making of the plan. Elected officials were actively involved in the making of the plan. The impact assessment and its use as a planning tool was successful yet room for clarifying main results still exists. An impact assessment panel with outside expertise from universities, researchers, and students could be of value.

Keywords: regional planning; impact assessment; participation

394 Structuring peri-urban living with the railway system: stakeholders representations of urban planning around peri-urban rail stations

Sophie Hasiak[a]*, Cyprien Richer[a]

a Cerema Hauts de France, research project-team Esprim, 44 ter rue Jean Bart, 59019 Lille, France
** sophie.hasiak@cerema.fr*

Abstract

Urban sprawl and peri-urbanization processes have been important challenges for cities all around the world, generating car dependency. Public policies have taken up this issue with the aim of managing peri-urban mobilities by considering the opportunity of rail services through a sustainable approach. Indeed, the enhancement of the railway system has been at the heart of concerns of land use

public stakeholders since the early 2000s. This paper suggests a specific approach to assess how this aim of railway enhancement is really a topic taken into account by all the stakeholders, whether they are inhabitants, elected representatives or representatives of economic societies. It relies on analyzing the representations they have for peri-urban areas. Based on different methodological approaches, it highlights a certain convergence of interests to live near peri-urban railway stations, which could contribute to strengthen "urbanity" in a sustainable way.

Keywords: rail station; peri-urban, representation, way of living, urbanization policy, property promotion

399 Urban Mobility Systems Evaluation with focus on Business Sustainability and Stakeholders Influence

Asad Karisik[a]*

a Blue Desk Sarajevo, Bosnia and Herzegovina
** asad.karisik@gmail.com*

Abstract

Urban Mobility Systems UMS are in the constant process of evolution within the complex technical, administrative, and regulatory environment. Well-structured process of UMS development requests continuous implementation of targeted and structured phases of evaluation and improvement. Selection of limited numbers of available UMS indicators have significant interpretation limitations. Comprehensive approaches give complex matrix of indicators difficult to understand and handle. UMS are heterogeneous systems with complex relations among main stakeholders' groups with fundamental differences in interests, roles and competences. Despite those differences, all UMS stakeholders have significant impact on UMS purpose and sustainability. Irrelevant to the UMS technical and organizational aspects, UMS is a service provider. Provision of UMS services is a market activity defined by mobility demand and service quality. UMS market success or failure shapes the Business sustainability and UMS development perspectives. This paper proposes new UMS evaluation approach with focus on UMS stakeholders and business sustainability.

Keywords: Urban Mobility Systems (UMS), UMS Evaluation, UMS Capability

Full paper:
https://www.researchgate.net/publication/339499845_Urban_Mobility_Systems_Evaluation_with_focus_on_Business_Sustainability_and_Stakeholders_Influence

415 Positive Planning Approach to Secure Logistics facilities in Swiss Urban Areas

Martin Ruesch[a]*, Paolo Todesco[a], Philipp Hegi[a]

a Rapp Trans Ltd, Max-Högger-Strasse 6, 8048 Zurich, Switzerland
** martin.ruesch@rapp.ch*

Abstract

The growing logistics market leads to an additional need for logistics and freight transport facilities for transhipment, storage, picking etc. with correspondent need for space. Another trend is the advancing urbanization, which increases the need for space for the city development (housing, business, leisure activities etc.). This development creates a strong pressure on existing logistics facilities and leads to a limited availability of space for new logistics facilities. The observed "Logistics

sprawl" increases the transport performance and related emissions. Therefore land use strategies should be based on a «positive planning approach». This approach includes the identification of suitable areas for logistics based on relevant location requirements. In Switzerland a project has been carried out to develop a methodology to identify suitable areas for logistics facilities , to test the methodology and to applicate it. The results are used to secure space for logistics in regional land use plans.

Keywords: Logistics Sprawl; Logistics Facilities; Positive Planning Approach; Location Planning; Location Evaluation

652 Decision support for reliability improvement of multimodal public transport services

Vítor Santos[a]*, Tânia Fontes[a], Joel Ribeiro[a], Jorge Pinho de Sousa[a,b], Jorge Freire de Sousa[a,b]

a INESC TEC, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal
b Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal
** vitor.h.santos@inesctec.pt*

Abstract

A set of processes, including the collection of heterogeneous data and in-depth knowledge on multiple dimensions, are required to enhance multimodal public transport services and address traveller needs in an effective and efficient way. The main purpose of this paper is to use reliability data to drive the planning and operationalisation of a multimodal metropolitan-wide network of public transport, covering the needs of authorities, transport providers and travellers. This will be achieved by a methodology using data from current public transport lines and design process to find the best combination of hubs, stops and connections, fully controlled by the transport authority and with the assistance of transport providers. The expect result is a more "predictable" network that maximises schedule reliability, while providing better information for travellers.

Keywords: reliability; urban public transport; multimodal networks; decision support systems

Full paper:
https://www.researchgate.net/publication/339843921_Decision_support_for_reliability_improvement_of_multimodal_public_transport_services

824 Toward carbon neutrality in French regions: a case study for passengers' local mobility

Patrice Nogues[a]*

a EDF R&D avenue des Renardières Moret-Loing-et-Orvanne, 77250, France
** patrice.nogues@edf.fr*

Abstract

The French regions are in charge of implementing an energy-climate strategy for their territory. To date, no mandatory targets have been set at this level, as each region can choose its own overall objective and distribute the burden among the different sectors. However, the recent national energy law has set a carbon neutrality target by 2050, corresponding to a reduction of at least 83% in GHG emissions compared to 1990. With 33% of greenhouse gases emissions in 2018 in France, the transport sector is the main emitter and the only one which emissions

have been increasing since 1990. It is therefore a key sector to achieve the objective of decarbonization. In this article we will present a synthesis of 3 regional case-studies and highlight specificities concerning the regional level. Specific modelling will assess the key factors for achieving carbon neutrality at this scale for passengers' local mobility.

Keywords: carbon neutrality; regional energy planning; scenarios; energy; climate

Full paper:
https://www.researchgate.net/publication/339725964_Toward_carbon_neutrality_in_French_regions_a_case_study_for_passengers'_local_mobility

956 Urban mobility planning in Czechia: change of paradigm, challenges and barriers in local governance

Hana Brůhová Foltýnová[a]*, Radomíra Jordová[a]

a Faculty of Social and Economic Studies, Jan Evangelista Purkyně University in Ústí nad Labem, Pasteurova 3544/1, 400 96 Ústí nad Labem, Czech Republic
** hana.bruhova-foltynova@ujep.cz*

Abstract

The approach of Czech cities to urban transport planning has been changing substantially during the last years. This policy shift has been accelerated by the European legislation, which encourages larger cities to prepare their first Sustainable Urban Mobility Plans. The aim of this paper is to explore the institutional issues regarding practice and barriers of sustainable transport planning in Czech cities. Qualitative and quantitative data were collected between June 2018 and February 2019: we interviewed 45 key stakeholders, and further 67 representatives from 53 cities completed a questionnaire. Results of our research indicate that Czech cities are still in the initial phase of the change towards sustainable urban mobility planning. The main identified barriers of sustainable mobility are complicated legislation, a lack of political consensus, and attitudes of the society, which is quite car-oriented. Monitoring and evaluation, as well as public involvement are underestimated and the perception of a need for a significant transport behaviour change is quite low among the local politicians.

Keywords: Urban mobility; monitoring and evaluation; policy-making of cities; sustainable urban mobility plan

1120 Intermodal scenarios in the Adriatic-Ionian area: the Stakeholders' views of Corfu, Bari, Pula and Dubrovnik

Veronika Andrea[a]*, Konstantinos Malagas[b], Chrysostomos Stylios[a], Nikitas Nikitakos[b]

a University of Ioannina, Dept. of Informatics & Telecommunications. Laboratory of Knowledge and Intelligent Computing, Kostakioi, Arta 47150, Greece
b University of the Aegean, Address, Korai 2A, Chios 82100, Greece
** stylios@uoi.gr*

Abstract

Intermodal transportation systems have been emerged by the need for advanced, responsive, safe, sustainable, smart and cost-efficient solutions in transportation of goods and passengers. The European Union policies, strategies and initiatives aim to successfully enhance connectivity. The current study examines four (4) intermodality cases in the Adriatic-Ionian area, located in Corfu, Bari, Pula and Dubrovnik. The data were collected with the use of a structured and a semi-

structured questionnaire addressing experts, airport and port professionals, researchers, and travel agents. The stakeholders' views were analyzed by descriptive statistics and a SWOT analysis was also conducted. The study aims to provide important insights on the prospects and challenges for the development of intermodal scenarios in the Adriatic-Ionian area according to the stakeholders' views. The main findings of the study are focusing on the realization of tailor-made scenarios such as new soft infrastructures with the incorporation of innovative e-services aiming to improve the quality of the passengers' experience.

Keywords: intermodal transportation, airport, port, Adriatic Ionian area, passengers, stakeholders

Full paper:
https://www.researchgate.net/publication/339915822_Intermodal_scenarios_in_the_Adriatic-Ionian_area_the_Stakeholders'_views_of_Corfu_Bari_Pula_and_Dubrovnik

1127 Assessing user expectations, requirements, and concerns toward automated driving progressed by internet of things – a user-centric development approach

Viktoriya Kolarova[a]*, David Ertl[b], Elina Aittoniemi[c], Gillian Harrison[d], Katerina Touliou[e], Yvonne Barnard[d], Lara Naendrup-Poell[a]

a German Aerospace Center, Institute of Transport Research, Rudower Chaussee 7, 12489 Berlin, Germany
b FIA, Rue de la Science 41, 5TH Floor 1040 Brussels, Belgium
c VTT Technical Research Centre of Finland Ltd, P.O.Box 1000, FI-02144 VTT, Finland
d Institue for Transport Studies, University of Leeds, Leeds, LS2 9JT, UK
e CERTH, 6th km Charilaou-Thermis, 57001 Thermi Thessaloniki, Greece
** viktoriya.kolarova@dlr.de*

Abstract

Road vehicles are becoming increasingly automated and connected due to rapid technological progress and digitalization trends. Vehicle connectivity might improve automated driving (AD) in various ways. The EU project "AUTOPILOT" develops, tests and evaluates different services and use cases of automated driving focusing on the potential of Internet of Things (IoT) to progress AD. In order to provide early insights on expectations, requirements and concerns of potential users, an online survey was conducted following a user-centric development approach. Three different scenarios of AD progressed by IoT as well as desirable functions of the services were evaluated from user perspective. The analyses look into how IoT enhances, enables and accelerates AD. The results suggest the following benefits of IoT for AD when considering user acceptance: first, IoT can enable using the services with AD through easier trip planning by providing real-time traffic system information. Second, IoT can accelerate the market deployment of AD services as trust in the system is increased by providing information about the vehicle operation – one aspect which is crucial for user acceptance of AD. Third, IoT can contribute enhancing the user experience by providing real-time information about POIs and enabling customization options. This contribution summarizes the main results and discusses their implication for the development of the technology.

Keywords: automated driving, internet of things, connected driving, user acceptance

Full paper:
https://www.researchgate.net/publication/338149313_Assessing_user_expectations_requirements_and_concerns_toward_automated_driving_progressed_by_internet_of_things_-_a_user-centric_development_approach

1169 Enhancing social outcome from urban transport development: examining planning process and outcomes at multiple scales

Juhyun Lee[a]*, Jos Arts[a], Frank Vanclay[a]

a Faculty of Spatial Science, University of Groningen, Landleven 1, 9747 AD Groningen, Netherlands
** juhyun.lee@rug.nl*

Abstract

Urban infrastructure are promoted as a catalyst of urban development. However, it may not always improve society as a whole, because long-term consequences often fail to meet all the respective interests. We explore social outcomes arising from urban transport by examining consequences of spatial changes at multi-scales triggered by such projects, and extent to which the consequences meet varied interests. A multi-methods case study approach is used, using exemplars, metro projects in metropolitan cities, to observe planning process and social outcomes in specific contexts. We demonstrate that urban transport development tend to focus on immediate outcomes at macro scale, neglecting interests related to second-order, long-term consequences at multi-scales. These projects did not enhance wellbeing of all citizens due to spatially differentiated benefits, and negative consequences created at local levels. We argue for integrated approaches to urban transport and spatial planning at multi-scales to enhance social outcomes from urban transport projects.

Keywords: social outcomes; urban spatial transformation; urban infrastructure development; megacities; megaprojects

1.19 Scientific and technical session 19: Safety and security in cyberspace

274 DEIS – Dependability Engineering Innovation for smart transportation

Eric Armengaud[a]*, Cem Kaypmaz[b], Erhan Ozkaya[b], M. Zeller[c], S. Longo[d], M. Melis[d], R. Groppo[e], E. O'Carroll[f], D. Schneider[g], J. Reich[g], Y. Papadopoulos[h], I. Sorokos[h], T. Kelly[i], I. Habli[i], R. Wei[i], F. Villa[j], G. Regan[k]

a AVL List GmbH, Hans List Platz 1, Graz 8020, Austria
b AVL Research and Engineering Turkey, Akpınar Mahallesi Tuna Caddesi Ballıca Sokak No: 1 34885. Sancaktepe Istanbul, Turkey
c Siemens AG, Wittelsbacherplatz 2, Munich 80333, Germany
d GM Global Propulsion Systems – Torino Srl, Corso Castelfidardo 36, Torino 10129, Italy
e Ideas&Motion S.r.l., via Santa Margherita 8, Alba 12051, Italy
f Portable Medical Technology Ltd, 66 Pairc Chuiminn Kilcumin, Killarney Kerry V93V6K4, Ireland
g Fraunhofer IESE, Fraunhofer-Platz 1, 67663 Kaiserslautern, Germany
h University of Hull, Cotthingham road, Hull HU6 7RX, United Kingdom
i University of York, Heslington, York North Yorkshire YO10 5DD, United Kingdom
j Politecnico of Milano, Piazza Leornado da Vinci 32, Milano 20133, Italy kDundalk Institure of Technology, Dublin road, Dundalk, Ireland
** eric.armengaud@avl.com*

Abstract

Ensuring appropriate dependability of modern industrial systems is becoming more and more challenging due to the raising complexity of modern embedded systems and the introduction of connectivity, possibly leading to ad-hoc creation of systems' configuration. State-of-the-art dependability analysis techniques, applied during design phase, provide limitation in terms of scalability with respect to the system size and in terms of runtime flexibility and ad-hoc reorganization. The DEIS project† addresses these important and unsolved challenges by developing technologies that

form a science of dependable system integration. Main contributions of this paper are (a) the introduction of the DDI concept and DEIS outcomes available for the community, (b) the illustration of DDI usage to increase functional safety development efficiency for railways systems, (c) the usage of DDI for data privacy management in context from Intelligent physiological parameter monitoring for road transportation, and (d) the introduction of DDI for trusted runtime collaborative platooning for road transportation.

Keywords: dependability; functional safety; SOTIF; data privacy; railway; automotive

311 Railway cybersecurity: Comprehensive and standardized approach to security risk assessment

Francisco Daza Pastrana[a]*, François Hausman[a], Katja Stumpp[b]

a Alstom, Rue Cambier Dupret 50-52, Charleroi 6001, Belgium
b Siemens Mobility, Kiefholzstraße 44, Berlin 12435, Germany
** francisco-jose.daza-pastrana@alstomgroup.com*

Abstract

Railway systems have been considered immune to cybersecurity threats and attacks for years. Nevertheless, the increase of interconnected and digitalized assets in the railway sector and the parallel rise of cyber-crime targeting industrial systems, have driven the need for a coordinated approach to deliver cyber-secure infrastructures and solutions to the railway sector. In this paper, a holistic approach based on the IEC 62443 cybersecurity standard framework is proposed by the cybersecurity work package 8 of Shift2Rail. This method includes the analysis of the IEC 62443 standard framework for application in railways, the definition of a generic signaling architecture and the specification of a common approach for risk assessment. Then, based on the results of the risk assessment, generic protection profiles for railway-specific components have been specified. In parallel, security-by-design concepts are investigated to specify a common quality framework for including cybersecurity in development lifecycles for the railway sector.

Keywords: cybersecurity, railway, IEC 62443, risk assessment, protection profile, security by design, ERTMS

319 Cryptographic protocols for secure communications over computer networks - Transport Layer Security

Kim Nordström[a]*, Anna Quach[a]

a Helsinki Region Transportation, Opastinsilta 6A, Helsinki 00077, Finland
** kim.nordstrom@hsl.fi*

Abstract

Cryptography is the art of secure data communication. Cryptographic protocols provide secure data connections, enabling parties to communicate with each other in a secure way. The Transport Layer Security (TLS) protocol enables two parties to identify and authenticate each other over the internet and enable client/server applications to communicate in a confidential and reliable way1. TLS is the mostly widely used cryptographic protocol for secure communications on the internet.2 One of the most well-known use for TLS is to protect information in transit between internet browsers and web servers using Hypertext Transfer Protocol Secure (HTTPS). This article focuses on the use of the TLS protocol in web servers used by Helsinki Region Transportation (HRT). Web sites developed by HRT were tested to

verify the security configuration of the web servers. As a result of the analysis several significant vulnerabilities were discovered.

Keywords: Information security; Network security; Transport Layer Security

629 Unmanned maritime infrastructure inspection– a mixed method risk management approach from German port facilities

Michael Stein[a]*

a Kühne Logistics University, Großer Grasbrook 17, Hamburg 20457, Germany
** Michael.stein@the-klu.org*

Abstract

Operations of unmanned technologies have risen considerably over the past decade given their advanced technology and affordable prices. It is widely agreed that this former military technology has established a valuable position in civil especially industrial applications. However, best practice of using unmanned systems is scars both in academia and the industry due to isolated applications and missing operational experience. This paper aims to shed light on the applicability of unmanned systems in critical infrastructure facilities on the example of port facilities. Conducting a mixed-method analysis, this paper introduces unmanned operations in the context of well accepted risk management models - the Swiss Cheese Model and a connected Bow Tie Analysis. The contribution of this paper provides tangible insights on novel inspection approaches using qualitative analysis. Furthermore, practical experiences from maritime operations pave the way for future unmanned operations in other sensible infrastructures and future risk management approaches.

Keywords: Unmanned Aerial Vehicles, Remotely Operated Vehicles, Drone Inspection, Port Infrastructure Inspection, Bow Tie Analysis, Swiss Cheese Model, Risk Analysis

Full paper:
https://www.researchgate.net/publication/339915476_Unmanned_maritime_infrastructure_inspection-a_mixed_method_risk_management_approach_from_German_port_facilities

658 Advances of Cybersecurity in Maritime Port Operations

Nils Meyer-Larsen[a]*, Rainer Müller[a], Katja Zedel[a]

a ISL Institute of Shipping Economics and Logistics, Barkhausenstrasse 2, 27568 Bremerhaven, Germany
** meyer-larsen@isl.org*

Abstract

Maritime transport is central to the world economy. More than 90 percent of inter-continental goods are transported by sea. In that way, ports are a key prerequisite for economic success. Consequently, significant disruptions to large ports therefore can negatively impact maritime supply chains and can cause damage to the maritime and trading industries. In today's maritime logistics, cybersecurity is an issue of high importance. A number of incidents such as the NotPetya attack on Maersk in summer 2017 impressively demonstrate that cyber threats impose a high risk of considerable financial and reputational damage for the maritime industry. This paper presents the project SecProPort, co-funded by the German Federal Ministry of Transport and Digital Infrastructure in the IHATEC program, which aims

to develop a security architecture for the communications network in maritime port operations.

Keywords: maritime blockchains; maritime cybersecurity; maritime port operations; port communications network; port community system

867 The Cyber Threat Preparedness in the Maritime Logistics Industry

Harri Pyykkö[a]*, Jarkko Kuusijärvi[b] Bilhanan Silverajan[c], Ville Hinkka[a]

a VTT Technical Research Centre of Finland Ltd, Vuorimiehentie 3, FI-02150 Espoo, Finland
b VTT Technical Research Centre of Finland Ltd, Kaitoväylä 1, FI-90571 Oulu, Finland
c Tampere University, FI-33014 Tampere University, Tampere, Finland
** harri.pyykko@vtt.fi*

Abstract

This paper reflects the importance of preparedness regarding cybersecurity and cyber threat related factors in maritime logistics industry in present era when the digitalization combined with new emerging technologies i.e. Artificial Intelligence, Internet of Things, Blockchain and so forth are being utilized with accelerating speed in the maritime logistics among others. The future trend in the maritime logistics indicates that all the resources are connected with each other in order to form integrated autonomous operating systems based on IT-platforms. Therefore, there is a need also in the maritime logistics industry to attach cybersecurity related matters and cyber threat prevention more systematically to the existing procedures in every level of the organization and consider these aspects when new technologies are being implemented. Training the personnel from the non-technical to the technical experts in realistic exercises help to prepare and handle the cyber incidents and raise the overall level of cybersecurity preparedness.

Keywords: Cybersecurity, cyber threat, cyber exercise, maritime, logistics, port

Full paper:
https://www.researchgate.net/publication/339845298_The_Cyber_Threat_Preparedness_in_the_Maritime_Logistics_Industry

925 Automated driving systems meet edge computing: A security perspective

Tahsin C. M. Dönmez[a], Yuan Zhang[a], Ethiopia Nigussie[a], Antti Hakkala[a]*, Jouni Isoaho[a]

a Department of Future Technologies, University of Turku, 20014 Turun yliopisto, Turku, Finland
** antti.hakkala@utu.fi*

Abstract

This work presents an overview of security challenges associated with Automated Driving Systems (ADSs), covering on- and off-board computations, trustworthiness of data sources, and communications. We focus on the security of computations and emergent involvement of the edge computing paradigm in ADSs. Analysis of ADS and edge computing security reveals that ensuring the integrity of offloaded computations and availability of the offloading service are major security challenges that must be addressed if edge computing is to play a significant role in ADSs. Verifiable computation is investigated as a security solution to ensure integrity of offloaded ADS computations, and a method for deciding on the adequateness of a verifiable computation scheme for ADS applications is proposed.

Keywords: Automated Driving System; Edge Computing; Security; Verifiable Computation; Self-driving; Driverless

969 Are there disadvantages in port digitalization?

Olli-Pekka Brunila[a]*, Vappu Kunnaala-Hyrkki[a]

a South-Eastern Finland Univeristy of Applied Science, Pääskysentie 1, Kotka, 48220, Finland
** olli-pekka.brunila@xamk.fi*

Abstract

Digitalization is revolutionizing the maritime logistics sector. Digital innovations are essential and will bring benefits to all stakeholders and actors, especially in the long run. Nevertheless, the transition to becoming a digital port can difficult and complex and, in the initial phases, disadvantages of digitalization may emerge. This paper aims to establish the disadvantages of digitalization especially at the initial phases, when the ports are beginning to adopt digital solutions. In the paper, a literature review will be performed, during which digital solutions and their potential disadvantages will be established. Based on the literature review, the disadvantages of digitalization in ports are related to incompatible systems, lack of resources, security threats and resistance towards digitalization. Yet, the benefits of digitalization cannot be denied and digitalization will become a necessary tool. Digitalization offers many opportunities for ports to improve their efficiency, productivity, security and sustainability.

Keywords: digitalization, logistics, maritime, ports

1180 Security and safety integrated approach for multimodal-hubs crisis management: a railway and airway proposition

Simon Collart-Dutilleul[a]*, Hela Kadri[a], Philippe Bon[a], Georges Mykoniatis[b], Samir Ben Ahmed[c]

a Ifsttar, 20 rue Elisée reclus, 59666 villeneuve d'ascq Cedex, Address, France
b Enac,Avenue Edouard Belin, 31055 Toulouse cedex 4, France
c Universite de Tunis El Manar, Campus Universitaire Farhat Hached, Tunisia
** Simon.Collart-Dutilleul@ifsttar.fr*

Abstract

This paper proposes a methodology to address the problem of international multi modal hubs crisis management. The analysis starts from the case study of the Brussel airport terrorist attacks to highlight multi-modal and international aspects of this kind of crisis. Then, focusing on railway and airway modes, the contextual and organizational diversity is explained. The need of a global crisis management system is justified, but the challenges ensuing from the different transportation modes are highlighted. The proposition of a modelling approach based on System of Systems formalism is studied. The possibility of building a correct by construction design of common functioning mode is justified using the scientific state of the art of formal methods providing a scientific framework for future technological and organizational innovations assessment.

Keywords: Crisis management, Safety and security integration, Multimodal approach, System of Systems, Airport, Railway

1.20 Scientific and technical session 20: Service provision and quality

140 Piloting the use of a passenger panel to improve public transport service quality

Antti Vuorela[a], Sampsa Laine[b]*

a Helsinki Regional Transport Authority, Opastinsilta 6 A, Helsinki 00520, Finland
b Data Rangers Oy, Pasilankatu 2, Helsinki 00240, Finland
** antti.vuorela@hsl.fi*

Abstract

There is a problem in service quality. Most public transport authorities present it as a key strategic component, but do not have an efficient approach to achieve it. This paper describes the pilot, which demonstrates the approach, that leads to efficient and continuous development of service quality. We show, how to clarify the need, which business process can be used to satisfy the need, which tools are required in this process, and what kind of a platform is required to make these tools possible. We constantly look for international collaboration. Do join us.

Keywords: customer experience; efficiency; communities; service design; mobile applications

196 HiReach: Innovative mobility solutions to cope with transport poverty

Stefano Borgato[a]*, Simone Bosetti[a], Cosimo Chiffi[a]

a TRT Trasporti e Territorio, Via Rutilia 10/8, 20141 Milan, Italy
** borgato@trt.it*

Abstract

The goal of this paper is to explore the rationale behind transport-related disadvantages and social exclusion by presenting how the ongoing (2018-2020) Horizon 2020 project HiReach (http://www.hireach-project.eu) contributes to tackling such issues across Europe. While supporting the EU's objective of coping with transport poverty, HiReach aims at developing new tools and business models capable of improving accessibility for special areas and communities and favouring inclusive and participative mobility for targeted vulnerable groups. Firstly, this paper provides a literature review on the concept of transport poverty and its connection with social exclusion. Then, it introduces the scope of HiReach and how the project addresses the transport needs of the most vulnerable people. Innovative mobility options that are part of the current transport offer are also explored. Finally, it provides recommendations respectively to users and communities, policymakers and public authorities, entrepreneurs and investors on how to successfully develop more inclusive mobility solutions.

Keywords: Transport poverty; Inclusive mobility; Vulnerable user groups; Rural mobility; Social issues

447 The Antwerp Marketplace for Mobility: Partnering with private mobility service providers as a strategy to keep the region accessible

Katia Kishchenko[a]*, Chris Van Maroey[b], Marijke De Roeck[c], Marjolein Salens[d]

a communication and dissemination manager Civitas Portis and Smart Ways to Antwerp, City of Antwerp
b project leader Smart Ways to Antwerp, City of Antwerp
c programme manager Smart Ways to Antwerp and coordinator Civitas Portis, City of Antwerp
d site coordinator Civitas Portis, City of Antwerp
** katia.kishchenko@antwerpen.be*

Abstract

Antwerp is the second largest Belgian city (ca. 524,000 inhabitants) and Europe's second largest port. Just like other European port cities, Antwerp faces the challenge of reconciling freight/logistic transport with major flows of commuter, citizens and visitors in and around the city. The mobility objective of the city of Antwerp is to tackle this port-city challenge, reducing motorized road movements and keep the region accessible and liveable. To achieve this, the city, port and its stakeholders, together with support from the European-funded project CIVITAS PORTIS, are implementing a wide range of measures to improve transport infrastructure and to stimulate a modal shift. The programme Smart Ways to Antwerp is aimed at informing, creating awareness and achieving behavioural change. It works togethers with many stakeholders and target groups (citizens, visitors, commuters, companies, providers). One of the projects is the Marketplace for mobility, a platform for partnerships with private mobility providers.

Keywords: sustainable mobility; Public-Private partnerships; cooperation framework; growth; accessibility; port cities

498 Integrating public transport and car-pooling services: Evidence from a field test in Switzerland

Francesca Cellina[a]*, Marco Derboni[b], Nikolett Kovacs[a], Andrea Emilio Rizzoli[b], Fabio Cartolano[c]

a University of Applied Sciences and Arts of Southern Switzerland (SUPSI), Institute for Applied Sustainability to the Built Environment (ISAAC), Campus Trevano, CH-6952 Canobbio, Switzerland
b Università della Svizzera Italiana (USI) - University of Applied Sciences and Arts of Southern Switzerland (SUPSI), Dalle Molle Institute for Artificial Intelligence (ISDSIA), Galleria 2, CH-6914 Manno, Switzerland
c FIT Consulting srl, via Lavinio 15, Rome 00183, Italy
** francesca.cellina@supsi.ch*

Abstract

This paper introduces the SocialCar platform aimed at reducing individual car use by combining the car flexibility and comfort with the advantages by public transport, such as punctuality, safety and lower environmental impact. SocialCar delivers its services by means of a smartphone app, which performs multi-modal vehicle routing by accounting for walking, public transport and car-pooling rides. It was field tested in four European sites, engaging common citizens and their everyday mobility needs. Here we present the app and the test we run in Switzerland, by involving 74 citizens for four weeks. Its outcomes provide a positive evaluation of the app effectiveness but also highlight the challenges of using real-life data, such as shortcomings in the availability of detailed and up-to-date public transport and car-pooling data. We conclude with the users' viewpoint on SocialCar's strengths and weaknesses and its potential for large-scale diffusion, based on focus groups with 19 participants.

Keywords: public transport; car-pooling; multi-modal routing algorithms; artificial intelligence; field test

588 The importance of commercial speed and operating costs for planning high-speed train services

Oskar Fröidh[a]*

a KTH Royal Institute of Technology, Div. of Transport Planning, Brinellvägen 23, SE-100 44 Stockholm, Sweden
** oskar.froidh@abe.kth.se*

Abstract

Examples from liberalized and vertically separated railway sectors show some operators do not necessarily run trains at the permissed line speed, and do not use the most efficient train types. This results in lower than possible commercial speeds or higher costs, consequently leading to lower socio-economic benefits. These phenomena are relevant for Sweden as the country plans for a possible high-speed rail network. For this project, an economic model was constructed based on available operating cost data to analyze two economic drivers of the operators behind the choice of train types. Costs and revenues including demand elasticity for travel time are calculated. Results clearly shows the importance of knowing market conditions, that is, the travel time sensitivity of potential train passengers. With lower time sensitivity, the importance of lower operating costs in terms of more efficient train concepts increases while higher time sensitivity increases the impact of high commercial speed.

Keywords: high-speed rail; railroad; travel market; train concept; operating profit

875 Encouraging park-and-ride use in commuter traffic: an investigation of user needs and requirements for the Viennese commuter belt

Karin Markvica[a]*, Christian Rudloff[a], Gernot Lenz[a], Martin Binder[b], Bernd Schweiger[c]

a AIT Austrian Institute of Technology, Center for Mobility Systems, Giefinggasse 4, 1210 Vienna, Austria
b AUTOBAHNEN- UND SCHNELLSTRASSEN-FINANZIERUNGS-AKTIENGESELLSCHAFT, Rotentrumstrasse 5-9, 1011 Vienna, Austria
c ÖBB-Infrastruktur AG, Praterstern 3, 1020 Vienna, Austria
** karin.markvica@ait.ac.at*

Abstract

The traffic system of urban areas is challenged by commuter traffic at peak periods. Especially motorized individual transport leads to congestion of the main transport axis and associated environmental and noise pollution. From a policy perspective, park-and-ride systems are necessary to ensure that commuters leave the car behind and cover at least a part of their journey with public transportation; however, the provision of infrastructure alone does not bring about a behavior change. It is necessary to encourage park-and-ride usage by providing services and information in a suitable, user-oriented manner. In this paper we present our approach to identify needs and requirements of commuters regarding parking lot availability and pricing that can be used as trigger points for behavioral change for the Viennese commuter belt. Persona development and the collection of type- and scenario-based behavioral data form the basis for addressing commuters appropriately to encourage park-and-ride usage in commuter traffic.

Keywords: park-and-ride systems; commuters; modal shift; personas; mobility behavior; Vienna

1023 Procurement models for modular mobility ecosystem services

Juho Kostiainen[a]*, Ville Valovirta[a], Jenni Eckhardt[b]

a VTT Technical Research Centre of Finland, Vuorimiehentie 3, Espoo 02150, Finland
b VTT Technical Research Centre of Finland, Kaitoväylä 1, Oulu 90570, Finland
** juho.kostiainen@vtt.fi*

Abstract

Providing cost-efficient transport services in remote areas with sparse population is very challenging. Neither schedule based public transport nor taxi services provide a feasible solution for offering sufficient service levels at affordable prices. Yet, significant budgets are used for providing subsidized taxi services for social and health care related transport. Modern digital on-demand services provide the technical tools for utilizing this capacity more efficiently by matching and combining the trips of several people rather than transporting them one-by-one. The different service components such as the on-demand transport optimization, dispatch and combination systems and end-user applications are provided by specialized companies. For the whole service, these need to be integrated. Based on a pilot project, this paper analyses the opportunities and implications of procuring such systems as open and modular components. While open systems and modularity provide flexibility and support innovation, for procurement it requires a lot of competences and effort.

Keywords: on-demand service; shared rides; taxis; rural area; MaaS; platform

1108 Commute mode choice: The quality of the public transport service and competition with car

Erik Bjørnson Lunke[a]*, Nils Fearnley[a]

a Institute of Transport Economics, Gaustadalleen 21, 0349 Oslo, Norway
** ebl@toi.no*

Abstract

An attractive public transport (PT) service is essential to reduce car commuting in cities. We analyse how different aspects of PT journeys affect the propensity to choose PT over car on commute trips. It is well established that the travel time ratio is crucial in affecting mode choice. In addition to door-to-door travel time ratio, we find that the number of transfers and the frequency of PT routes have a significant effect on commute mode choice. With direct routes and high frequencies, PT is an attractive alternative even when the door-to-door travel time is twice that of car. By applying these findings on commute patterns in Norwegian cities, we find that there are large geographical variations in the quality of the PT service relative to the car.

Keywords: Public transport; travel time; commute mode choice; value of time; public transport demand

1.21 Scientific and technical session 21: Simulation, modelling and algorithms – studies, tools and examples

117 PORTMOD - a Simulation Tool to Improve Container Terminal Operation

Toni Lastusilta[a]*, Hannu Rummukainen[a], Ville Hinkka[a]

a VTT Technical Research Centre of Finland Ltd, Vuorimiehentie 3, Espoo 02150 , Finland
** toni.lastusilta@vtt.fi*

Abstract

PORTMOD is a new simulation tool that aims to facilitate Container Terminal (CT) operation improvements. Some of the main tasks of a Terminal Operating System (TOS) is to determine container allocations on the container yard and schedule container moves performed by cranes and machines, e.g. Ship-To-Shore cranes and Straddle Carriers. Currently, no TOS provider provide what-if analyses. PORTMOD aims to fill this gap by simulating CT operation, which can be used to improve CT efficiency by adjusting CT operation or analysing investment decisions. Furthermore, PORTMOD enables analyzation of container flows in order to identify improvements. PORTMOD is built on open source DESMO-J framework, where the acronym stands for Discrete-Event Simulation and MOdelling in Java. PORTMOD differs from many other CT simulators by retaining the programming language possibility to build up customized simulations. Therefore, it is well suited for CT simulations with customizations; expansion of new simulation modules; and research purposes.

Keywords: Container Terminal, Discrete Event Simulation, Simulator, PORTMOD, Optimisation, Terminal Operating System

217 Methodology for Estimating the NOx Saving Potential by Building Charging Infrastructure for Electromobility

Teresa Eickels[a]*, Fabian Kühnel[a], Alexandra Theißen[a], Waldemar Brost[a]

a Chair and Institute of Urban and Transport Planning, RWTH Aachen University, Mies-van-der-Rohe-Str. 1, 52074 Aachen, Germany
** eickels@isb.rwth-aachen.de*

Abstract

Currently, the topic of air pollution control is of great interest in Germany. The reasons for this are the longer-lasting exceedances of the mandatory NO2 limit since 2010. These have led to lawsuits by the Environmental Action Germany. To comply with the demands quickly, one plotline is the promotion of electromobility. In this context, a methodology for estimating the potential savings of NOx emissions by modelling the substitutable vehicle kilometers of conventionally powered vehicles is being developed. One of the aims is to derive the connection between the expansion of the charging infrastructure or rather the promotion of electromobility and the reduction of NOx pollution. To this end, analyzes and forecasts relating to developments in the vehicle market and mobility in Düren are linked with the emission factors resulting from a traffic situation model. The basis for this includes region-specific, spatially highly resolved infrastructural, spatial structural and traffic data.

Keywords: electromobility; charging infrastructure (CIS); emission calculation; nitrogen oxide (NOx); site selection; HBEFA

Full paper: https://www.isb.rwth-aachen.de/global/show_document.asp?id=aaaaaaaaaltqhgq

243 Emerging Technologies in Development of Vehicle Fuel Consumption Models

DraženkoGlavić[a]*, Katarina Tadić[a], Katarina Kukić[a], Marina Milenković[a]

a University of Belgrade, Faculty of Transport &Traffic Engineering, V. Stepe 305, Belgrade Serbia
** drazen@sf.bg.ac.rs*

Abstract

Constant research of the relationship between roads, vehicles, drivers and weather conditions variables on fuel consumption (FC) is present. However, the impact of pavement condition has been rarely analyzed. The reason might be found in the lack of data on pavement conditions, exemplified in international roughness index (IRI). The general trend of digitalization in transportation enables usage of emerging technologies such as smartphone, that can collect data based on the various smartphone sensors. Undertaking a case study approach, this research aims to analyze the impact of IRI and vehicle speeds on the FC. Data on FC, IRI and speeds has been collected in a set of field experiments. Regression analysis was conducted to develop FC model. As a result, the obtained model contributes to increasing understanding of the factors affecting FC. The recommendations about FC modeling using smartphone collection process are provided, together with limitations of paper.

Keywords: Fuel consumption models; IRI; highway; smartphone; road geometry

Full paper:
https://www.researchgate.net/publication/339447114_Emerging_Technologies_in_Development_of_Vehicle_Fuel_Consumption_Models

281 Evaluating behavioral validity in traffic simulators

Sonja Schneider[a]*, Klaus Bengler[a]

a Chair of Ergnomics, Department of Mechanical Engineering, Technical University of Munich, Boltzmannstr. 15, 85748 Garching, Germany
** sae.schneider@tum.de*

Abstract

In traffic simulation, various approaches have been suggested to demonstrate behavioral validity, encompassing numerous parameters that presumably indicate the predictive value of simulator studies. The confusion about this nonetheless central concept is fostered by a surprising lack of guidelines or even minimum criteria for demonstrating the agreement of experimental and naturalistic settings. Summarizing common approaches and evaluating them with regard to their individual strengths and weaknesses, the present article argues for a more conservative use of the term validity. We thereby assume validation studies to provide insights on the transferability to uninstructed behavior in real world rather than the appropriateness of replacing physical testbeds by means of virtual reality. Suggesting a multi-stage procedure, we extend the comparison to physical environments by a deliberate definition of context variables, appropriate statistical methods, and thresholds tailored to the respective simulator's purpose.

Keywords: Simulator; behavioral validity; guidelines

Full paper:
https://www.researchgate.net/publication/339746571_Evaluating_behavioral_validity_in_traffic_simulators

287 Detecting possibly threatening conspicuous human behaviour in airport terminals via movement categorization

Olaf Milbredt[a]*, Florian Rudolph[a]

a German Aerospace Center (DLR), Lilienthalplatz 7, 38108 Braunschweig, Germany
** olaf.milbredt(at)dlr.de*

Abstract

Facing security issues is one of the most challenging aspects of global transportation. Detecting suspicious behaviour of passengers decreases the risk of an attack inside airport terminals. The preparation of attacks requires deception with concealment. In this paper we describe a methodology to detect categories of passenger movement which are based on analogies to visual and vocal signs of deception. We analyse position data for each passenger which is assumed to be derived by software examining raw surveillance camera data. Passengers are categorized by the shape of their path using physical quantities such as speed. Detected passengers are marked for further inspection. Testing and calibration of the proposed detector is done by a simulation environment covering a medium sized airport terminal building. After calibration, the detector is able to identify all previously defined conspicuous passengers. The approach can be applied to other traffic nodes.

Keywords: Human Motion Classification; Trajectory; Variability; Agent-based Simulation

Full paper: https://elib.dlr.de/134339/

305 Energy Minimization for an Electric Bus Using a Genetic Algorithm

Sina Torabi[a]*, Mauro Bellone[a], Mattias Wahde[a]

a Chalmers University of Technology, Gothenburg, Sweden
** sina.torabi@chalmers.se*

Abstract

This paper addresses, in simulation, the energy minimization of an autonomous electric minibus operating in an urban environment. Two different case studies have been considered, each involving a total of 10 different 2 km bus routes and two different average speeds. By following an optimized speed profile, generated using a genetic algorithm, in the first case study the vehicle was able to reduce its energy consumption by around 7 to 12 % relative to a baseline case in which it maintains a constant speed between stops, with short acceleration and deceleration phases. In the second case study, involving mass variation (passengers entering and alighting) it was demonstrated that the number of round trips that can be completed on a single battery charge is increased by around 10% using the proposed method.

Keywords: Energy minimization; autonomous vehicles; electric minibuses; speed profile optimization; genetic algorithms

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

482 Induction motor design tool for drivetrain applications

Lauriane Prongué[a]*, Nicolas Broch[a], Tobias Wellerdieck[a]

a BRUSA Elektronik AG, Neudorf 14, Sennwald 9466, Switzerland
** lauriane.prongue@brusa.biz*

Abstract

In this paper, an analytical design tool for the development of induction motors in automotive traction drivetrain applications is presented. The software was developed by BRUSA Elektronik AG to accelerate motor design development. The main motivation for the introduction of the new tool originates from the decreasing product life cycles of electrified drivetrains compared to classical internal

combustion engines. This trend is mainly driven by the switch towards hybrid and battery electric vehicles. The novel design tool optimizes the motor topology using analytical formulas considering automotive requirements, key performance indicators, and motor control strategy. The analytical approach allows for short computation times. This facilitates the analysis of a wide design space and the subsequent reduction to a manageable set of promising designs. The different parts of the design tool are described in detail in this paper and its accuracy is discussed with an example of a traction drive.

Keywords: induction motor; analytical motor design; efficiency optimization; automotive drivetrain; machine optimization

Full paper:
https://www.researchgate.net/publication/339830942_Induction_motor_design_tool_for_drivetrain_applications

731 Visibility estimation based on camera data and algorithm of snow recognition on traffic signs

Marjo Hippi[a]*, Daria Stepanova[a], Antti Mäkelä[b], Mika Rantonen[b]

a Finnish Meteorological Institute, P.O. BOX 503, FI-00101 Helsinki, Finland
b J AMK University of Applied Sciences, P.O. BOX FI-40101 Jyväskylä, Finland
** marjo.hippi@fmi.fi*

Abstract

Finnish Meteorological Institute (FMI) and JAMK University of Applied Sciences have developed algorithms to monitor safety condition on roads using new methods, like machine learning and image recognition. The idea is to estimate visibility on the roads based on camera data and recognize snow on the traffic signs. The idea to solve the first problem is to classify the observed visibility into three classes (normal, poor and very poor) and clarify the reason for the reduced visibility (snowfall, sleet, drifting/blowing snow on the road surface). Visibility information can be delivered to drivers who are driving to the area where horizontal visibility is reduced. The algorithm for the second issue is analyzing camera images to find the traffic sign, identify it and estimate amount of snow on the traffic sign. As a result, maintenance services can monitor traffic signs condition remotely which would help to save some resources and time.

Keywords: Machine learning, image recognition, road safety, road maintenance

Full paper: https://5gsafeplus.fmi.fi/docs/Hippiaetal_TRA2020.pdf

736 Modelling of bridge-vehicle interaction using 3D road surface models of bridge pavement

Maja Kreslin[a], Rok Vezočnik[a], Peter Češarek[b], Aleš Žnidarič[a], Darko Kokot[a]*

a Slovenian national building and civil engineering institute, Dimičeva 12, 1000 Ljubljana, Slovenia
b Faculty of civil and geodetic engineering, Jamova 2, 1001 Ljubljana, Slovenia
** darko.kokot@zag.si*

Abstract

The paper presents some results of the study of a complex model simulating bridge-vehicle interaction. Different real data were employed to build this simulation model and to study the level of dynamic impact that vehicles exert on the bridge as a direct result of driving over its uneven surface. The model incorporates input data from the scanning survey, i.e. the static terrestrial laser scanning technology that

was used to obtain a precise and detailed above-the-bridge road surface model. Additional data were gathered from sensors which were placed under the bridge construction and were exposed to a simulated crossing of a test vehicle. The study indicates a high level of compliance between simulated and measured bridge response. While knowing the magnitudes and locations of various kinds of road surface defections and measuring bridge response this helped to understand the simulation model more precisely and in a greater detail.

Keywords: terrestrial laser scanning; road surface unevenness, numerical simulations, bridge-vehicle interaction

737 Multiphysics and system simulation: a future game-changing process for railway system design and validation?

Emmanuel Batista[a]*, Johana Vally[a], Yann Daguin[a], Catherine Narbais-Jaureguy[a]

a Alstom SA, rue du Docteur Guinier, 65600 SEMEAC, France
** emmanuel.batista@alstomgroup.com*

Abstract

This paper describes how simulation can be a significant way of reducing needed time and costs for railway system design and validation. With a focus on train's traction system and its environment, several means of simulation will be detailed i.e. 3D accurate multiphysics modeling and system real time simulation. Their accuracy will be demonstrated based on experimental correlations for electrical, thermal, mechanical and system validation tests done on real traction system. To conclude this paper, a status will be presented on the simulation acceptation in norms and standards today and how simulation could be standardized. Some difficulties and bottlenecks will be also discussed.

Keywords: simulation, 3D multiphysics modelling, real time simulator, traction railway system, virtual validation

771 SPRINT: Semantics for PerfoRmant and scalable INteroperability of multimodal Transport

Mersedeh Sadeghi[a], Petr Buchníček[b], Alessio Carenini[c], Oscar Corcho[d], Stefanos Gogos[e]*, Matteo Rossi[a], Riccardo Santoro[f],

a Politecnico di Milano, Dipartimento di Elettronica, Informazione e Bioingegneria, Piazza L. Da Vinci 32, 20133, Milan, Italy
b OLTIS Group, Dr Milady Horakove 1200/27a, 77900, Olomouc, Czech Republic
c CEFRIEL, Viale Sarca, 226, 20126 Milano, Italy
d Ontology Engineering Group, Departamento de Inteligencia Artificial, Facultad de Inform´atica, Universidad Polit´ecnica de Madrid, Campus de Montegancedo s/n 28660, Boadilla del Monte, Spain
e UNIFE (European Rail Industry), 221 Avenue Louise, Brussels 1050, Belgium
f TRENITALIA, 1 Piazza della Croce Rossa, 00161 Roma, Italy
** stefanos.gogos@unife.org*

Abstract

Interoperability is a long-standing challenge slowing down the digitalization of mobility systems and the provision of full mobility-as-a-service offerings. This paper presents early results achieved by the SPRINT project (Semantics for PerfoRmant and scalable INteroperability of multimodal Transport), an integral part of the Shift2Rail IP4 work programme, in meeting the challenge. It introduces the conceptual architecture and describes the demonstrator implementation of the Interoperability Framework (IF), a solution designed to support servitization in the mobility domain in two directions: From the Travel Application perspective, the IF

provides semantically-consistent abstractions of distributed ICT resources offered by Service Provider Companies, insulating them from the "mechanics" of operating remotely over networks and across multiple communication protocols and/or data formats; from the Service Provider Companies perspective, the IF allows leveraging their native ICT computing environment and resources as elements of an end-to-end integrated intermodal mobility solution, insulating them from the specifics of the customer front-end applications.

Keywords: Mobility-as-a-Service, Servitization; S2R; Semantic Web; Semantic heterogeneity; multi-modal marketplace; Ontology

Full paper: https://re.public.polimi.it/handle/11311/1132635

945 Improving inbound logistic planning for large-scale real-world routing problems: a novel ant-colony simulation-based optimization

Vincenza Torrisi[a]*, Giovanni Calabrò[a], Matteo Ignaccolo[a], Giuseppe Inturri[a]

a University of Catania, Department of Civil Engineering and Architecture, Via Santa Sofia 64, Catania 95123, Italy
** vtorrisi@dica.unict.it*

Abstract

This paper presents the first results of an agent-based model aimed at solving a Capacitated Vehicle Routing Problem (CVRP) for inbound logistics using a novel Ant Colony Optimization (ACO) algorithm, developed and implemented in the NetLogo multi-agent modelling environment. The proposed methodology has been applied to the case study of a freight transport and logistic company in South Italy in order to find an optimal set of routes able to transport palletized fruit and vegetables from different farms to the main depot, while minimizing the total distance travelled by trucks. Different scenarios have been analysed and compared with real data provided by the company, by using a set of key performance indicators including the load factor and the number of vehicles used. First results highlight the validity of the method to reduce cost and scheduling and provide useful suggestions for large-size operations of a freight transport service.

Keywords: Ant Colony Optimization; Vehicle Routing Problem; Multi-agent simulation, Logistics

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

1037 A data-based traffic modeling approach for inter-vehicular collision simulation

Lu Zhao[ab]*, Nadir Farhi[a], Zoi Christoforou[a], Nadia Haddadou[b]

a Université Paris Est, IFSTTAR, COSYS, GRETTIA, F-77447 Marne-la-Vallée, France.
b Renault, 1 Avenue du Golf, 78280 Guyancourt, France
** lu.zhao@ifsttar.fr / lu.zhao@renault.com*

Abstract

Driver behaviour has a critical impact in crash occurrence rates and severities, meanwhile crash generation mechanisms and crash influence on traffic are not fully integrated in traffic simulators. In this paper, we propose a methodology for specific driver profile identification and generation, aiming to establish a relationship of the different driver profiles with crash occurrences. With this purpose, drivers with different profiles are extracted from NGSIM 101 vehicle trajectory dataset and

Intelligent Driver Model (IDM) is applied to represent the selected driver profiles in simulation. In order to simulate real driver behaviours, parameters of IDM have been calibrated using a genetic algorithm with trajectory data. As the NGSIM 101 dataset does not contain accidents, we have succeeded to generate inter-vehicular collisions by appropriately modifying the proportions of the selected driver profiles through numerical simulation with SUMO (Simulation of Urban Mobility) simulator. We have observed that the number of inter-vehicular collisions increases with the increasing of the proportions of the selected driver profiles, and that all collisions occurred in simulation are caused by the drivers with the proposed specific profiles.

Keywords: Vehicular collisions, Human driving behavior, Traffic modeling, Car-following models, Microscopic traffic simulation

1.22 Scientific and technical session 22: Smart city mobility solutions

304 Rethinking EU Urban Mobility Research: Lessons from the ECCENTRIC Project in Madrid

Ángel Aparicio[a]*

a Technical University of Madrid (UPM), Escuela de ingenieros de caminos, Madrid 28040, Spain
** angel.aparicio@upm.es*

Abstract

Since 2002, the CIVITAS initiative has been the cornerstone of transport research and demonstration in European cities, providing a selection of priority topics, a unified evaluation framework and a forum for regular networking and discussion. ECCENTRIC is one of the three full-size CIVITAS demonstration projects selected for the 2016-2020 period. While generally successful in terms of implementation of the measures envisaged, ECCENTRIC has also made evident the limitations of CIVITAS. Based on ECCENTRIC's experience in Madrid, three main limitations are identified: The CIVITAS top-down approach, focused on technical solutions, the neo-liberal roots of the EU transport policy, and local decision-making structures poorly suited to deal with innovation. The consequences of this mismatch include high implementation costs, modest engagement of residents and other local stakeholders, low impacts in terms of equity and quality of life, and limited influence on governance reform.

Keywords: urban mobility; social issues; equity; EU research; CIVITAS; quality of life, ECCENTRIC

Full paper:
https://www.researchgate.net/publication/339916398_Rethinking_EU_Urban_Mobility_Research_Lessons_from_the_ECCENTRIC_Project_in_Madrid

314 Public transport priority in 2020: Lessons from Zurich

Andrew Nash[a]*, Francesco Corman[b], Thomas Sauter-Servaes[c]

a Crowdsourced-transport.com; Bandgasse 21/15, Vienna 1070, Austria
b Institute for Transport Planning and Systems, ETH Zurich, 8093 Zurich, Switzerland
c Zurich University of Applied Sciences, School of Engineering, Winterthur, Switzerland
** andy@andynash.com*

Abstract

Priority significantly improves public transport attractiveness and efficiency, but how does it fit in an era of micro mobility, MAAS, shared mobility and smart cities? Zurich's systematic implementation of public transport priority created one of the

world's best public transport systems. While public transport priority is still very effective, cities face fresh challenges: increasing transport demand, calls for more active transport, a need for improved public spaces, and new players, technologies and business models disrupting the urban transport market. This paper investigates Zurich's program in light of these challenges and recommends that cities create and implement comprehensive sustainable transport priority programs. These programs would be fully integrated, support innovation, and build political support for implementation. They would strongly prioritise public transport, sustainable transport (walking, cycling), and complimentary liveability improvements. In short, cities should follow Zurich's approach for public transport – but broaden it to include all forms of sustainable transport.

Keywords: Public Transport, Priority, Sustainable Transport, Zurich, Urban Transport

Full paper: https://andynash.com/projects-3/zurich-public-transport-priority/

349 Advanced 5G validation trials across multiple vertical industries: transport, healthcare, and aquaculture

Meng Lu[a]*, Haibin Zhang[b], Bastiaan Wissingh[b], Robbin Blokpoel[a]

a Dynniq, Basicweg 16, 3821 BR Amersfoort, The Netherlands
b TNO, Anna van Buerenplein 1, 2595 DA, The Hague, The Netherlands
** meng.lu@dynniq.com*

Abstract

Transport, healthcare and aquaculture are important industry sectors in Europe, in terms of jobs, market size and international trade. Moreover, they are vital from a social perspective, e.g. for better patient treatment, more sustainable food production and safer road transport. The paper targets 5G applications in these three vertical industries especially for improving utility, efficient processes, and safety. It defines vital vertical use cases of transport, healthcare and aquaculture respectively by using the fifth generation wireless mobile telecommunications technology. Moreover, it investigates approaches for the technological and business validation of the trials of the three vertical industries. In addition, business opportunities for future 5G applications in transport, healthcare and aquaculture industries are discussed, and an European 5G Vision of "5G empowering vertical industries" is proposed.

Keywords: 5G; use case; transport; business

Full paper: www.linkedin.com/pub/meng-lu/4b/12b/758

461 Sustainable mobility persuasion via smartphone apps: Exploiting external extrinsic motivational factors

Francesca Cellina[a]*, José Veiga Simão[a], Francesca Mangili[b], Nicola Vermes[b], Pasquale Granato[a]

a University of Applied Sciences and Arts of Southern Switzerland (SUPSI), Institute for Applied Sustainability to the Built Environment (ISAAC), Campus Trevano, CH-6952 Canobbio, Switzerland
b Università della Svizzera Italiana (USI) - University of Applied Sciences and Arts of Southern Switzerland (SUPSI), Dalle Molle Institute for Artificial Intelligence (ISDSIA), Galleria 2, CH-6914 Manno, Switzerland
** francesca.cellina@supsi.ch*

Abstract

Cities worldwide seek to counteract problems associated with car-based carbon intensive lifestyles and novel appbased tools persuading mobility behaviour change are emerging as effective supports to structural and regulatory measures. Most persuasive apps adopt a gamified approach and motivate behaviour change through external extrinsic motivational factors, such as real-life prizes, with point-based rewarding systems depending on the distance travelled by non-car transport modes. Use of prizes, however, could be counter-productive, if not properly designed: promoting additional soft mobility leisure trips instead of modifying car-based commuting habits or stimulating wrong validations of automatically detected transport modes to gain points. In this paper, we introduce the features of a persuasive app co-designed with citizens in a Swiss-based living lab experiment, showing how, accounting for current limitations in automatic mobility tracking, we avoided counter-productive effects of typical point-based rewarding systems and guaranteed fairness, reducing the chances for app users to cheat the system.

Keywords: mobility tracking, behaviour change, persuasion, points, prizes, smartphone

616 BLEUN: Bluetooth Low Energy Urban Networks for Smart Mobility applications

José F. Papí[a], Francisco Aletta[b]*, Benjamin Le Collen[c]

a Etelätär Innovation, Claude Debussylaan 7-29, Amsterdam SOM, 1082 MC Amsterdam, The Netherlands
b Etelätär Innovation, Claude Debussylaan 7-29, Amsterdam SOM, 1082 MC Amsterdam, The Netherlands
c Etelätär Innovation, Claude Debussylaan 7-29, Amsterdam SOM, 1082 MC Amsterdam, The Netherlands
** f.aletta@etelatar.com*

Abstract

BLEUN (Bluetooth Low Energy Urban Networks) was a EU-funded research project spanning from September 2018 to August 2019, which explored the potential application of BLE technology to Smart Mobility, demonstrating the advantage of low-energy consumption. BLE technology clears the path for the new mobility paradigm behind crowd-sourced mobility. Led by Etelätär Innovation (Netherlands), in cooperation with Intelligent Parking (Spain) and Semab Projects (Spain), the project was co-financed by the TETRAMAX programme, an EU-funded innovation hub in the domain of customized and low-energy computing (CLEC). During the 12-month project, the team designed BLE nodes with the capacity of being deployed as scalable networks using extended MESH topology. This was done so through the development of a first prototype with the purpose of tracking and geo-locating public shared bicycles. It consisted of two field trials in Vitoria (Spain), which served as pilots for network deployment and operation, as well as for providing a proof-of-concept for potential customers.

Keywords: Bluetooth, Mobility, Network, Location, Positioning, Tracking

618 City Needs and FIWARE-based Smart City Solutions

José F. Papí[a], Francisco Aletta[b]*, Benjamin Le Collen[c]

a Etelätär Innovation, Claude Debussylaan 7-29, Amsterdam SOM, 1082 MC Amsterdam, The Netherlands
b Etelätär Innovation, Claude Debussylaan 7-29, Amsterdam SOM, 1082 MC Amsterdam, The Netherlands
c Etelätär Innovation, Claude Debussylaan 7-29, Amsterdam SOM, 1082 MC Amsterdam, The Netherlands

* *f.aletta@etelatar.com*

Abstract

This research was conducted to highlight mutual opportunities for cities and start-ups in the implementation of FIWARE–based solutions for Smart Mobility and was undertaken within the framework of the EC-funded frontierCities2 (fC2) Incubation & Acceleration Programme (2016-2018). The research's methodology was based on an online questionnaire fulfilled by a pool of 19 cities and 18 start-ups, both stakeholders in fC2. The latter aimed at assessing issues affecting the 'smart-competitiveness' of cities and the ability of the start-ups to tackle these by implementing FIWARE-powered solutions. The questionnaire sourced information from both actors, which consisted of ranking issues by order of importance and how each start-up could tackle them by order of efficiency. The results yielded by the research enabled a direct effort-allocation insight and advice for both stakeholders through the city and start-up matching matrices. Within the matching results, Transport and Mobility were denoted as a critical nucleus of issues.

Keywords: Smart City; Mobility; FIWARE; Survey

798 e-Mobility to add new innovative mobility solutions for citizens and local authorities

Aki Lumiaho[a]*, Dolores Ordóñez[b], Giuseppe Roccasalva[c], Ursula Lackner[d], Francesca Bena[e], Christina Strasser[f]

a VTT Technical Research Centre of Finland Ltd, Visiokatu 4, 33560 Tampere, Finland
b AnySolution, Camí de ca na Gallura, 7, 07010 Palma, Spain
c Politecnico di Torino (DAD) and City of Venaria (former major of town planning and mobility office), Viale P. A. Mattioli 39, Italy
d City of Villach, Rathausplatz 1, 9500 Villach, Austria
e City of Turin, Mobility Division, Piazza Palazzo di Citta 1, Torino 10123, Italy
f KELAG - Kärntner Elektrizitäts-Aktiengesellschaft, Arnulfplatz 2, 9020 Klagenfurt, Austria
* *aki.lumiaho@vtt.fi*

Abstract

This paper discusses of preparation of electromobility (e-Mobility) pilots and involvement of city administration and authorities pursuing target users for a new kind of e-Mobility offering using electric L-category vehicles (ELVs) as an extension of personal shared mobility and eventually an integrated part of electric Mobility-as-a-Service (eMaaS). The cities of Torino, Venaria Reale and Villach with the extension of City of Calvià (Spain) are involved in a European jointly funded research and innovation project to provide citizens, elderly people and tourists an innovative means of e-Mobility in the urban context. The actual pilots will start this summer, and the first results of user experience and feedback will be available in the spring 2020.

Keywords: electric L-category vehicles EL-V, e-Mobility, user involvement, administration cooperation, eMaaS, electricity utilities

896 Feasibility Study of Public Transport Ticketing using Bluetooth Beacons

Janne Lahti[a], Immo Heino[a], Olli Pihlajamaa[a], Juho Kostiainen[a]

a VTT Technical Research Centre of Finland Ltd, Vuorimiehentie 3, Espoo, Finland
* *Janne.Lahti@vtt.fi*

Abstract

Easy and reliable ticketing is essential for keeping public transportation fluent and comfortable for passengers. New ticketing models such as automatically tracked usage-based ticketing require accurate and real-time boarding detection. Using Bluetooth beacons for detecting and tracking when a passenger is in a vehicle (without having to take the phone out to validate or activate the ticket) allows various usage-based ticketing systems. This paper examines applicability of beacon-based approach for Walk-In/Walk-Out (WIWO) ticketing scheme and presents results of a conducted feasibility study along with some preliminary results of a hybrid detection system based on using both beacons and sensors, addressing the challenges encountered of using purely beacon-based systems.

Keywords: public transport; Bluetooth beacon; ticketing; WIWO; BIBO

948 Framework for developing solutions for accessible mobility: Potential of IoT solutions in public transportation

Olli Pihlajamaa[a]*, Juho Kostiainen[a], Maija Federley[a], Olli Kuusisto[a], Matti Luhtala[a]

a VTT Technical Research Center of Finland Ltd, P.O. Box 1000, VTT, FIN-02044, Finland
** olli.pihlajamaa@vtt.fi*

Abstract

A significant portion of global population has disabilities limiting their independent mobility. Assistive technologies and accessible physical environment can reduce the challenges. Concepts such as Internet of Things (IoT) and smart environments, however, are still scarcely utilized in practice although they can provide a new level of assistance by interconnecting people and their personal devices with their environment. In this paper, we analyse opportunities and prerequisites of IoT solutions for improving accessibility in a public transport context. Furthermore, we define a framework for understanding and analysing how humans, their activities and supporting solutions are intertwined in and with their context. An essential value is a multidisciplinary approach that helps to find and design solutions with a comprehensive view: understanding different users' needs, the related tasks as well as opportunities and preconditions for solutions scalable to different user groups and situations.

Keywords: IoT; public transport; mobility; accessibility; people with disabilities; development framework

1.23 Scientific and technical session 23: Rethinking public transport, commuting and mode choice

187 Affective User Interfaces: a conceptual framework of emotional design at mobile routing applications

Eleni Chalkia[a,b]*, Evangelos Bekiaris[a], George Yannis[b]

a Hellenic Institute of Transport, Center of Research and Technology Hellas, 6th km Charilaou-Thermis, GR- 60361, Thessaloniki, Greece
b Department of Transportation Planning and Engineering, National Technical University of Athens, 5 Iroon Polytechniou Street, GR-157 73 Zografou, Athens, Greece
** hchalkia@certh.gr*

Abstract

Humans perceive reality in, at least two ways; one is emotional (intuitive and experiential), and the other is rational (analytical and cognitive). Therefore, the emotional or affective design has become a hot topic in applications' design, as well

as in human factors. Nowadays, the success of an application requires understanding what the users want and prioritize their needs. When the designers understand the users in-depth, they can implement small changes in design that have a significant impact on users' experience (UX). The current paper presents the conceptual framework of an affective design process that allows understanding users' affective needs. The primary purpose is to build a conceptual model for application interface design, to uncover and document user emotional needs. The primary purpose of this framework is to prompt the designer to consider both affective and functional requirements of the users when conceptualizing the design of the application.

Keywords: Affective Design, User Experience, User Interface

233 Is there a modal shift due to transport restrictions aimed at mitigating NO2 episodes? Case study of a commuting corridor in Madrid Metropolitan Area

Fernando Romero[a]*, Juan Gomez[a], Thais Rangel[a], José Manuel Vassallo[a]

a Transport Research Centre TRANSyT-UPM Universidad Politécnica de Madrid, Calle Profesor Aranguren 3, Madrid 28040, Madrid
** fernando.romero@upm.es*

Abstract

It is well demonstrated that air pollution poses a significant risk to public health. For this reason, European Authorities have established limits on the concentrations of certain air pollutions. Like many other European cities, Madrid has systematically breached the EU rules on NO2. Consequently, in June 2015, the European Commission opened infringement proceedings against Spain. Accordingly, in order to comply with EU thresholds, Madrid City Council passed a protocol to address high NO2 pollution episodes establishing parking and driving restrictions. This paper aims at gaining deeper insight into the effectiveness of this Protocol in promoting a modal shift from private to public transport modes. Based on traffic counts and transit entrances, two multinomial logit models are calibrated. We conclude that NO2 Protocol has a very limited effect on modal choice in suburban trips. Therefore, more severe measures should be implemented to achieve a greater modal shift towards greener transport modes.

Keywords: Air pollution; Madrid; Modal shift; Parking restrictions; Policy measures; Speed limit

339 Bus Demand Predictive Analysis on Barcelona Waterfront

Josep Mension[a]*, Michael Pellot[b]*

a Director Central Services, Service Planning and Bus Infrastructures Division, TMB – Transports Metropolitans de Barcelona, Carrer 60, num 21, Zona Franca, 08040 Barcelona, Spain
b Director of Innovation, TMB – Transports Metropolitans de Barcelona, Carrer 60, num 21, Zona Franca, 08040 Barcelona, Spain
** jmension@tmb.cat*

Abstract

This paper explains the methodology and key findings of a test pilot carried out in summer of 2018 and aimed at improving TMB Bus provision on the Barcelona waterfront. The city has nowadays 4 km of beach and a wide waterfront area, very crowded in sunny weather days. At the weekend, all of this increases precisely when TMB supplies slightly fewer buses than on a working day. To improve our service on those areas and fulfil the higher ridership demand, we undertook a predictive

demand study, as part of the TMB Big Data Analytics projects. The project focused on drawing up a predictive model using advanced analytic technology on Machine Learning (ML) over the TMB Big Data Analytics cluster, to find out the ridership (passenger boarding) at several pre-set bus stops, near the shore.

Keywords: Big Data; Bus ridership forecast; Machine learning; Predictive analysis; Random Forest regression

553 The new European Sustainable Urban Mobility Plan (SUMP) Guidelines – Moving towards implementation

Siegfried Rupprecht[a]*, Susanne Böhler-Baedeker[a], Lisa Marie Brunner[a], Lasse Brand[a]

a Rupprecht Consult, Clever Strasse 13-15, 50668 Cologne, Germany
** s.rupprecht@rupprecht-consult.eu*

Abstract

The SUMP Guidelines are an important European strategic planning instrument for authorities to establish an integrated, long-term, sustainable mobility plan. The guidelines serve to aid in the process of transitioning to a more sustainable urban mobility system. With the wider goal of improving quality of life for citizens and facing mobility issues as well as the climate crisis globally, SUMPs have been developed and implemented in more than 1,000 cities. New developments in many areas of urban mobility and a wealth of SUMP implementation experience has required rethinking and extending the original guidelines from 2013. While the concept is still based on the eight principles of Sustainable Urban Mobility Planning, the guidelines offer clear guidance on how to develop and implement a SUMP, highlighting the flexibility of the process and presenting a detailed consideration of the transferability of the SUMP concept to various planning contexts for cities.

Keywords: Sustainable Urban Mobility Plan; SUMP; Integrative Development; Urban Mobility; Capacity Building; Transport Planning

678 Cable cars for public transport: The transformation of La Paz and El Alto in Bolivia

Marc Funda[a]*, Reinhard Fitz[a]

a Doppelmayr, Konrad-Doppelmayr-Str. 1, 6900 Wolfurt, AUSTRIA
** marc.funda@doppelmayr.com*

Abstract

The world’s largest cable car network was built between 2012 and 2019 to serve for public transport in La Paz and El Alto, both heavily affected by congestion. The provision of a safe, reliable and comfortable mode of transport had a positive impact on the population’s mobility and achieved significant time savings for commuters. It also acts as a catalyst for urban development. Connecting the neighbouring cities of El Alto and La Paz had long been a planning goal. While only a few hundred metres apart, a challenging topography made movement between the cities difficult and limited options for transport links. Despite their proximity the cities had a very different social and income structure. Cable cars lines were built to facilitate movement between the cities, reduce air pollution and finally to achieve social cohesion. It was recognised that a mobile population has better economic, cultural and social dynamics.

Keywords: cable car, ropeway, public transport, urban mobility, inclusive transport, social inclusion

907 Addressing the public transport ridership/coverage dilemma in small cities: a spatial approach

Nadia Giuffrida[a]*, Michela Le Pira[a], Giuseppe Inturri[b], Matteo Ignaccolo[a]

a Department of Civil Engineering and Architecture, University of Catania, via Santa Sofia 64, Catamia 95125, Italy
b Department of Electrical Electronic and Computer Engineering, University of Catania, via Santa Sofia 64, Catamia 95125, Italy
** nadia.giuffrida@dica.unict.it*

Abstract

This paper presents a spatial approach to design new on-demand flexible transport services in urban areas characterized by inefficient public transport and modal imbalance in favour of private cars. These services, enabled by technologies and inspired by the shared mobility approach can complement conventional public transport and reduce car use. The methodology has been applied to Acireale, a town in Southern Italy. A redesign of existing bus lines together with a proposal of flexible services was formulated. Scenario analysis was based on the evaluation of a simple accessibility measure; the computation of the Gini coefficient has been performed to evaluate social equity of the different scenarios. Results show an increase in equity with a lower coverage of traditional lines and the introduction of on-demand service. This approach can help the strategic planning of such services, having the potential to reduce the gap between ridership and coverage in public transport planning.

Keywords: accessibility; social exclusion; weak-demand areas; flexible transport; complementary travel services, shared mobility

927 Gamification and engagement of tourists and residents in public transportation exploiting location-based technologies

Bruno Cardoso[a]*, Miguel Ribeiro[a], Catia Prandi[b], Nuno Nunes[a]

a ITI Larsys, Caminho da Penteada, Funchal, 9020-105, Portugal // Tecnico Lisboa, Av. Rovisco Pais 1, Lisboa, 1049-001, Portugal
b Università di Bologna, Via Zamboni, 33, 40126, Italy
** bruno.cardoso@tecnico.ulisboa.pt*

Abstract

Cities are becoming very congested. There is a need to reduce the number of private cars on the roads, by maximising the potential for local public transport. With the increasing awareness of transport that is sustainable in the sense of environmental impact, but also climate and social, there is the need to create engagement into public transportation. Gamification, which is the use of game elements in non-game contexts, has proven to deliver very positive results, by turning regular activities into engaging ones, which are fun to perform. We have designed a mobile application, that interacts with short-range wireless communication technologies, inviting people to use public transport. To evaluate the solution, we have created a questionnaire based on the System Usability Scale, but also using usability testing with specific tasks.

Keywords: Gamification, Short-range wireless communication technologies, public transport, sustainability

934 Inferring Commuting Routes and Transportation Modes from Call Detail Records

Joel Pires[a]*, Aldina Piedade[a], Marco Veloso[a], Santi Phithakkitnukoon[b], Zbigniew Smoreda[c], Carlos Bento[a]

a Center for Informatics and Systems of the University of Coimbra, Coimbra, Portugal
b Chiang Mai University, Chiang Mai, Thailand
c Orange Labs, Paris, France
** jfpires@student.dei.uc.pt*

Abstract

Call Detail Records constitute a valuable data source to infer the mobility patterns of the users. In order to do so, a more meticulous process of pre-processing and subsample of the data is needed. Considering challenges like the low spatial resolution or temporal sparsity, we propose an optimized approach to infer commuting patterns of 1500 users in three different Portuguese cities with different mobility profiles, namely: Porto, Coimbra, and Lisbon. The commuting patterns inferred are the commuting routes home to workplace and workplace to home as well as the transportation modes adopted in those routes. This work uses a CDR dataset that comprises fourteen months of communications between users across all the Portuguese territory. Percentages of the use of each travel mode were computed, and two-thirds of the results fall within the ground-truth values obtained from Portuguese censuses; the other third shows very slight deviations.

Keywords: Call Detail Records, Commuting Routes, Origin-Destination Trips, Transportation Modes Detection

935 Matching users´ expectations in school public behavior: where are we in public transport?

Mariza Motta Queiroz[a]*, Pedro Celeste[b], Filipe Moura[a]

a CERIS, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais 1, 1049-001 Lisboa, Portugal, Contact: 218 418 371
b Universidade Católica de Lisboa, Ciências Económicas e Empresariais; Palma de Cima,1649-023 Lisboa, Portugal, Contact: 217 214 000
** marizaqueiroz@tecnico.ulisboa.pt*

Abstract

Sustainable transport contributes to sustainable development, enabling people to meet their needs and to respect future generations´ while minimizing environmental impacts. Targeting particular and more vulnerable segments of the society, our goal is to influence younger generations by creating an impact on their school commuting decisions or their parents' decisions. Based on a survey in 10 schools of the Lisbon Metropolitan area, this paper addresses the schoolers' decisions and trade-offs between car and bus through a discrete choice model. The results (1640 households) suggest that in order to achieve a modal shift towards public transportation, we should focus on improving flexibility, tracking and trip time. Transport operators can use this study to better understand school commuters' perceptions and leverage the role of public transportation to access school. Policies aiming to promote new mobility habits should involve the youth in the planning of school commuting, since they are the end-users.

Keywords: Public transport to school; Trade-off; Marketing; Discrete Choice Model; Lisbon Metropolitan Area

952 Investigating user preferences in night bus lines operation using Conjoint Analysis in the city of Thessaloniki, Greece

Dimitra Giannaka[a], Stavros Malliaris[a], Evangelos Genitsaris[a], Ioannis Karagiotas[a], Aristotelis Naniopoulos[a], Dimitrios Nalmpantis[a]*

a School of Civil Engineering, Faculty of Engineering, Aristotle University of Thessaloniki, PO Box 452, 541 24 Thessaloniki, Greece
** dnalba@civil.auth.gr*

Abstract

Conjoint Analysis is modeling the way consumers behave in the market and reveals the attributes of a product that have the greatest influence on consumers' choices. With the aim of identifying the desired levels of certain attributes of the night bus services in the city of Thessaloniki, a questionnaire was developed utilizing special software. In total, 105 individuals between 18 and 35 years old were questioned, the majority of whom are traveling during night for leisure and entertainment, using the bus line 78N. Every user could choose the most preferred between two scenarios of night bus services, by examining their attributes, of which following were selected: hours of service, operating days, frequency, distance from/to the bus stop, and ticket price. The results showed, among other, that the operation of night bus lines after midnight is necessary, the service offered is not satisfactory, and ticket price was the most important factor.

Keywords: Conjoint Analysis (CA); Choice-Based Conjoint (CBC); Public Transport (PT); night buses; optimization; Thessaloniki

Full paper: https://doi.org/10.5281/zenodo.3708354

1007 Spatiotemporal dynamics of public transport demand: a case study of Riga

Dmitry Pavlyuk[a]*, Nadezda Spiridovska[a], Irina Yatskiv (Jackiva)[a]

a Transport and Telecommunication Institute, Lomonosova 1, Riga, LV-1019, Latvia
** Dmitry.Pavlyuk@tsi.lv*

Abstract

This study is aimed to estimation and analysis of the spatiotemporal dynamics of public transport passenger flows in Riga, Latvia. We composed a methodology and applied it for mining of a large smart card data set (124 million records) for one year (2018). The developed methodology includes three stages: 1) estimation of individual trip vectors, 2) clustering of trip vectors into spatiotemporal mobility patterns, and 3) further analysis of mobility patterns' dynamics. The best practice methodologies were applied at every research stage: extracting boarding stops using the flow of smart card validations; estimation of individual trip destination using trip chains; vector-based clustering for mobility pattern identification and discovering their dynamics. The resulting methodology provides an advanced tool for observing and managing of public transport demand fluctuation on a daily basis. We also discuss practical benefits of obtaining mobility patterns at tactical, operational and strategic levels of public transport management.

Keywords: user travel behaviour; transport modelling; big data; public transport; smart card data; clustering

1076 Estimating Alighting Stops and Transfers from Entry-Only Automatic Fare Collection: the Case-Study of Porto

Joana Hora[a,b]*, Teresa Galvão Dias[a,b], Ana Camanho[a,b]

a Faculdade de Engenharia da Universidade do Porto, Porto 4200-465, Portugal
b INESC TEC, Porto 4200-465, Portugal
** joana.hora@gmail.com*

Abstract

This study estimates alighting stops and transfers from entry-only Automatic Fare Collection (AFC) data. The methodology adopted includes two main steps: an implementation of the Trip Chaining Method (TCM) to estimate the alighting stops from AFC records and the subsequent application of criteria for the identification of transfers. For each pair of consecutive AFC records on the same smart card, a transfer is identified considering a threshold for the walking distance, a threshold for the time required to perform an activity, and the validation of different boarding routes. This methodology was applied to the case study of Porto, considering all trips performed by a set of 19999 smart cards over one year. The results of this methodology allied with visualization techniques allowed to study Origin-Destination (OD) patterns by type of day, seasonally, and by user frequency, each analyzed at the stop level and at the geographic area level.

Keywords: Origin-Destination; Trip Chaining Method; Public Transportation, Automatic Fare Collection

1100 A Study of the Effects of Individual and Activity Characteristics on the Mode Choice - A case Study of Budapest Metropolitan Region, Hungary

Wissam Qassim Al-Salih[a]*, Dr. Domokos Esztergár Kiss[a]

a Budapest Universityof Technology and Economics (BME), Budapest 1111, Hungary
** al-salih.wissam@mail.bme.hu*

Abstract

In this paper we focus on the impact of the characteristics of the individuals, such as gender, age and income in addition to the activity characteristics that including activity purpose and distance of the trip, on the mode choice for completing activities of travelers. The aim is to use statistical analysis to investigate the impact of these variables on mode choice applying the decision tree model, which provides a set of easy-to-interpret decision rules that are necessary to make appropriate decisions. The data processing in this study is based on real observations of travel behavior in Budapest. Findings of our analysis indicate that income, distance and activity purpose are the most significant factors in the decisions related to mode choice. Also, this study provides promising insights for developing activity chain modelling.

Keywords: Characteristics of individuals; Characteristics activity chains; Mode Choice; Decision tree

1130 How perceptions, attitudes, perceived level of service and mode choice shape our value of time (VOT)

Marco De Angelis[a]*, Luca Mantecchini[b], Filippo Paganelli[b], Luca Pietrantoni[a]

a Department of Psychology, Unversity of Bologna, Via Berti Pichat 5, Bologna 40126, Italy
b Department of Civil, Chemical, Environmental, and Material Engineering, Unversity of Bologna, Viale Risorgimento 2, Bologna 40136, Italy
** marco.deangelis6@unibo.it*

Abstract

In transport economics, the value of time (VOT) has received crucial attention because it constitutes a measure to justify investment in transport schemes. The present work aimed at exploring the relationship between traditional mobility surveys, namely for university commuters in a medium-sized city, commuting trip chain and VOT. Multiple regression coefficients showed that older adults, those who usually adopt means of transport with a higher pollutant level and need to cover less km attributed higher value to the time spent on commuting. On the contrary, participants with a higher level of perceived behavioural control (thus able to use transport modes other than the car), with positive attitudes towards the use of public transport, and more satisfied with the level of service during their commuting trip declare a lower VOT. Outcomes are discussed to support relevant stakeholders on traffic travel management and research.

Keywords: value of time travel; perceived behavioural control; attitudes towards public transport; level of service; commuting trip chain

1.24 Scientific and technical session 24: Thought – tried – tested – taken to use; Test sites, labs and pilots

271 Transport policy labs: Accelerating mobility innovations in Sweden

Maria Schnurr[a]*, Håkan Burden[a], Linda Olsson[a], Kristina Andersson[a]

a RISE Research Institutes of Sweden, Lindholmspiren 3A, 41756 Gothenburg, Sweden
** maria.schnurr@ri.se*

Abstract

The current paradigm shifts in the transport sector, electrification, servitisation and automation, will only develop their full sustainability potential with the help of enabling policies and regulations. Policy development needs to follow new paths that allow for an iterative and inclusive problem solving in order to meet changing market and technology needs better and more quickly. At the same time, it is paramount to safeguard established policy making processes in democracies. One way this balance may be achieved is by policy labs, a collaboration format applying problem solving methods from product and service design (so-called design thinking) to policy development. We present three case studies from Sweden where the policy lab method was used to improve or accelerate policy innovation in the mobility area: private carsharing, sustainable business travel and commuting, and an autonomous truck trial on public roads.

Keywords: policy; innovation; design thinking; autonomous vehicles; carsharing; shareconomy; taxation

317 Living labs and co-creation in infrastructure planning: a comparative case study into enabling conditions and mechanisms

Maria Alina Rădulescu[a, b]*, Wim Leendertse[a, b], Jos Arts[b]

a Ministry of Infrastracture and Water Management, Rijkswaterstaat, Griffioenlaan 2, 3526 LA, Utrecht, The Netherlands
b University of Groningen, Faculty of Spatial Sciences, Department of Planning, Landleven 1, 9747 AD, Groningen, The Netherlands
** m.a.radulescu@rug.nl*

Abstract

Our cities, regions and nations are exposed to increasing challenges due to climate change, energy transition and smart mobility. Consequently, in spatial and infrastructure planning there is a need for adaptive and integrated planning approaches based on cooperation, experimentation, adaptability, innovation and learning. To ensure interventions are tailored to their context and are well aligned to various stakeholders' interests, experimental approaches set in a real-life contexts and based on co-creation processes, such as the living labs, have been suggested as potential effective planning instruments. Living labs are widely discussed in literature, however, methodological aspects of running a living lab and the conditions and mechanisms that enable co-creation processes specifically in the spatial and infrastructure planning domain have been rarely addressed. The paper discusses conditions that enable co-creation and lead to and stimulate innovation and creativity based on a comparative case study of the Dutch Room for the River programme.

Keywords: spatial and infrastructure planning; living lab; innovation; co-creation; creativity; enabling conditions and mechanisms

335 An innovative and safe active light weight design chassis suspension system - An enhanced development methodology

Oliver Deisser[a]*, Thomas Gruenheid[a], Michael Schaeffer[a]

a DLR Institute for Vehicle Concepts
** oliver.deisser@dlr.de*

Abstract

Lightweight design is still very important for an all-electric vehicle especially when used in an urban area. Simple chassis systems for small urban vehicles covering the weight limitations often lack an acceptable drive comfort and driving stability in extreme situations. A new active chassis suspension designed for such an urban car is in development at the DLR Institute for Vehicle Concepts in the founded project Next Generation Car (NGC) Urban Modular Vehicle (UMV). This concept even provides active safety measurements regarding small overlap crash scenarios. Main components are a composite traverse leaf spring, an orbital wheel bearing optional with an integrated electrical drive and an innovative wheel independent two axis steering actuator changing the toe and camber angle. For the creation of this concept an existing development methodology is used, which is extended by a (partly) automated design and dimensioning process.

Keywords: road safety; occupant safety; active chassis system; lightweight design; automated design methodology

Full paper: https://elib.dlr.de/134442/

496 5G-DRIVE: EU China C-V2X collaboration

Lasse Nykänen[a]*, Matti Kutila[b], Matti Lankinen[a]

a Vediafi, Valimotie 13A, 00380 Helsinki, Finland
b VTT Technical Research Centre of Finland, Visiokatu 4, 33101 Tampere, Finland
** lasse.nykanen@vedia.fi*

Abstract

This paper is a review of preliminary results and progress of the EU-5G-DRIVE and corresponding twinning project in China. The project is funded under the EU Horizon-2020, from where 5G development and especially enhanced Mobile Broadband and V2X technologies are studied by various organizations around EU.

The paper focuses on the first field tests of the project, which has been done in Espoo Finland in May 2019. The field tests are planned so that there are two use case test scenarios, where hybrid communication technologies (ETSI ITS-G5 and LTE/5G) are experimented together with automated car. The tests will produce more information about 5G development and especially focus on interoperability issues between EU and China, where 5G-DRIVE's counter project is executed in parallel. The preliminary results indicate that the current network is not ready for having real collaborative driving and especially, steps towards C-V2X is not straightforward as thought in headlines.

Keywords: automated driving; V2X; C-V2X; hybrid communication; 5G; EU-China collaboration

Full paper:
https://drive.google.com/open?id=1SsiLNqQ5f3GnRCrBlP10BZ6EDB2HO8Im

557 OBELICS – Optimization of e-drive concepts with scalable realtime models and functional testing based on real use-cases

Horst Pfluegl[a]*, Hellal Benzaoui[b], Benjamin Zillmann[c], Tomaž Katrašnik[d], David Delichristov[e], Raul Estrada Vazquez[f], Matthieu Ponchant[g], Nicola Tobia[h]

a AVL List GmbH, Hans-List-Platz 1, 8020 Graz, Austria
b Volvo Group Trucks Technology, 1, avenue Henri Germain, 69806 Saint Priest Cedex, France
c Robert Bosch GmbH, Renningen, 70465 Stuttgart, Germany
d University of Ljubljana, Faculty of Mechanical Engineering, Aškerčeva 6, 1000 Ljubljana, Slovenia
e Virtual Vehicle - Das virtuelle Fahrzeug Forschungsgesellschaft mbH, Inffeldgasse 21/A, 8010 Graz, Austria
f FH Joanneum Gesellschaft mbH, Werk-VI-Straße 46, 8605 Kapfenberg, Austria
g Siemens Industry Software, Le Diagonal, 150 Avenue de la Rêpublique, 92320 Châtillon, France
h Centro Ricerche Fiat Scpa, Strada Torino 50, 10043 Orbassano, Italy
** horst.pfluegl@avl.com*

Abstract

Wide global deployment of EVs is necessary to reduce transport related emissions, as transport is responsible for around a quarter of EU CO2 emissions and more than two thirds of transport-related CO2 emissions are from road transport. OBELICS addresses the urgent need for new tools for multi-domain modelling and testing of EVs and their components in order to design and implement new, more efficient vehicles faster, while at the same time enabling modularity for mass production to significantly improve affordability. The overall objective of OBELICS is to develop a systematic and comprehensive framework for the design, development and testing of advanced e-powertrains and EVs, reducing development efforts by 40% while improving e-drivetrain efficiency by 20% and increasing safety by a factor of 10 using OBELICS advanced heterogeneous model-based test methods and tools; as well as scalable and easy to parameterize real-time models.

Keywords: Model based development; Real-time models; E-vehicle development process; Safety and Reliability; Co-simulation

721 i-DREAMS: an Intelligent Driver and Road Environment Assessment and Monitoring System

Tom Brijs[a]*, Kris Brijs[a], Susanne Kaiser[b], Rachel Talbot[c], André Lourenço[d], Constantinos Antoniou[e], George Yannis[f], Antonio Avenoso[g], Geert Wets[a]

a UHasselt, Transportation Research Institute (IMOB), Science Park – Building 5, 3590 - Diepenbeek, Belgium
b Kuratorium fuer Verkehrssicherheit (KFV), Schleiergasse 18, 1100 Wien, Austria

c Loughborough University, Loughborough Design School, Ashby Road, LE11 3TU, Loughborough, UK
d CardioID Technologies, CEIIA Av. Dom Afonso Henriques, 1825, 4450 Matosinhos, Portugal
e Technical University of Munich, Dept of Civil, Geo and Envirnonmental Engineering, Arcisstrasse 21, 80333 München, Germany
f National Technical University of Athens, Dept of Transp Planning and Engineering, 5 Heroon Polytechniou str, 15773 Athens, Greece
g European Transport Safety Council (ETSC), Avenue de Celtes 20, 1040 Brussels, Belgium
** tom.brijs@uhasselt.be*

Abstract

The objective of the Horizon2020 project i-DREAMS is to setup a framework for the definition, development and validation of a context-aware 'safety tolerance zone'. Taking into account, on the one hand, driver-related background factors and real-time risk-related physiological indicators, and on the other hand, driving task-related complexity indicators a real-time assessment will be made to determine if a driver is within acceptable boundaries of safe operation. Additionally, interventions will be developed to prevent drivers from getting too close to the boundaries of unsafe operation. These will be composed of in-vehicle interventions, and interventions aimed at enhancing the knowledge, attitudes and behavioural reaction of drivers. A holistic approach will be taken suitable for use in multiple transport modes. Initial testing will take place in a driving simulator after which promising interventions will be tested and validated under real-world conditions in a testbed of 600 drivers across 5 EU countries.

Keywords: task complexity, coping capacity, driver monitoring, interventions

916 In-lab testing of future modularized and standardized systems for rail and road

Daniel Schwencke[a]*, Lennart Asbach[a]

a German Aerospace Center, Institute of Transportation Systems, Lilienthalplatz 7, 38108 Braunschweig, Germany
** daniel.schwencke@dlr.de*

Abstract

The current developments towards connected cars (road) and digital interlockings (rail) parallel each other in more than just their timing. In both cases, modularized system architectures with standardized interfaces arise: their components are cars and railway infrastructure elements respectively, coming from different manufacturers but interacting using standards. In both cases, verification of conformity to the interface standards as well as verification of interoperability of the components is of great importance. In this paper, we discuss challenges common to system verification in both domains. We present a basic in-lab testing approach to solve those challenges, consider peculiarities of rail and road and look into the examples of the EULYNX standards and C2X communication. Furthermore, we report on what can be learned from in-lab conformity testing against the European Train Control System (ETCS) standard. Finally, we point out which steps remain towards established verification procedures and how future labs may look like.

Keywords: standard interface; verification; conformity; interoperability; C2X; EULYNX

949 Public transport innovation platform boosting ITS value chains

Toni Lusikka[a]*, Tuomo K Kinnunen[a], Juho Kostiainen[b]

a VTT Technical Research Centre of Finland Ltd., P.O. BOX 1100, Oulu and FI-90571, Finland

b VTT Technical Research Centre of Finland Ltd., P.O. BOX 1000, Espoo and FI-02044, Finland
** toni.lusikka@vtt.fi*

Abstract

This paper discusses use of open innovation platforms in public transport context to create more value with shared assets and collaboration. Open innovation platforms allow businesses to develop new, better and more personalized services to citizens. Main result of this paper is the Value Ramp, which is a new description of value creation of different enabling features of innovation platform. The result is demonstrated as an added value description of Living Lab Bus project, but the Value Ramp can be further utilized in other ITS contexts also. With this description it is easier to demonstrate the versatile opportunities in enabling value creation. In addition, morphology theory related to the Value Ramp is presented. Used together, the Value Ramp and morphology provide easy method to overview what is offered and how different combinations of the offerings create added value. This way investments and sustenance of innovation platforms can be justified.

Keywords: Value network; Living Lab; Value description; Morphology; Added value; Systemic value

This paper is a part of the Utilities Policy Special Issue:
https://www.sciencedirect.com/journal/utilities-policy/special-issue/10D8V459F11

Full paper: https://doi.org/10.1016/j.jup.2019.100998

1035 Comparing the mobile road temperature observations and road temperature analysis made with kriging method

Janne Miettinen[a]*

a Finnish Meteorological Institute, Erik Palménin aukio 1, Helsinki 00530, Finland
** janne.miettinen@fmi.fi*

Abstract

Purpose of this work is to study the usability of mobile road temperature observations as an input for the road weather model. Road weather model is used at Finnish Meteorological Institute (FMI) to predict the road temperature and conditions. The forecasts help the decision making at road maintenance and warning the road users forehand about safety critical phenomena on the road. Traditionally, the input data of the road temperature is given to the model as an analysis from stationary road weather stations (RWS). The analysis is done with so called kriging method. Nowadays, also mobile observation data is available from the roads between these RWSs. In the study we test if the kriging analysis should be replaced with the mobile observations or can we get comparable results with just kriging analysis.

Keywords: Road temperature; Road weather; Mobile observations; Road temperature analysis; Road weather forecasting

1093 A tool to improve the efficiency of waste collection: development and application to a case study

Jesús Aransay[a]*, Víctor Galilea[a], Inés Hernández[a]

a Universidad de La Rioja , Departamento de Matemáticas y Computación, c/ Madre de Dios 53, Logroño 26004, Spain
** jesus-maria.aransay@unirioja.es*

Abstract

In this work, we present a real case study of optimization of waste collection routes. In our particular case, the collection area is La Rioja (a region of Spain with an area of 5.045 km^2 and a population of ca. 300.000 people). The starting point of our study was some unstructured data that The Circular Lab (https://www.thecircularlab.com/en/) handed us from the routes that were being used, as well as some particular instances of these routes that had been completed by trucks in their daily routine. From that particular routes we generated our own data model, a middleware and a connection to specialised computing services that allowed us to optimise the routes. These optimisations gave place in some particular cases to savings of up to 40% (either in the distance, the time, or the CO2 emissions required to complete the routes).

Keywords: waste collection, route planning, data processing, linear programming, high performance computing

Full paper:
https://ur.portalcientifico.es/documentos/5e4fd80829995273a130e4c9

1.25 Scientific and technical session 25: Electrification and energy alternatives I

189 Smartroad Gotland: Demonstration of a wireless electric road

Håkan Sundelin[a]*, Oren Ezer[b], Stefan Tongur[a]

a Electreon, Stockholm, Sweden
b Electreon, Hadasa Neurim, Beit Yanai, Israel
** hakan@electreon.com*

Abstract

Electric road systems by ElectReon has the potential of creating a paradigm shift through its smart infrastructure solutions. As the required infrastructure around the world move away from fossil fuels, the main form of propulsion will be some combination of e-mobility. ElectReon uses inductive technology for wireless charging of electric vehicles. A vehicle can contain more than one receiver where each receiver can generate up to 20 kw and each management unit can power up to 6 buses or 18 cars in parallel. This solution creates a modular concept which is very cost- and weight effective for different vehicle types. A typical passenger car would need one receiver and a 40-ton truck would use five or six. The development has taken large steps during the last year and at TRA will be able to present the first results of real operation on public road on Gotland, Sweden.

Keywords: Electric Road System; Electromobility; Electrification; Emission reduction; Innovation; Infrastructure

Full paper:
https://drive.google.com/open?id=1tsmGyyiuhi4OxpqxNyWrHfzgIhZnPUxW

215 Electric road system technologies in Sweden - Gaining experience from research and demo facilities

Magnus Lindgren[a]*

a Swedish Transport Administration, SE-781 89 Borlange, Sweden
** magnus.lindgren@trafikverket.se*

Abstract

Electric Road System (ERS) is a technology concept that has the potential to heavily reduce the fossil fuel dependency in the transport system. ERS is defined by electric power transfer from the road to the vehicle while the vehicle is in motion through rail, overhead-line, and wireless solutions. The basic technologies for power transfer from the road to vehicles in motion have been developed through various research projects across the globe. However, electric road systems had never been demonstrated for heavy-duty vehicles on the public road until the Swedish pre-commercial procurement. The first ERS in the world was inaugurated in 2016 and since then significant amounts of experience regarding building, operating and maintaining ERS has been gathered. The main conclusion is that ERS works, it is possible to transfer electric energy from the road to a vehicle in motion. However, additional verification is needed before any ERS is fully mature.

Keywords: Low emission transport, Electric road system, Sustainability, Demonstration, Infrastructure, Electrification

299 TrAM – Transport: Advanced and Modular

Evangelos Boulougouris[a]*, Alexandros Priftis[a], Mikal Dahle[b], Edmund Tolo[c], Apostolos Papanikolaou[d], Yan Xing-Kaeding[d], Christoph Jürgenhakee, Thomas Svendsen[f], Morten Bjelland[g], Aphrodite Kanellopoulou[h], Geoff Symonds[i], Torleif Stokke[j], Patrick Bollaert[k], Marie Launes[l]

a University of Strathclyde, Richmond Street 16, Glasgow G1 1XQ, United Kingdom
b Kolumbus, Jernbaneveien 9, NO-4005 Stavanger, Norway
c Fjellstrand yard, Omavegen 225, NO-5632 Omastrand, Norway
d Hamburg Ship Model Basin, Bramfelder Str. 164, Hamburg D-22305, Germany
e Fraunhofer IEM, Hansastradde 27C, Munchen 80686, Germany
f Hydro, Metallvägen, Vetlanda 574 81, Sweden
g Leirvik, Storhaugvegen 130, NO-5416 Stord, Norway
h National Technical University of Athens, Heroon Polytechniou 9, Athens 15773, Greece
i MBNA Thames Clippers, The Studio, The O2, London SE10 0DX, United Kingdom
j Servogear, Brubakken 73, NO-5420 Rubbestadneset, Norway
k De Vlaamse Waterweg nv, Oosdijk 110, Willeborek 2830, Belgium
l NCE Maritime CleanTech, Meatjonnsvegen 74, NO-5412 Stord, Norway
** evangelos.boulougouris@strath.ac.uk*

Abstract

Europe has taken a leading role in the international effort for a drastic reduction of greenhouse gas (GHG) emissions. Maintaining its focus on sustainability, Europe is seeking to produce transport solutions with a cost effective and environmentally friendly life cycle, integrated in its smart cities. This is what the H2020 funded project "TrAM – Transport: Advanced and Modular" aims to offer. It is validating a concept for waterborne transport by implementing state-of-the-art "Industry 4.0" holistic ship design and production methods, for fully electrical vessels, operating in the vicinity of urban areas. The project will lead to significant lower construction costs and reduction in engineering hours for new zero emission vessels. Three different catamarans are going to be designed implementing the developed methods and one of them is going to be model tested, constructed and operated in Norway. The paper outlines the R&D outcomes and the main challenges of the project.

Keywords: Industry 4.0; modular production; holistic ship design; zero emission transport; battery electric systems; electrically powered vessels

Full paper: https://www.researchgate.net/publication/339509907_TrAM_-_Transport_Advanced_and_Modular

328 Emission and performance potential of paraffinic diesel fuels

Timo Murtonen[a]*, Rasmus Pettinen[a], Petri Söderena[a], Mårten Westerholm[a], Christer Söderström[a], Nils-Olof Nylynd[a]

a VTT Technical Research Centre of Finland, Tietotie 4C, Espoo 02150, Finland
** timo.murtonen@vtt.fi*

Abstract

Global energy politics sets demands on engine manufacturers and fuel developers to produce sustainable, efficient and environmental friendly products. One solution is paraffinic diesel fuels, which can be produced from diverse feedstocks through the Fisher-Tropsch or hydrotreatment process. This paper presents the results measured with paraffinic diesel fuels in comparison with conventional diesel fuel. Engine measurements were performed with the original engine operating parameters and parameters optimized for paraffinic diesels. The aim of the parameter optimization was to achieve as high engine efficiency as possible without increasing the emissions. Measurements were performed with commercial non-road diesel engine using steady-state and transient driving cycles. The results show that paraffinic diesel fuels can be used for improving engine efficiency and/or emission formation. With optimized ECU parameters improvements in CO, THC and PM emissions, as well as a maximum gain of ca. 4% in engine efficiency, were achieved when compared to conventional diesel fuel.

Keywords: diesel; renewable; emission; efficiency; paraffinic

380 AEROFLEX smart power dolly: Towards efficient and mission-oriented long-haul vehicles

Henning Wittig[a]*, Julius Engasser[b], Paul Mentink[c], Andelko Glavinic[d], Ton Bertens[e]

a Fraunhofer Institute for Transportation and Infrastructure Systems, Zeunerstraße 38, Dresden 01069,Germany
b MAN Truck & Bus SE, Dachauer Straße 667, München 80995, Germany
c TNO Business Unit Traffic & Transport, Automotive Campus 30, Helmond 5708, The Netherlands
d WABCO Vehicle Control Systems, Am Lindener Hafen 21, Hannover 30453, Germany
e Van Eck Trailer Research and Development, Oude Waag 24, BV Beesd 4153, The Netherlands
** henning.wittig@ivi.fraunhofer.de*

Abstract

This paper is part of the AEROFLEX – AEROdynamic and FLEXible Trucks for Next Generation of Long Distance Road Transport – project. This project develops and demonstrates new technologies, concepts and architectures for complete vehicles that are energy efficient, safe, comfortable, configurable and cost-effective, while ensuring that the varying needs of customers are satisfied by being flexible and adaptable with respect to the continuously changing operational conditions. The paper concentrates on the concept and development of the distributed hybrid powertrain and the sophisticated energy and torque management system. In long-haul vehicles a distributed powertrain can be realized by installing additional power units in the towed vehicles like dollies and/or trailers. This pursues two main objectives: 1. reducing fuel consumption by the usage of electric powertrains and thus hybridizing the whole vehicle combination and 2. improving the driveability of longer and heavier long-haul vehicles by adding additional drive axles, which e.g. improve gradeability.

Keywords: efficient road transport, long-haul vehicle, hybrid powertrain, energy management system

Full paper: http://publica.fraunhofer.de/documents/N-581118.html

409 Virtual Component and System Integration for Efficient Electrified Vehicle Development

Reinhard Tatschl[a]*, Zissis Samaras[b], Philip Scarth[c], Carlo Beatrice[d], Mihai Mihaescu[e], Matteo Rostagno[f], Angelo Onorati[g], Gladys Moreac Njeim[h], Clemens Biet[i], Alberto Broatch[j], Yousef Firouz[k], Bernd Deibler[l], Damijan Miljavec[m], Marco Plieske[n]

a AVL List GmbH, Hans-List-Platz 1, A-8020 Graz, Austria
b Aristotelio Panepistimio Thessalonikis,University Campus, Thessaloniki GR54124, Greece
c FPT Motorenforschung AG, Schlossgasse 2, 9320 Arbon, Switzerland
d Consiglio Nazionale Delle Ricerche, Piazzale Aldo Moro 7, 00185 Roma, Italy
e KTH Royal Institute of Technology, Brinellvagen 8, Stockholm 100 44, Sweden
f Centro Ricerche Fiat Scpa, Strada Torino 50, 10043 Orbassano, Italy
g Politecnico Di Milano, Piazza Leonardo Da Vinci 32, 20133 Milano, Italy
h RENAULT SAS, Quai le Gallo 13, 92100 Boulogne Billancourt, France
i Technische Universitaet Berlin, Straße des 17. Juni 135, 10623 Berlin, Germany
j Universitat Politècnica de València, Camino de Vera SN, 46022 Valencia, Spain
k Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussel, Belgium
l QPUNKT Deutschland GmbH, Straußenlettenstraße 15, 85053 Ingolstadt, Deutschland
m Univerza V Ljubljani, Kongresni trg 12, 1000 Ljubljana, Slovenia
n ZF Friedrichshafen AG, Löwentaler Straße 20, 88046 Friedrichshafen, Deutschland
** reinhard.tatschl@avl.com*

Abstract

To successfully master the upcoming challenges related to the 2030 EU fleet-wide average CO2 emission targets for passenger cars and light-duty vehicles as well as for heavy-duty vehicles such as trucks and lorries, further increased electrification/hybridization of vehicle powertrains is indispensable. In this context, simulation is an efficient and effective way to compare powertrain layouts, to virtually analyze driving scenarios and to optimize vehicle overall energy efficiencies for different configurations under real driving conditions. The rapid evolution of simulation technologies offers a unique opportunity to work at virtual level, both for the optimum powertrain/vehicle configuration choice and for simulation-based testing, in order to save time and development costs. The present paper outlines the overall concept and methodology and presents first results of the research project VISION-xEV, aiming at the development of a comprehensive simulation framework for supporting virtual component and system integration during electrified vehicle development.

Keywords: electrification, hybridization, energy efficiency, thermal management, simulation

Full paper:
https://www.researchgate.net/publication/339942326_Virtual_Component_and_System_Integration_for_Efficient_Electrified_Vehicle_Development

488 Emissions from city busses operated by alternative fuels; ethanol, compressed natural gas and diesel-electric

Sanna Saarikoski[a]*, Liisa Pirjola[b,c], Jarkko Niemi[d], Heino Kuuluvainen[e], Topi Rönkkö[e], Hilkka Timonen[a]

a Atmospheric Composition Research, Finnish Meteorological Institute, P.O.Box 503, 00101 Helsinki, Finland
b Department of Technology, Metropolia University of Applied Sciences, P.O. Box 4071, 01600 Vantaa, Finland

c Department of Physics, University of Helsinki, P.O. Box 64, 00014 Helsinki, Finland
d Helsinki Region Environmental Services Authority, P.O. Box 100, 00066 HSY, Helsinki, Finland
e Aerosol Physics Laboratory, Physics Unit, Tampere University, P.O.Box 692, 33101 Tampere, Finland
** sanna.saarikoski@fmi.fi*

Abstract

This study characterizes the real-world emissions from 16 individual city buses in Helsinki, Finland. All of the buses operated at enhanced environmentally friendly vehicle (EEV) emission level but two of the buses were fueled by ethanol, five by CNG and two were diesel-electric hybrid buses. For the reference, seven diesel fueled buses were examined. The exhaust emissions of buses were investigated by using a mobile laboratory van by chasing the buses at the bus depot and on their normal route. The instrumentation in the mobile laboratory included devices for particle number concentrations, size distributions, volatility and chemical composition. Additionally, the concentrations of gaseous CO2, NO, NO2 and NOx were monitored. Emission factors were calculated for particle number, mass, black carbon, particulate organic matter and NOx.

Keywords: particulate matter; black carbon; organic matter; size distribution; emission factor; after-treatment system

522 DOMUS: Design OptiMisation for efficient electric vehicles based on a USer-centric approach

Guillem Badia[a]*, Ines Muñoz[a], James Brusey[b], Peter Moertl[c], Hélder Filipe[d], Benoit Taillandier[e], Alberto Merlo[f]

a IDIADA Automotive Technology SA, l'Albornar s/n, Santa Oliva 43710, Spain
b Coventry University, Priory St, Coventry CV1 5FB, United Kingdom
c Virtual Vehicle Research Center, Inffeldgasse 21a, 8010 Graz, Austria
d Hutchinson, Parc d'Activités de l'Eglantier, 91028 Lisses, France
e Faurecia Interiors, 8 rue Emile Zola, BP 20449, Méru 60114, France
f CRF, Str. Torino, 50, 10043 Orbassano TO, Italy
** Guillem.badia@idiada.com*

Abstract

The DOMUS project intends to radically change the way in which vehicle passenger compartments and their respective comfort control systems are designed, by optimising energy use and efficiency while keeping user comfort and safety needs central. DOMUS aims to create a revolutionary approach to the design of vehicles from a user-centric perspective for optimal efficiency, the application of which will be key to increasing range and hence customer acceptance and market penetration of Electric Vehicles (EVs) in Europe and around the world in the coming years. The combined approach of innovating at a component level together with optimising the overall configuration will deliver at least the targeted 25% improvement in EVs range without compromising passenger comfort and safety. The DOMUS project will develop innovative solutions for glazing, seats, insulation and radiant panels, along with controllers to optimize their performance individually and when operating in combination.

Keywords: user centric, electric vehicle, increase range, optimized control, energy efficiency, vehicle comfort

571 Grid Impact Assessment of High Power E-Bus Charging Methods with Seasonal Load Variations

Daniel Stahleder[a]*, David Reihs[a], Stephan Ledinger[a], Felix Lehfuss[a]

a Austrian Institute of Technology, Giefinggasse 4, Wien 1210, Austria

* daniel.stahleder@ait.ac.at

Abstract

The ongoing electrification of public road transport helps to significantly reduce greenhouse gas emissions and increase the local air quality. Besides financial and operational challenges during this process, the high electric power demand for charging e-buses raises questions about potential impacts on the local distribution grid. This work addresses these questions by modeling several types of e-bus charging behavior in a representative European city and performing grid simulations with seasonal load variations at a high time resolution. The results show that charging at the end stations of the bus line caused smaller voltage drops at the grid than charging at every station. Moreover, the increased energy consumption of e-buses and households in winter led to a higher grid loading than in summer. To conclude, the presented simulation approach has proven to be an adequate method for assessing grid impacts of charging e-buses and will be used for future research.

Keywords: grid integration; e-bus; electric vehicle; EV; heavy-duty

Full paper:
https://www.researchgate.net/publication/339874802_Grid_Impact_Assessment_of_High_Power_E-Bus_Charging_Methods_with_Seasonal_Load_Variations

760 Alternative fuels in transport systems: A review on state-of-the-art market developments in the European Union

Jonatan J. Gómez Vilcheza*

a European Commission, Joint Research Centre (JRC), Ispra, Italy
** jonatan.gomez-vilchez@ec.europa.eu*

Abstract

To reach transport greenhouse gas emissions reduction targets and lower air pollution, the European Union is relying on, among others, increasing the use of alternative fuels in transport. These include biofuels, electricity, hydrogen, liquefied petroleum gas, natural gas and synthetic and paraffinic fuels. In order for that to realistically happen without curbing mobility, market uptake of powertrain technologies is needed. This paper reviews alternative fuels in transport systems by identifying state-of-the-art developments, comparing their evolution since 2015 and gauging the market prospects of the powertrain options. The road, rail, water and air transport systems are considered. In conclusion, the EU transport systems are evolving at different paces and thus with differing degrees of success, without a single fuel clearly dominating the alternative fuel transport system yet.

Keywords: electrification; batteries; alternative fuels; biofuels; fuel cells; hydrogen

Full paper:
https://www.researchgate.net/publication/339913068_Alternative_fuels_in_transport_systems_A_review_on_state-of-the-art_market_developments_in_the_European_Union

862 MEISTER: fostering smart e-mobility large scale adoption in European cities

Antonio Marqués[a], Patricia Bellver[a]*, Alejandro Gómez[a]

a ETRA Investigación y Desarrollo, C/Tres Forques, 147, 46014 Valencia, Spain
** pbellver.etraid@grupoetra.com*

Abstract

MEISTER is a research and demonstration project with three large scale pilots in Berlin, Gothenburg and Malaga promoting and supporting 'smart electric mobility' in cities, through the design, development, implementation and evaluation of ITS solutions that address and solve current existing gaps in the state of the art of electromobility. These technological solutions, such as the e-mobility interoperability platform or the smart charging and storage platform, are packaged in the form of 5 products that are being delivered and analyzed in order to guarantee not only their technical performance within the project but their sustainability and market transferability after the project completion. MEISTER is a 36 months project funded by the European Commission under Horizon 2020, started on September 2018. It is coordinated by ETRA and counts on a strong consortium of ten partners from Spain, Germany, Sweden and Greece.

Keywords: interoperability; large scale pilot; innovation; MaaS; business models technological solutions

951 Maturity of power transfer technologies for electric road systems

Martin G. H. Gustavson[a]*, Magnus Lindgren[b]

a RISE Research Institutes of Sweden, SE-417 56 Göteborg, Sweden
b Swedish Transport Administration, SE-781 89 Borlänge, Sweden
** martin.gustavsson@ri.se*

Abstract

Drawing on the method associated with Technology Readiness Levels (TRLs) and previous efforts, this article provides a maturity assessment of several electric road system (ERS) technologies with focus on the power transfer technology subsystem, and the transition context is also discussed. ERS involves electric power transfer from the road to the vehicle while the vehicle is in motion and could be achieved through different technologies such as rail, overhead line, and wireless solutions. ERS is a technology area with immense potential to reduce fossil fuel dependency, reduce greenhouse gas emissions, reduce air pollution as well as reduce noise in urban environments, while increasing energy efficiency in the transport sector. There are numerous promising ERS development and demonstration projects globally since several years. However, the investment cost for large-scale deployment of ERS is considerable and decision makers will require knowledge about how mature different solutions are compared to other transportation solutions.

Keywords: dynamic charging; ERS; maturity assessment; technology readiness level; TRL; transition

Full paper: http://urn.kb.se/resolve?urn=urn:nbn:se:ri:diva-44423

1009 Feasibility study of reconfigurability between different power transmission concepts for electric bus charging

Ashkan Pirooz[a,b]*, Foad Heidari Gandoman[a,b], Yousef Firouz[a,b], Joeri Van Mierlo[a,b]

a Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium
b Flanders Make, 3001 Heverlee, Belgium
** ashkan.pirooz@vub.be*

Abstract

Within the framework of ASSURED project, towards fast and smart charging solutions for electric urban heavy-duty vehicles e.g. buses and trucks, a feasibility study on reconfiguration of two pantograph concepts into each other is performed. The concepts are categorized as inverted and roof-mounted pantographs. State of the art of both concepts in mechanical, electrical, and communications points of view are considered. Both systems are used and well-integrated in the fast charging infrastructure, which can allow the electric buses to charge on route at terminal stops. Since both concepts are incompatible, a bus with a roof-mounted pantograph cannot be charged at a charging station built for an inverted pantograph system due to different interfaces, and vice versa. Thus, this feasibility study focuses on required modifications at both charging infrastructure, and vehicle sides. Technical possibilities of switching between two pantograph solutions are also investigated.

Keywords: pantograph concepts; fast charging solution; inverted pantograph; roof mounted pantograph; charging infrastructure

1046 Use cases for supporting evaluation of e-mobility services

Joel Anttila[a]*, Elina Aittoniemi[a], Petr Hajduk[a]

a VTT Technical Research Centre of Finland Ltd., P.O. Box 1000, FI-02044 VTT, Finland
** joel.anttila@vtt.fi*

Abstract

The introduction of light electric vehicles forms one of the emerging solutions for tackling air pollution and congestion in cities. In the STEVE project under the H2020 framework, electric mobility services with electric quadricycles and electric bicycles are tested at four demonstration cities in Europe. To prepare a way for describing and evaluating the services from the end users' point of view, three user centric use cases were defined and are presented in this paper: eMaaS, eco-driving and delivery. The potential of the services and use cases in addressing travel behaviour and road transport emissions will be assessed with mesoscopic and microscopic simulations.

Keywords: electric mobility; use cases; MaaS; light electric vehicles

1156 The vehicle scheduling problem of electric buses

Leonor Ayres Pereira[a]*, Teresa Galvão Dias[b]

a Faculdade de Engenharia da Universidade do Porto, FEUP, Porto, Portugal
b Department of Industrial and Management at Faculdade de Engenharia da Universidade do Porto, Porto, Portugal
** up201403121@fe.up.pt*

Abstract

Despite its evident advantages, electric vehicles face two major limitations: its lower autonomy and long charging time. Therefore, its adoption for public transportation forces the study of new approaches in the scheduling method. Developed for a homogeneous fleet, the present mathematical formulation allows the determination of an optimized vehicle scheduling with a multi-depot and charging station model, minimizing the total cost involved. Real data is tested using CPLEX software with Optimization Programming Language. A comparison between electric and non-electric vehicles scheduling is carried out, contrasting its percentage of operational time. When replaced by electric vehicles, a decline of the vehicle useful time is observed and compensated by the purchased of a higher number of vehicles. After, it is concluded that the charging time has a higher influence on this decline than the autonomy of the vehicle.

Keywords: Electric vehicle; Electric bus; Vehicle scheduling problem; Transportation system model; Multi-depot

1.26 Scientific and technical session 26: Electrification and energy alternatives II

303 REDIFUEL: Robust and Efficient processes and technologies for Drop-In renewable FUELs for road transport

Benedikt Heuser[a]*, Andreas Vorholt[b], Gonzalo Prieto[c], Barbara Graziano[a], Sascha Schönfeld[a], Maarten Messagie[d], Giuseppe Cardellini[d], Sanna Tuomi[e], Nina Sittinger[f], Roy Hermanns[f], Sangeetha Ramawamy[f], Chandra Kanth Kosuru[g], Hajo Hoffmann[g], Linus Schulz[h], Jaykumar Yadav[i], Maarten Weide[j], Thorsten Schnorbus[a]

a FEV Europe GmbH, Neuenhofstr. 181, 52078 Aachen, Germany
b MPI Max-Planck-Institute for Chemical Energy Conversion CEC, Stiftstraße 34-36, 45470 Mülheim an der Ruhr, Germany
c Instituto de Tecnología Química (ITQ), Consejo Superior de Investigaciones Científicas-Universitàt Politècnica de València, Avd. Los Naranjos s/n, 46022, Valencia, Spain
d Vrije Universiteit Brussel, Boulevard de la Plaine 2, 1050 Bruxelles, Belgien
e VTT Technical Research Centre of Finland Ltd, Ruukinmestarintie 2, ESPOO, P.O. Box 1000, FI-02044 VTT, Finland
f OWI Oel-Waerme-Institut gGmbH, Kaiserstraße 100, Herzogenrath, Germany
g Tec4Fuels GmbH, Kaiserstraße 100, Herzogenrath, Germany
h INERATEC GmbH, Siemensallee 84, 76187 Karlsruhe, Germany
i Institute for Combustion Engines, RWTH Aachen University, 52074 Aachen, Germany
j Uniresearch, Elektronicaweg 16C, 2628 XG Delft, The Netherlands
** heuser@fev.com*

Abstract

This paper introduces the work of the joint project "Robust and Efficient processes and technologies for Drop-In renewable FUELs for road transport" (REDIFUEL). The overall aim is to enable the utilization of various biomass feedstocks for an ultimate renewable EN590 diesel biofuel in a sustainable manner. REDIFUEL's ambition is to develop new technologies, solutions and processes to reach high conversion efficiencies for renewable fuel production. The proposed drop-in biofuel contains high-cetane liquid (C11-C21) bio-hydrocarbons and C6-C11 bio-alcohols showing exceptional combustion and pollutant mitigation performance. Environmental and social aspects are also considered by carrying out a comprehensive Biomass-to-Wheel performance analysis. First artificial fuel samples simulating the final product have been synthesized and analyzed with regard to fuel relevant properties, showing very promising results.

Keywords: Bioenergy; biofuels; transport; pollutant reduction; drop-in; EN590

Full paper: https://hal.archives-ouvertes.fr/hal-02506871/document

331 3D printing application in personal light electric transport production in Belarus

Alexander Volochko[a], Stsiapan Yankevich[a], Natallia Yankevicha[a]*

a National Academy of Sciences of Belarus, 66, Independence av., Minsk, 220072, Belarus
** lab_12@tut.by*

Abstract

It is currently recognized in Belarus that electric vehicles are the optimal type of passenger transport for a city usage that meets all the requirements of environmental and energy security. However, electric vehicles are very expensive

in Belarus. This fact makes the development of the personal light electric transport segment (electric bicycles, scooters, motorcycles, etc.) very actual.At the same time, the introduction of new technologies is of particular importance for their mass production. The range of tasks that can be solved with the help of modern additive technologies is expanding every day. First of all, this refers to the field of engineering (3D printing). This study is aimed at an experimental investigation of the filling density influence of parts and components of engineering structures that have been made by 3D printing, on their mechanical properties. Specific solutions for the manufacture of electric bicycle components using FDM technology have been proposed.

Keywords: 3D-printing, light personal electric transport means, electric bicycles

Full paper:
https://www.researchgate.net/publication/339389646_3D_printing_application_in_personal_light_electric_transport_production_in_Belarus

579 Thermal High Performance Storages as heating systems for electric buses

Werner Kraft[a]*, Anthony Rawson[b], Veronika Stahl[a], Peter Vetter[a], Florian Kargl[b], Michael Sonnekalb[c], Pascal Best[c]

a Institute for Vehicle Concepts – German Aerospace Centre (DLR), Pfaffenwaldring 38-40 Stuttgart 70569, Germany
b Institute for Material Physics in Space – German Aerospace Centre (DLR), Linder Höhe, Cologne 51147, Germany
c Konvekta AG, Am Nordbahnhof 5, 34613 Schwalmstadt, Germany
** Werner.Kraft@dlr.de*

Abstract

Heat generated by combustion engines in vehicles may be seen as a necessary inefficiency, but it is valuable for cabin heating purposes. Electric vehicles are efficient in energy conversion from battery to mechanical drive. However the absence of plentiful waste heat presents a challenge in efficiently maintaining appropriate temperatures for passengers and sensitive equipment. Direct resistive heating or heat pump operation draws battery capacity that could be used for driving, reducing the range of the vehicle. Using combustion heaters for cabin heating might maintain range, however local emissions are generated. A Thermal High Performance Storage is proposed to overcome these issues. Using an aluminium-silicon eutectic alloy, Thermal High Performance Storages can provide an energy dense, economical solution for space heating in electric vehicles. A case study of electric buses at the Stuttgart Airport is utilised to demonstrate the benefits of Thermal High Performance Storages and propose future research opportunities.

Keywords: Thermal Storage; Thermal Management; Metallic Phase Change Materials; Electric Buses; Public Transport

583 Improvement potentials for user-centrically designed electric vehicles: The QUIET Project

Hansjörg Kapeller[a]*, Dominik Dvorak[a], Dragan Simic[a]

a AIT Austrian Institute of Technology GmbH, Giefinggasse 2, Vienna 1210, Austria
** hansjoerg.kapeller@ait.ac.at*

Abstract

Current activities in the field of vehicle electrification offer a great potential for contributing to climate change mitigation by reducing anthropogenic CO2 emissions. Beyond the environmental strain, there is an economic one, too. It is therefore crucial for the European automotive industry to exploit not only the environmental benefits, but also the business opportunities which come from the transition from conventional fuel powered to electrified vehicles. To capture these opportunities, electric vehicles must deliver better performance at a lower price, overcoming the constraints that are currently limiting their mass-market uptake. This paper presents the approach of the research and innovation action H2020 project QUIET to meet these stringent requirements by developing an improved and energy efficient electric vehicle with increased driving range under real world driving conditions. This is achieved by exploiting the synergies of a technology portfolio in the areas of: user centric design with enhanced passenger comfort and safety, lightweight materials with enhanced thermal insulation properties, and optimised vehicle energy management.

Keywords: environmental- and economic benefits; increased driving range; user centric design; lightweight materials; vehicle energy management

Full paper:
https://www.researchgate.net/publication/339875514_Improvement_potentials_for_user-centrically_designed_electric_vehicles_The_QUIET_Project

732 Horizon2020 ReFreeDrive Project: Rare Earth Free e-Drives featuring low cost manufacturing

Alicia Rodriguez[a]*, Javier Romo[a], Giuseppe Fabri[b], Mircea Popescu[c], Misa Milosavljevic[d]

a Fundación Cidaut, Plaza Vicente Aleixandre Campos nº2 (Parque Tecnológico de Boecillo), Boecillo 47151, Spain
b Dept. of Industrial and Information Engineering and Economics, University of L'Aquila, Via Giovanni Gronchi 18, L'Aquila I-67100, Italy
c Motor Design Limited, 5 Edison Court (Wrexham Technology Park), Wrexham LL13 7YT, United Kingdom
d IFP Energies nouvelles, 1 et 4 avenue de Bois-Préau, 92852 Rueil-Malmaison, France ; Institut Carnot IFPEN Transports Energie
** alirod@cidaut.es*

Abstract

EU-Horizon2020 funded project ReFreeDrive focuses on innovative electric motor designs for automotive industry completely free of rare earth magnets. Compared with the benchmark motors and manufacturers within the electric vehicles industry, ReFreeDrive motors are expected to improve specific torque and specific power by 30%, with a 50% increase in maximum operating speed and power density in power electronics, while halving motor losses. Two technologies, fabricated and die cast induction motor, and synchronous reluctance motor with and without ferrite permanent magnets assistance were analyzed for 200kW and 75kW power levels. Electromagnetic, thermal and mechanical performances of each motor have been optimized for each case, in order to fulfill industry requirements. Low manufacturing cost and reduction of the use of materials have been considered during the design stage, which allowed achieving 15% lower production cost. Prototypes of each kind of motor will be manufactured and tested before the end of the project.

Keywords: Horizon2020; rare earth elements; induction motor; synchronous reluctance motor; power electronics; efficiency

Full paper: http://www.refreedrive.eu/wp-content/downloads/TRA2020_25102019_Rodriguez.pdf

774 Battery and Fuel Cell Aging Conscious Intelligent Energy Management Strategy for Hydrogen Hybrid Electric Buses

Jon Ander López-Ibarra[a,b]*, Nerea Goitia-Zabaleta[a], Aitor Milo[a], Haizea Gaztañaga[a], Haritza Camblong[b,c]

a IKERLAN Technology Research Centre, Spain
b University of the Basque Country (UPV/EHU), Spain
c ESTIA Research, France
** jonander.lopez@ikerlan.es*

Abstract

This paper aims to propose a battery and PEM fuel cell aging conscious energy management strategy. The initial design of an energy management strategy is a significant point, in order to fulfill the efficiency goals in a shortterm scope. However, with the aging, the initial conditions vary. The new trend of digitalization allows to monitor the operation, widening the degrees of freedom and making possible to improve the developed first strategy in a long term. Therefore, a methodology for updating the energy management strategy throughout the bus lifetime is proposed, in order to improve the running costs and extend the battery and fuel cell lifetime. The proposed energy management strategy is based on a dynamic programming optimization, tuning the fuzzy logic membership functions and rules based on neuro-fuzzy technique. The obtained results have shown hydrogen consumption errors differences up to 0.16% and 1.83% in the updated and non-updated strategies respectively.

Keywords: Hydrogen hybrid electric bus, energy management strategy, total cost of ownership, dynamic programming, neuro-fuzzy, battery aging, fuel cell aging

Full paper: https://www.researchgate.net/profile/Jon_Ander_Lopez-Ibarra2

901 Ensuring short-term e-bus compatibility and interoperability within Europe - ASSURED 1.0 interoperability reference

Marko Paakkinen[a], Peter Cremers[b], Mehrnaz Farzam Far[c]*

a VTT Technical Reseach Centre of Finland, Visiokatu 4, 33720 Tampere, Finland
b VDL Bus and Coach bv, De Vest 7, 5555XL, Valkenswaard, Netherlands
c VTT Technical Reseach Centre of Finland, Tietotie 4C, 02150 Espoo, Finland
** mehrnaz.farzamfar@vtt.fi*

Abstract

At present, the standardisation efforts are still ongoing on the e-bus fast charging. To support these efforts, project ASSURED has developed a first baseline specification called "ASSURED 1.0 interoperability reference" to enable conformance and interoperability testing. This first issue has been developed in close cooperation with the project partners and it is based on the latest draft standards. The ASSURED 1.0 solution includes three different fast charging methods utilizing Automated Connection Devices. The ASSURED 1.0 specification is filling the currently existing gaps in and between the standards. This baseline specification can be utilized as the first guidebook or reference in the implementation of e-bus systems also outside the project, until the standardisation is finalized.

Keywords: E-bus; electric; bus; fast charging; charging infrastructure; standardisation

917 Fuel cell electric buses: Experience of a zero emission solution through JIVE, JIVE 2 and MEHRLIN projects

Sabrine Skiker[a]*, Efe Usanmaz[b]

a Hydrogen Europe, avenue de la Toison d'o 56-60r, 1060 Brussels, Belgium
b International Association of Public Transport (UITP), Rue Sainte-Marie 6, 1080 Molenbeek-Sainte-Jean, Brussels, Belgium
** s.skiker@hydrogeneurope.eu*

Abstract

Fuel cell (FC) electric buses represent a key zero emission transport solution which will help tackle climate change challenges and clean cities' air. The JIVE, JIVE 2 and MEHRLIN projects will deploy some 300 fuel cell buses and their hydrogen infrastructure in 22 cities across Europe. After introducing the topic and explaining what fuel cell buses are, the paper will highlight the joint procurement and commercialisation strategies for fuel cell buses deployment as well as the early results and recommendations from the projects, 2019 being the year of arrival of the first buses, the early results will focus on the joint procurement of fuel cell buses and of the infrastructure.

Keywords: fuel cells, hydrogen, emission reduction, electrification, public transport, alternative fuels

919 Thermal Management Strategy of Electric Buses towards ECO Comfort

Mohammed Mahedi Hasan[a,b], Jeroen Maas[c], Mohamed El Baghdadi[a,b], Roel de Groot[c], Omar Hegazy[a,b]*

a Vrije Universiteit Brussel (VUB), ETEC Department and MOBI Research Group, Pleinlaan 2, 1050 Brussels, Belgium
b Flanders Make, 3001 Heverlee, Belgium
c TNO Automotive, Automotive Campus 30, 5708 JZ Helmond, Netherlands
** omar.hegazy@vub.be*

Abstract

Energy Management System (EMS) is a critical aspect in electric vehicles to increase driving range, minimize costs, and extend battery life. In E-bus drivetrains, EMS can be utilized to optimize thermal management of associated auxiliaries and en-route charging. A bus cabin environment is a dynamic environment contending with varying levels of passengers and ambient conditions. Buses use the Heating Ventilation and Air Conditioning (HVAC) system to maintain the internal cabin climate. In E-buses, the HVAC system draws electrical energy from the main battery; therefore, a suitable strategy is required to minimize the power utilization. The "comfort" aspect should ensure regulation of both temperature and humidity in the cabin. The controlling mechanism should provide proper comfort to the passengers, utilize the least energy, and respect the constraints of the HVAC system. In this paper, a dynamic thermal cabin model is developed to investigate the ECO-comfort strategy of E-bus and their impact on the energy consumption. Results show that HVAC power usage is inversely proportional to passenger load when ambient temperature is less than reference setpoint and vice versa, and the ECO-comfort offers substantial energy savings over contemporary climate control algorithms when the HVAC system is operated in moderated weathers.

Keywords: ECO-comfort; E-Bus: HVAC; Cabin climate; EMS; Thermal management system

987 Selected functionalities of the PLATON Planning Tool to support electric bus deployment in transport networks

Krzysztof Krawiec[a]*, Grzegorz Karoń[a], Olaf Czogalla[b], Mikhail Kovalyov[c], Gerfried Cebrat[d]

a Silesian University of Technology, Faculty of Transport, Krasinskiego 8, 40-019 Katowice, Poland
b Institute for Automation and Communication, Werner-Heisenberg-Straße 1, 39106 Magdeburg, Germany
c The United Institute of Informatics Problems of the National Academy of Sciences of Belarus, Surganova 6, 220012 Minsk, Belarus
d Energie- und Umwelt-Consulting, Hermann Bahr-Gasse 5/II/12, A- 8020 Graz, Austria
** krzysztof.krawiec@polsl.pl*

Abstract

A process of electric bus deployment in transport networks of cities and agglomerations is nonhomogeneous. In this process, there are numerous obstacles of economic, optimization, technical and mental nature. The paper presents intermediate results of the international research project 'Planning Process and Tool for Step-by-Step Conversion of the Conventional or Mixed Bus Fleet to a 100% Electric Bus Fleet' (acronym: PLATON), which main objective is to create an information technology (IT) support tool for electric bus deployment in transport network. The focus is put on a description of the already designated functionalities of the tool. These include: a decision support system for electric bus deployment, an optimal selection of electric bus fleet and charging infrastructure, and bus scheduling being a subject to the limited budget and bounded electric power as well as economic models for the calculation of a Total Costs of Ownership (TCO).

Keywords: electric mobility, planning process, battery electric bus, transport system, optimization model, TCO model

Full paper: https://drive.google.com/file/d/1LaNUvY5Xar9YMw-X29iCesl-pOoR6Rp5/view?usp=sharing

1021 Optimization of electric vehicle system utilizing a hybrid particle swarm algorithm

Mikaela Ranta[a]*, Mikko Pihlatie[a], Ari Hentunen[a]

a VTT Technical Research Centre of Finland, Tietotie 4 C, Espoo FI-02044, Finland
** mikaela.ranta@vtt.fi*

Abstract

A method for optimization of electric vehicle fleets is proposed. The method utilizes a hybrid particle swarm optimization algorithm with both continuous and binary variables. The battery capacity, battery chemistry, charging locations, charging power and number of chargers are obtained as an output of the optimization. A vehicle fleet simulation model is used to evaluate the cost of the system. The energy consumption for various routes and the costs for charging infrastructure, energy and purchase of vehicles are obtained as a result from the simulations. The battery ageing is evaluated based on the state-of-charge cycles. The method is demonstrated on two different cases of electric buses in the Helsinki region.

Keywords: fleet simulation, energy consumption, total cost of ownership, opportunity charging

1103 User segmentation, user preferences and current challenges in the Austrian electric vehicle market

Wolfram Groschopf[a]*, Stefan Schönfelder[a], Nicole Leovac[b]

a University of Economics and Business, Institute for Transport and Logistics Management, Welthandelsplatz 1, 1020 Wien, Austria
b University of Applied Sciences BFI Vienna, Wohlmutstraße 22, 1020 Wien, Austria
** wolfram.groschopf@wu.ac.at*

Abstract

While the demand for battery electric vehicles (BEV) is growing, little empirical knowledge about BEV owners and their usage patterns exists. An analysis of current literature on the use of BEVs from different countries leads to the conclusion, that BEV users are mainly defined by their charging requirements. We address the need for a more advanced and data driven user segmentation of private households owning BEVs by using online survey data from Austria to cluster different user segments based on individual use patterns. Different variables turn out to be suitable for user segmentation. We provide an insight into the structure of BEV user segments based on a sample from Austria. In addition, we identify and illustrate individual preferences, perceived challenges and resulting opportunities in association with use and ownership of BEVs within and across different user segments.

Keywords: E-mobility; battery electric vehicle (BEV); user segmentation; online survey; cluster analysis; Austria

Full paper:
https://www.researchgate.net/publication/339875566_User_segmentation_user_preferences_and_current_challenges_in_the_Austrian_electric_vehicle_market

1105 Embracing Electromobility in Europe: Analysis of good practices and their Transferability in nine European Regions

Jordi Broos[b], Lieselot Vanhaverbeke[b]*, Foteini Orfanou[a], Panagiotis Papantoniou[a], Eleni Vlahogianni[a], George Yannis[a]

a National Technical University of Athens, 5, Iroon Polytechniou, Athens GR-15773 Athens Greece
b Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, 1050, Belgium
** lieselot.vanhaverbeke@vub.be*

Abstract

Emissions production and energy consumption are continuously and exponentially increased worldwide. European Union annual reports concerning mobility and transport reveal that transportation sector has the highest share in energy consumption while road transportation constitutes the second contributing factor in CO2 emissions. The shift towards a more sustainable mobility seems to be an urgent need and alternative fuels and electromobility are considered the key solutions for more environmental-friendly transportation systems. The scope of this paper is to identify the good practices related to electromobility and alternative fuels already implemented or planned to be implemented in nine European regions. The good practices are classified and evaluated for their effectiveness and their transferability potential constituting a useful guide for policy makers and stakeholders. Results showed that the transferability of a practice highly depends on regional characteristics and indicators and that similar region profiles present higher transferability potential.

Keywords: electromobility; good practices; European regions; energy saving

1.27 Scientific and technical session 27: Catering non-motorised transport

144 An Ex-Ante Impact Assessment Model for Testing Different Strategies for the Implementation of Cargo Bike Transshipment Points in Urban Districts

Tom Assmann[a]*, Sebastian Lang[b], Florian Müller[a], Michael Schenk[a]

a Otto von Guericke University Magdeburg, Universitätsplatz 2, Magdeburg 39106, Germany
b Fraunhofer Institute for Factory Operations and Automation IFF, Sandtorstrasse 22, Magdeburg 39106, Germany
** tom.assmann@ovgu.de*

Abstract

This study presents a quantitative scenario-based model that assesses the impacts the implementation of a cargo bike delivery network with different strategies for siting urban transshipment points in a single district has on traffic, the carbon footprint and air quality while varying population density and business population. The findings obtained will provide logisticians and urban planners guidance for strategic planning of UTPs. The model is intended to deliver generic, strategic insights for researchers, policymakers (including planners) and logistics providers. The findings demonstrated that the use of cargo bikes to make CEP deliveries in urban districts can reduce GHG, PM10 and NOx emissions significantly. The choice of vehicles completing inbound and outbound processes to and from distribution centers or network hubs and the strategies for siting urban transshipment points display widely differing and even conflicting potential to reduce emissions.

Keywords: urban logistics, cargo bike, urban transshipment point, city logistics, urban planning, urban freight

181 More feet on pavements and more feet on pedals: Enabling safe walking and cycling in CIVITAS Eccentric

Paul Fenton[a]*

a City of Stockholm, Environment & Health Administration, Fleminggatan 4, SE-11226, Sweden
** paul.fenton@stockholm.se*

Abstract

This paper looks at the work of five cities to demonstrate nine measures enabling safe walking and cycling in CIVITAS Eccentric, an EU-funded project running during 2016-2020. Each of the measures focuses on different aspects, processes and techniques that can enhance the quality of walking and cycling in cities, and the paper presents main findings and main influences on the demonstration of the measures during the first three years of the project. These include stakeholder participation, data collection and management, institutional barriers and the obligations imposed and opportunities provided by external funding. Project-based funding is shown to be a double-edged sword, yet an important enabler of action that contributes to safer walking and cycling and indicates a pathway for other cities to follow.

Keywords: Walking; Cycling; Safety; CIVITAS Eccentric; sustainable mobility

Full paper:
https://www.researchgate.net/publication/339618249_More_feet_on_pavements_and_more_feet_on_pedals_Enabling_safe_walking_and_cycling_in_CIVITAS_Eccentric

354 Latent class ordered probit model for bicycle crash severity

Marcus Skyum Myhrmann[a]*, Kira Hyldekær Janstrup[a], Mette Møller[a], Stefan Eriksen Mabit[a]

a DTU Management , Bygningstorvet 116B 2800 Kgs. Lyngby , Denmark
** mskyum@dtu.dk*

Abstract

Finite Mixture models have in recent years been embraced for modelling injury severity outcome of crashes. These models have mostly been used for crashes with collisions of several parties. The purpose of this study is to analyse the injury severity sustained in by cyclists in crashes, without disregarding single-bicycle crashes. For this we use a latent class ordered probit model. The model includes socio-demographic variables in both class-probability and injury severity outcome model. The estimation process identifies four latent classes as most suitable trade-off between parsimony and data fit. The results reveal that the use of socio-demographic variables in class-assignment and injury severity model not only benefits the model fit, but also allows for better interpretation of the latent classes. Furthermore, the analysis shows that the use of medical records and road maintenance data offers additional insight into factors contributing to more severe injuries following cyclist crashes.

Keywords: Cyclist crashes; Injury severity; Medical records; Latent class ordered probit; Unobserved heterogeneity

510 Cycling rail trails increase commuters' safety and comfort: examples from Czechia

Michal Bíl[a]*, Marek Sova[a], Richard Andrášik[a], Jan Kubeček[a], Martina Bílová[a], Vojtěch Cícha[a]

a CDV – Transport Research Centre, Líšeňská 33a, 636 00, Brno, Czechia
** michal.bil@cdv.cz*

Abstract

Cycling rail trails (CRT) are comfortable for cyclists due to their gentle longitudinal slope as they were parts of a railway system. Traffic crashes with cars cannot occur there as motor traffic is not allowed to enter CRT. Local tracks have been recently canceled in Czechia due to many reasons. These abandoned tracks are sometimes transformed into CRT. We focused on 5 examples of the existing CRT which are frequently used by cyclists. Vibration as a dynamic comfort index, longitudinal profiles and energy consumption were measured for both CRT and adjacent roads which were used by cyclists previously. The results suggest that all CRT have gentler profiles than roads. Cyclists experience less vibrations and energetic consumption is also lower on CRT. Quantitative data demonstrate that CRT are safer, and more comfortable than adjacent roads and certain safety potential exist when other suitable abandoned railways were converted into CRT.

Keywords: Rail trails; cycling; safety; comfort; abandoned rail tracks; traffic crashes

574 Facing the needs for clean bicycle data – A bicycle-specific approach of GPS data processing

Sven Lißner[a]*, Stefan Huber[a]

a Technical University Dresden, Chair of Transportation Ecology, Hettnerstr. 1, 01062 Dresden, Germany
** sven.lissner@tu-dresden.de*

Abstract

GPS-based cycling data are increasingly available for traffic planning these days. However, the recorded data often contain more information than simply bicycle trips. Trips resulting from the use of different modes of transport than bike or long periods at working locations while people are still tracking are only some examples. Thus, collected bicycle GPS data needs to be processed adequately to use them for planning. The article presents a multi-level approach towards bicycle-specific data processing. The data processing model contains different steps (data filtering, smoothing, trip segmentation, transport mode recognition, driving mode detection). Validation reveals a sound accuracy of the model at its' current state (82-88%).

Keywords: bicycle traffic planning; GPS data, big data, crowdsourcing, data processing

787 Modelling and Simulation of Bicycle Dynamics

Murad Shoman[a]*, Hocine Imine[a]

a Université Paris-Est, LEPSIS, IFSTTAR, 14-20 Boulevard Newton, 77420 Champs sur Marne, France
** murad.shoman@ifsttar.fr*

Abstract

In this paper the authors present an experimental validation of the bicycle simulator developed by two IFSTTAR laboratories: LEPSIS and LPC. In the first part, we focus on improving the dynamics of the bicycle model and simulate the effects of road geometry and surface characteristics such as radius of curvature, road adhesion and unevenness of road profile. In order to verify the accuracy of the developed model, experimental results are shown. For future work, the authors will study the effect of these characteristics on user behaviour to improve the safety and stability of bicycles, particularly in bad weather conditions.

Keywords: Bicycle Modeling, Bicycle Simulator, Simulation, Dynamics, Road characteristics

Full paper:
https://www.researchgate.net/publication/339875438_Modelling_and_Simulation_of_Bicycle_Dynamics

874 Peer-to-Peer Cargo Bike Sharing: Findings from LARA Share project

Fabian Dorner[a]*, Martin Berger[a]

a Technische Universität Wien, Forschungsbereich Verkehrssystemplanung, Karlsplatz 13, 1040 Wien, Austria
** fabian.dorner@tuwien.ac.at*

Abstract

Cargo bikes offer the potential to shift transport activities from cars and small trucks which makes them a promising option for future urban mobility. Sharing cargo bikes could play a central role in helping them expand out of their current niche. The potential that results from peer-to-peer sharing is still hardly used for cargo bikes.

As part of the LARA Share project, a platform for peer-to-peer sharing of transport bikes and suitable parking spaces was developed and implemented as pilot. During conception, a survey among potential users of the platform took place. The article presents the results of the survey concerning the user structure, their attitudes towards cargo bikes and the intention to use cargo bike sharing. Afterwards, the supply and demand for cargo bikes on the sharing platform during the pilot phase will be presented and reasons will be discussed why demand for lending them has remained below expectations.

Keywords: cargo bikes, peer-to-peer sharing, users, providers, platform

Full paper: https://www.researchgate.net/publication/339899868_Peer-to-Peer_Cargo_Bike_Sharing_Findings_from_LARA_Share_project

939 How cycling perceived in Budapest based on household survey results

Tamás Mátrai[a]*, János Tóth[a], Julio Cruz[a]

a Department of Transport Technology and Economics, Faculty of Transportation Engineering and Vehicle Engineering, Budapest University of Technology and Economics, Műegyetem rkp 3., H-1111, Budapest, Hungary
** tamas.matrai@mail.bme.hu*

Abstract

With the increasing awareness of the ecosystem limitation, cycling, as a transportation mode, has been promoted as an initiative way to preserve our sources of raw materials and encourage healthier habits in our everyday lives. Aiming to gather data about cycling in Budapest and its agglomeration, a household survey with 1511 individuals was carried out. Two main groups were targeted during the household survey: citizens who has used bicycle for transportation in the last 30 days and those who are willing to use bicycles given the right circumstances. With a questionnaire about the cycling habits and preferences with a random sampling process, it was possible to value parameters such as cycling impacts in society, cycling infrastructure development and its spatial behavior, perceived safety, morale, safe infrastructure, facilities, cost sensitivity and the impact of dedicated cycling infrastructure in Budapest.

Keywords: household survey; cycling; mode choice; route choice; cycling infrastructure

1008 The creation of a citizen observatory campaign aimed at promoting cycling through FLAMENCO: an open and reconfigurable digital platform

Liesbeth De Wilde[a], Jesse Pappers[a]*, Imre Keserü[a], Cathy Macharis[a]

a Mobility, Logistics and Automotive Technologies Research Centre (MOBI), Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium
** jesse.pappers@vub.be*

Abstract

Recently there has been an increasing tendency towards bottom-up travel surveys when stakeholders initiate data collection campaigns in citizen observatories. This way, citizens can observe our environment by collecting data using smartphones. However, deploying new citizen observatories remains technically difficult and labor-intensive. The Flanders Mobile Enacted Citizen Observatories project (FLAMENCO) has developed an open, reusable and reconfigurable citizen

observatory platform which allows ICT-agnostic stakeholders to initiate new citizen observatories. Recently, a first campaign has been created through the platform with the aim of motivating students to cycle. In this paper we validate a technical framework under real life conditions, we examine the guidance needed when creating a citizen observatory and we evaluate whether the citizen observatory gives the desired results in terms of accuracy and user experience. The results of creating and evaluating the use case serves as a basis for a comprehensive manual that will later be developed.

Keywords: Citizen observatories; participatory sensing; technical requirements; travel surveys; data collection

Full paper: https://doi.org/10.5281/zenodo.3711942

1055 Nudging bicyclists towards a safer behavior -Experiences from the MeBeSafe project

Pontus Wallgren[a]*, MariAnne Karlsson[a], Viktor Bergh Alvergren[a]

a Chalmers University of Technology, Gothenburg SE-41296, Sweden
** pontus.wallgren@chalmers.se*

Abstract

The European union's official cycling strategy states that bicycle use should increase by 50 percent in ten years while at the same time halving the amount of deaths (ECF, 2019). It is therefore highly important to find safety increasing measures that are both acceptable for bicyclists and that actually work. The Horizon 2020 project MeBeSafe is investigating if nudging can be a fruitful way towards safer traffic behaviour of car and truck drivers, as well as cyclists. This paper reports on a series of quasi-experimental studies that investigated if nudging can affect bicyclists' speed as well as trajectory. The project has so far showed that visual nudges have a great potential for affecting speed and trajectory, while haptic nudges seems to have little effect.

Keywords: Nudging; Cycling safety; Speed reduction

Full paper:
https://research.chalmers.se/publication/515725/file/515725_Fulltext.pdf

1.28 Scientific and technical session 28: Pedestrian safety and Vulnerable Road Users

188 Towards a Distributed Data Fusion Pipeline for Pedestrian Behaviour Analysis

Thiago RPM Rúbio[a,d], João Jacob[a,d], Henrique Lopes Cardoso[a,d], Daniel Castro Silva[a,d], Rui Rodrigues[a,c,d], Sara Ferreira[b,d], Eugénio Oliveira[a,d], Rosaldo J.F. Rossetti[a,d]

a LIACC – Artificial Intelligence and Computer Science Laboratory
b CITTA – Research Centre for Territory, Transports and Environment
c INESC TEC- Institute for Systems and Computer Engineering, Technology and Science
d FEUP – Faculty of Engineering, University of Porto

Abstract

As our reliance on road transportation for moving people and goods is paramount in today's socio-economic panorama, there is a need to ensure both efficiency (in terms of speed and cost) and safety of all road users. It is necessary to understand

how traffic behaves from the perspective of each of the related entities. However, the process of collecting and analysing the data and computing associated metrics requires the combination of different participants, recording devices and data sources into a common source of facts. To address this issue, we propose a distributed data fusion pipeline for pedestrian behaviour analysis that may be generalised to other road users. Our proposed pipeline allows for the flexible and incremental combination of multiple data sources (such as sensors, video or psychological analysis), including a posteriori addition of new data sources and introduction of changes in how data is fused. Ultimately, this pipeline will be part of a learning platform, exploited by machine learning algorithms, capable of producing pedestrian behaviour models based on the collected data.

Keywords: data analysis, distributed data fusion, traffic analysis, pedestrian behaviour

254 VIRTUAL - a European approach to foster the uptake of virtual testing in vehicle safety assessment

Astrid Linder[a,b]*, Ragnhild J. Davidse[c], Johan Iraeus[b], Jobin D. John[b], Arne Keller[d], Corina Klug[e], Simon Krašna[f], Christoph Leo[e], Maria Ohlin[a], Ary P. Silvano[a], Mats Svensson[b], Linus Wågström[g], Kai-Uwe Schmitt[d]

a Swedish National Road and Transport Research Institute, VTI, P.O Box 8072, SE 402 78 Gothenburg, Sweden
b Department of Mechanics and Maritime Science, Chalmers University, Gothenburg, Sweden
c SWOV Institute for Road Safety Research, PO Box 93113, 2509AC The Hague, Netherlands
d AGU Zurich, Winkelriedstr. 27, 8006 Zurich, Switzerland
e Vehicle Safety Institute, Graz University of Technology, Graz, Austria
f Faculty of Mechanical Engineering, University of Ljubljana, Slovenia
g Volvo Car Corporation, Dept 91490, SE 405 31 Gothenburg, Sweden
** astrid.linder@vti.se*

Abstract

In the assessment of road user and vehicle occupant safety, physical testing is limited to a few scenarios. To advance transport safety it is vital to include more relevant scenarios. Virtual Testing offers an opportunity to introduce additional test scenarios. The objectives of the VIRTUAL project, described in this paper, include: Identifying impact scenarios relevant for the future, providing tools such as models, guidelines, and a corresponding platform to foster the uptake of virtual testing. The safety of standing passengers on public transport has been reviewed, scenarios for Vulnerable Road User testing have been identified and new seated positions for future vehicles have been described. In addition, a virtual testing platform has been established on which human body models are provided. The platform follows the open access approach, complements other approaches and does not just provide the models, but also guidelines on how to implement new scenarios in test procedures.

Keywords: Female and Male; Human Body Models; Open Source; Road Transport; Vehicle Safety; Virtual Testing; Vulnerable Road Users

Full paper: https://projectvirtual.eu/wp-content/uploads/2020/03/VIRTUAL-TRA-2020-Linder-et-al_12Mar20.pdf

594 Detecting and improving the safety of groups of pedestrians at signalised intersections

Nicolas Speisser[a]*, Samuel Lab[a]

a Cerema Est, 1 Boulevard Solidarité, 57070 Metz, France
** nicolas.speisser@cerema.fr*

Abstract

Traffic lights' cycles including pedestrian fixed green times are not suited for massive and irregular pedestrian flows. To address this issue, innovative thermal sensors were implemented in an intersection in Metz (France) to detect groups, evaluate their size and adapt the green time in real time. The assessment's results have first showed that the sensor was reliable to detect pedestrians: 99,82% of pedestrians were detected. Moreover, the regulation strategy that was set up gave satisfying results, since 91% of the groups of pedestrians observed (82/90) were detected, thus giving an extended green time, which had a significant impact on pedestrian crossing conditions. Before the system installation, 38% of the crossing groups would cause pedestrians to still be on the road when the light turned green for the vehicles. After that, the number dropped to 6%. The statistical tests revealed the device had a positive impact on the pedestrian safety conditions.

Keywords: safety; pedestrians; children; signalised intersections; detector

726 Exploring Contributory Parameters of Pedestrian Movement Using Low Cost GNSS Receiver Data

Eleni Andrikopoulou[a]*, Ioanna Spyropoulou[b], Harris Perakis[c], Vassilios Gikas[d]

a Postgraduate Student, School of Rural and Surveying Engineering, National Technical University of Athens, Iroon Polytechneiou Str. 9, Zographos, Athens 157 80, Greece
b Assistant Professor, School of Rural and Surveying Engineering, National Technical University of Athens, Iroon Polytechneiou Str. 9, Zographos, Athens, 157 80, Greece
c PhD candidate, School of Rural and Surveying Engineering, National Technical University of Athens, Iroon Polytechneiou Str. 9, Zographos, Athens, 157 80, Greece
d Professor, School of Rural and Surveying Engineering, National Technical University of Athens, Iroon Polytechneiou Str. 9, Zographos, Athens, 157 80, Greece
** helenandr05@hotmail.com*

Abstract

The aim of this research is the investigation of the impact that various parameters, such as pedestrians' characteristics, mobile phone use and walking pace may have on the characteristics of pedestrians' behaviour using low cost GNSS receiver data. For this purpose, a controlled experiment was designed involving participants walking along a 220m path in a pedestrian area under different types of distraction (no distraction, hand-held conversation and texting) and walking pace (normal, fast). Pedestrians' behaviour was captured through three behaviour indicators: mean speed, mean acceleration and mean deceleration. In particular, results indicated that walking speed, acceleration and deceleration are reduced with mobile phone use. At the same time, it was shown that older pedestrians move at lower speeds compared to younger, while gender does not appear to have a statistically significant impact on any of the explored variables.

Keywords: walking, distraction, pedestrian behaviour, discrete choice analysis, GNSS data

821 The influence of urban network characteristics in pedestrian injury severity. A case study from Lisbon.

Sandra Vieira Gomes[a]*, Carlos Roque[a], João Lourenço Cardoso[a]

a Laboratório Nacional de Engenharia Civil, Av. do Brasil, 101, 1700-066 Lisbon, Portugal
** sandravieira@lnec.pt*

Abstract

In Portugal, from 2010 to 2016, 97% of the injured pedestrians occurred on streets and roads in urban areas. This study aims to investigate the risk factors associated with various levels of injury severity that pedestrians experience in the city of Lisbon, Portugal. To accomplish this analysis, a geocoded database on road accidents and victims occurred in Lisbon between 2008 and 2011 was used. The analysis was conducted using a multinomial logit model, to estimate pedestrian' injury outcomes variables, disaggregated by level of severity. The driver's gender, the pedestrian's age, the type of pedestrian crossing, the land use characteristics, and the time of day were identified as influential in pedestrian injury severity. It was also found that, business areas increased the probability of pedestrian death and that serious pedestrian injuries were less likely to occur in the presence of female drivers compared to male drivers.

Keywords: Pedestrian safety; Injury severity; Built environment; Multinomial logit model; GIS

Full paper:
https://www.dropbox.com/s/5iyskriug55mxqo/TRA2020_Vieira_Gomes_et_al._v2.pdf?dl=0

905 Risk and characteristics of pedestrian fatalities and serious injuries: Case Finland

Fanny Malin[a]*, Anne Silla[a], Milos Mladenovic[b]

a VTT Technical Research Centre of Finland Ltd., P.O. Box 1000, FI-02044 VTT, Finland
b Aalto University, Otakaari 4, 02150 Espoo, Finland
** fanny.malin@vtt.fi*

Abstract

The aim of the study was to examine the risk (per kilometres walked) of a pedestrian getting killed or seriously injured, as well as describe and compare the characteristics of the severities. The study included all motor vehicle-pedestrian accidents in Finland over the period 2014–2017 and exposure data from the national travel survey of 2016. The results showed heightened risk specifically for pedestrians aged over 75 and in rural heartland areas. Furthermore, there are differences in the vehicle type, area type, accident location, current speed limit and road and lighting conditions between pedestrian fatalities and serious injuries. The main implications of the study are that traffic safety work should be tailored to local conditions and amended and redirected to account for both fatalities and serious injuries.

Keywords: traffic safety; pedestrian; killed and seriously injured

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

979 Analysis of pedestrian involved road accidents in the Vilnius City

Kornelija Ratkevičiūtė[a], Vilma Jasiūnienė[a], Laura Jateikienė[a]*, Dovydas Skrodenis[a]

a Vilnius Gediminas Technical University Road Research Institute, Linkmenu str. 28, Vilnius 08217, Lithuania
** laura.jateikiene@vgtu.lt*

Abstract

Despite the recently growing focus on pedestrian safety, pedestrians are still the most vulnerable group of road users. Walking is the mode of mobility to be

encouraged and pedestrian safety assurance is a very important area for improving road safety, especially on urban roads. A detailed analysis of road accidents is one of the key tools for selecting the most effective and useful measures for improving pedestrian traffic conditions. This paper presents the detailed road accident analysis of 2016–2017 in Vilnius City, develops the accident victim's (pedestrian's) portrait and identifies the most dangerous traffic conditions for pedestrians. Pedestrian involved accidents analysis shows that the most frequent victims of road accidents are drunken pedestrian men crossing the street on link where is no pedestrian crossing during a dark time of the day.

Keywords: road accidents; road safety; pedestrians; vulnerable road users; Vilnius City; statistical analysis

1049 Vehicle requirements for electric cargo bikes in commercial transport

Amelie Ewert[a]*, Özcan Deniz[a]

a German Aerospace Center (DLR), Institute of Vehicle Concepts, Pfaffenwaldring 38-40, 70569 Stuttgart, Germany
** Amelie.Ewert@dlr.de*

Abstract

Facing problems such as population growth cities have to cope with lack of space and increasing emissions from the transport sector. The need for commercial transport is rising and new sustainable mobility solutions have to be considered. One example is the deployment of electric cargo bikes. To develop a new vehicle concept the heterogeneous user characteristics need to be analysed to identify requirements. By looking at driving profiles and transported goods use cases were developed and included freight transport i.e. the CEP segment, last mile delivery and service transport such as municipal, craftsmen or care services. The results showed that based on the user characteristics all focused segments are suitable for e-cargo bikes. The characteristics differ in particular in operating times, downtime and number of trips, which places higher demands on the charging system and management in the case of service transport due to longer and more frequent travel times.

Keywords: Electric cargo bike; commercial transport; driving profiles; last mile delivery; vehicle requirements

1161 Investigation of traffic and safety behaviour of pedestrians texting or web-surfing

Marilia Ropaka[a], Dimitrios Nikolaou[a]*, George Yannis[a]

a National Technical University of Athens, Department of Transportation Planning and Engineering, Iroon Polytechniou 5 str., GR-15773, Athens, Greece
** dnikolaou@mail.ntua.gr*

Abstract

The objective of this research is the investigation of traffic and safety behaviour of pedestrians texting or web-surfing. To achieve this objective, a pedestrian outdoor-environment experiment was carried out at three signalized pedestrian crossings in the center of Athens in Greece. Data collected from 142 distracted pedestrians and 412 non-distracted pedestrians were analysed in order to examine the differences between their behaviour. Statistical analyses were carried out using multiple lognormal regression and binary logistic regression models. The results indicated

that distracted pedestrians have lower speeds than non-distracted pedestrians. Moreover, the probability of a near miss (distance between pedestrian and vehicle less than two seconds) for non-distracted pedestrians remains very low and almost equal to zero when pedestrian volume or pedestrian speed increase, while for the distracted pedestrians it is much higher and presents an increasing trend.

Keywords: pedestrian; distraction; traffic behaviour; safety behaviour; lognormal regression; binary logistic regression

1.29 Scientific and technical session 29: Tomorrows Europeans railways

244 Conceptualization of place quality in High-Speed Rail station areas: A Review

Jinglun Du[a]*, Oana Druta[a], Pieter van Wesemael[a]

a Department of the Built Environment, Eindhoven University of Technology, P.O.Box 513, 5600MB Eindhoven, the Netherlands
** j.du1@tue.nl*

Abstract

High-speed railway (HSR) station areas are expected to benefit the urban environment not simply as transportation or economic activity hubs but also as urban places. However, the relationship between HSR station areas and place quality has not received systematic attention, despite the evolution of urban planning paradigms towards a clearer focus on quality of life. In this paper, we review 44 academic articles written between 1996 and 2019, and analyze concepts of place quality spanning the disciplines of traffic, urban planning, economic development, place-making, and mega-project management. We demonstrate that the conceptualization of place quality in relation to HSR station area development has remained compartmentalized, and this conceptual ambiguity stems from insufficient attention to the HSR features and a systematic classification of station areas should be a necessary method for future discussion. Finally, we put forward a working definition of place quality and develop a framework for categorizing specific features.

Keywords: High-speed rail (HSR) station area; Place quality; Conceptualization; Evaluation

369 Optiyard, optimized real-time yard management. An impact assessment.

Celestino Sánchez Martín[a], Paola Pellegrini[b], Mark Robinson[c], Riccardo V. Licciardello[d], Andrew Smith[e], Armando Carrillo Zanuy[a]*

a Eurnex e. V., Hardenbergstr. 12, 10623 Berlin, Germany
b Univ. Lille Nord de France, IFSTTAR, COSYS, LEOST, rue Élisée Reclus 20, 59666 Villeneuve d'Ascq, Lille, France
c Future Mobility, School of Engineering, Newcastle University, Cassie Building, Newcastle-upon-Tyne, NE1 7RU, United Kingdom
d DICEA Dipartimento di Ingegneria Civile, Edile e Ambientale, Sapienza University of Rome, via Eudpssiana 18, 00184 Roma, Italy
e Institute for Transport Studies (ITS), University of Leeds, 34-40 University Road, Leeds, LS2 9JT, United Kingdom
** acarrillo@eurnex.eu*

Abstract

Freight rail terminals play a central role in increasing the capacity and the efficiency of the rail system and therefore have the potential to contribute to promote modal shift to rail. A Shift2Rail project OptiYard develops an innovative framework to optimize, in real-time, the operations in freight rail yards. To this end, OptiYard models the interactions between the yard and the surrounding network by providing a software module where real-time yard operations as well as ETA and ETD of trains are simulated and optimized in real-time. In this paper we present the framework and the results of the impact assessment based on a CBA. The impact assessment is based on a specific case study of a rail freight yard.

Keywords: marshalling yards; automation; shunting; rail; freight; CBA

410 How can active suspension reduce cost in rail vehicles?

Rickard Persson[a]*, Sebastian Stichel[a], Rocco Libero Giossi[a]

a KTH Royal Institute of technology, Rail Vehicles, Stockholm 100 44, Sweden
** patper@kth.se*

Abstract

Active suspension systems for increased speed and better comfort have been used on railway vehicles for decades. However, these solutions could also be used to reduce vehicle first and maintenance costs. The starting point for this simulation study within the EU-funded project RUN2Rail is a simple but safe 2-axle vehicle with single axle running gears. The long wheelbase and single step suspension lead to inferior curving and ride comfort performance compared to conventional bogie vehicles. Active wheelset steering is used to reduce wheel and rail wear to less than the wear number of the conventional bogie vehicle. Active dynamic suspension is introduced to attenuate the rail-initiated vibrations from rail to carbody to provide vibration comfort in line with the reference vehicle. This vehicle, with its significantly lower weight, would bring lower energy and track access costs. The business case becomes obvious, i.e. a low-cost vehicle with low operational costs.

Keywords: Rail vehicle; single axle running gear; active suspension; wheelset steering; simulations

416 Shift2Rail Adaptable Communication System – A key enabler for the digitalization of the rail system

Michael Mikulandra[a]*, Ben Allen[b], Jon Arrieta Etxeberria[c]

a Kontron Transportation Deutschland GmbH, Frankfurter Straße 120-126, 63263 Neu-Isenburg, Germany
b Network Rail, 2nd Floor, One Eversholt Street, London, NW1 2DN, UK
b CAF Signalling, C/ Juan Fermín Gilisagasti nº4, 2ª planta, 20018 San Sebastián, Spain
** michael.mikulandra@kontron.com*

Abstract

The Shift2Rail program has initiated several research projects for driving innovation and improving competitiveness of the rail system. Activities for the advanced traffic management and signaling systems fall within the Shift2Rail Innovation Program 2 (IP2), which aim to define, develop and validate solutions that have the potential to catalyze and game change in terms of automation and digitalization of the railway. The Adaptable Communication System (ACS) for all railways is one of the technology demonstrators within IP2 and represents a key enabling technology to overcome some of the existing challenges when it comes to communication in the rail environment. This paper summarizes progress of the ACS achieved in the first IP2 project, X2Rail-1. It outlines the current technology focus areas of the working

groups and provides an outlook of the upcoming steps in current and forthcoming IP2 member projects.

Keywords: Shift2Rail; adaptable communication system; X2Rail; FRMCS; 5G; GSM-R

620 NextEVC: An opportunity to reduce costs and facilitate migration from class B to ETCS

Romain Bosquet[a]*, Damien Martinetti[b], Matthieu Thibault[a]

a SNCF Mobilité, 4 allée des Gémeaux, Le Mans, France
b SNCF Réseau, 6 avenue François Mitterrand, La Plaine Saint Denis, France
** romain.bosquet@sncf.fr*

Abstract

There are now around 30 different signalling systems across the European Union (EU) managing railway traffic which are not interoperable. The European Train Control System (ETCS) project, led by the European Commission, aims to provide a unique signalling system for all countries. To work, tracks and trains must be equipped with a compatible version. Unfortunately, ETCS is slowly implemented especially because of the on-board constraints: price, volume required, numerous interfaces, etc. This is why a new European Virtual Computer (EVC) is being developed, based on:

- A technological innovation with a virtual euro-antenna (balise map, GNSS and inertial unit imported from aviation);
- A pragmatic approach with reduction of functions and interfaces;
- An Innovative design (Model based design, early cooperation with suppliers, etc.).

This approach should reduce costs by a factor of 10 without hampering the interoperability of ETCS.

Keywords: railway; signalling; ETCS; EVC; GNSS; model based design

631 Contributing to Shift2Rail's Next Generation of High Capable and Safe TCMS

Igor Lopez[a]*, Imanol De Arriba[a], Gernot Hansb, Stefan Tesar[c]

a CAF R&D. Iturrioz 26, 20200 Beasain, Spain
b Bombardier Transportation, Neustadter Str. 62, 68309, Mannheim, Germany
c Deutsche Bahn AG, Richelstr. 5, 80634 München, Germany
** igor.lopez@caf.net*

Abstract

The Train Control and Monitoring System (TCMS) is the train's on-board brain and backbone. TCMS provides communication between equipment of different on-board subsystems and it makes train control decisions based on the knowledge of the status of all subsystems. The Next Generation TCMS aims at providing new and safer features to on-board subsystems as a cornerstone for reaching high available and reliable train operation. This paper presents the ongoing work within Shift2Rail CONNECTA-2 project which is the continuation of CONNECTA-1 project. CONNECTA-2 aims at scaling up to TRL4/5 the specifications made in CONNECTA-1 project regarding the developing the next generation of TCMS, with radical new architectures and components, and with wireless capabilities. In order to do so, two laboratory environments, i.e. urban and regional applications, are being deployed based on a new Simulation Framework concept, which will allow testing new disruptive technologies with zero on-site testing concept.

Keywords: TCMS; safety; Drive-by-Data; Functional Open Coupling; Functional Distribution Framework; Simulation Framework

Full paper:
https://www.researchgate.net/publication/339875143_Contributing_to_Shift2Rail's_Next_Generation_of_High_Capable_and_Safe_TCMS

669 Safe4RAIL-2: Advanced architectures and components for the Next-Generation Train Control and Monitoring System

Aitor Arriola[a]*, Mario Münzer[b], Arjan Geven[c], Jordi Pujol[d], Henrik Envall[e], Jérôme Härri[f], Núria Mata[g], Reinhard Aigner[h]

a Ikerlan Technology Research Centre, J.M. Arizmendiarrieta 2, 20500 Arrasate-Mondragon, Spain
b Technikon Forschungs- und Planungsgesellschaft mbH, Burgplatz 3a, A-9500 Villach, Austria
c TTTech Computertechnik AG, Schoenbrunner Strasse 7, A-1040 Vienna, Austria
d Moxa Europe GmbH, Einsteinstraße 7, D-85716 Unterschleißheim, Germany
e Westermo Network Technologies AB, Metallverksgatan 8, SE-721 30, Västerås, Sweden
f EURECOM, 450 Route des Chappes – CS 50193, 06410 Biot – Sophia Antipolis, France
g ETAS GmbH, Borsigstraße 24, 70469 Stuttgart, Germany
h Liebherr-Transportation Systems GmbH & Co KG, Liebherrstrasse 1, A-2100 Korneuburg, Austria
** aarriola@ikerlan.es*

Abstract

The Train Control and Monitoring System (TCMS) is responsible for the management of the different on-board train equipments, such as brakes, doors, or passenger information. The Next Generation TCMS (NG-TCMS) intends to increase communication reliability, incorporate wireless technologies and simplify the number of computing devices in the train. This paper describes the architecture and components that Safe4RAIL-2 project is developing for the NG-TCMS, including innovations in train communications and subsystem integration, which will be the basis for the future railway system. Synergies with previous and on-going research activities are also addressed.

Keywords: NG-TCMS; DbD; TSN; wireless; HVAC; FDF

Full paper: https://safe4rail.eu/downloads/publications/Safe4RAIL-2-Advanced-architectures-and-components-for-next-gen-TCMS.pdf

692 Cargo Wagon Structural Health Estimation Using Computer Vision

Andrés Felipe Posada-Moreno[a]*, Christopher Klein[b], Marc Haßler[a], Damir Pehar[b], Alexia Fenollar Solvay[a], Christian Kohlschein[a]

a Institute of Information Management in Mechanical Engineering at the RWTH Aachen University, Dennewartstr. 25-27, 52068 Aachen,Germany
b DB Cargo AG, Rheinstr. 2, 55116 Mainz, Germany
** andres.posada@ima-ifu.rwth-aachen.de*

Abstract

European Railway companies have to guarantee the safety of their operations as well as compliance with the European standards. This includes the diagnosis and maintenance of each wagon during their operations. This process is reactive and timely based, which impedes an optimal working schedule of the wagons and hinders the lifecycle management of their components. This publication describes the vision of a support system for wagon health assessment, a detailed description of the underlying methodology as well as results of the image acquisition and object detection steps. Said system aims to assist the overall maintenance process by

delivering pertinent information regarding the state of the wagons as well as diagnostic results of automated components analysis. The proposed system consists of four stages, image acquisition, wagon identification, health estimation, and a decision support system.

Keywords: cargo wagons; computer vision; deep learning; safety; anomaly detection

Full paper: http://doi.org/10.18154/RWTH-2020-02698

790 Key challenges of European Rail traffic Management System

Vahid Ranjbar[a]*, Nils O.E. Olsson[b]

a KTH Raoyal Institute of Technology, Departmet of Transport Science, Brinellvägen 23, Stockholm 11428, Sweden
b Norwegian University of Science and Technology, Department of Production and Quality Engineering, Valgrinda, Trondheim 7491, Norway
** vahidr@kth.se*

Abstract

This study is designed to analyse key challenges to European Rail Traffic Management System (ERTMS) implementation encountered in recent years. To achieve this goal, a systematic literature review was conducted where data were gathered and analysed concerning challenges and current issues relating to ERTMS implementation projects. The findings show a growing literature of ERTMS experiences, especially in the last 4 years. Several European countries have contributed to the literature, which appears to be primarily based on qualitative research methods. To reduce complexity created by a plurality of actors, definition of a single regulatory entity to address uniformity and safety assessment of rolling stock, and deployment of wayside equipment is necessary. Concerning technical issues, outcomes show that interaction between the European Train Control System (ETCS) and Global System for Mobile Communications – Railway (GSM-R) requires replacing these with new hybrid technologies moving towards long-term evolution (LTE) and modular approaches.

Keywords: ERTMS, ETCS, GSM-R, Digitalization, Interoperability, Implementation

Full paper:
https://www.researchgate.net/publication/339340353_Key_challenges_of_European_Rail_traffic_Management_System

841 Optimal infrastructure utilization with regards to an integrated periodic timetable in a liberalized railway market

Martin Smoliner[a]*, Stefan Marschnig[a]

a Graz University of Technology, Rechbauerstraße 12, Graz, 8010, Austria
** martin.smoliner@tugraz.at*

Abstract

The liberalization of the European railway market is fostered by several guidelines and regulations. In particular the fourth railway package is promoting competition in the railway market to improve attractiveness of services and to raise the modal share. Several new competitors entered the railway market in recent years improving number and quality of services. However, challenges in infrastructure utilization or train slot allocation remain especially in countries that align their infrastructure to an integrated periodic timetable. Infrastructure managers are

challenged by an increased number of conflicting train path requests often resulting in trade-offs, which lower the network-wide customer benefit. A procedure is developed to guarantee optimal infrastructure utilization and to maximize the advantages for customers. Herein, train slots for integrated periodic timetables are systematically planned by the infrastructure manager. Railway undertakings can apply for bundles of predefined train slots or request individual slots not interfering with predefined train paths.

Keywords: liberalization; fourth railway package; infrastructure utilization; integrated periodic timetable; train slot allocation; system train paths

Full paper:
https://www.researchgate.net/publication/339352941_Optimal_infrastructure_utilization_with_regards_to_an_integrated_periodic_timetable_in_a_liberalized_railway_market

973 A hybrid network architecture for train-to-Ground communications based on Wi-Fi and LTE

Mohamed Kassab[a,b]*, Marion Berbineau[b], Maha Bouhaziz[b], Ying Yan[c], José Soler[c]

a ISIMM, Université de Monastir, 5000 Monastir, Tunisia
b Univ Lille Nord de France, IFSTTAR, COSYS, LEOST, F-59650 Villeneuve d'Ascq, France
c DTU Fotonik, 2800 Kgs.Lyngby, Denmark
** mohamed.kassab@gmail.com*

Abstract

Train Control Management Systems (TCMS) are evolving to integrate several services with heterogeneous quality of service requirements. The network architecture for Train-to-Ground communication is following these changes. It has to be able to support service requirements while ensuring connectivity in high mobility and loaded environments. In this work, we propose a hybrid network architecture based on LTE and Wi-Fi wireless technologies. The LTE covers the high-speed sections while the Wi-Fi covers highly loaded areas. We investigate, using simulations, the ability of this architecture to satisfy performances required by applications. Results show the ability of Wi-Fi to offer good performances and confirm the interest of this technology as an alternative to connect highly loaded areas. However, Wi-Fi to LTE handovers imply a serious loss of performances for video and voice applications. There is a need to consider robust mobility management mechanisms to ensure the viability of the proposed architecture.

Keywords: Railway, hybrid network, Train-to-Ground, Wi-Fi, LTE, network simulation

1038 Intelligent Video Gate – A Conceptual Application of Emerging Technologies in Rail Freight Transports

Behzad Kordnejad[a]*, Branko Mitrovic[b], Martin Aronsson[c], Ingrid Nordmark[d], Jan Bergstrand[e], Mats Åkerfeldt[e]

a PhD, KTH Royal Institute of Technology, Brinellvägen 32, 100 44 Stockholm, Sweden
b KTH Royal Institute of Technology, Brinellvägen 32, 100 44 Stockholm, Sweden
c PhD, RISE Research Institutes of Sweden AB, Box 1263, 164 29 Kista, Sweden
d PhD, TFK – Transport Research Institute, Warfvinges väg 29, 112 51 Stockholm, Sweden
e Swedish Transport Administration, 781 89 Borlänge, Sweden
** behzad.kordnejad@abe.kth.se*

Abstract

The emergence of new technologies and their corresponding applications within intermodal and rail freight terminals enable improvements in efficiency in existing business processes, relieving them of manual activities and enabling higher degree of automation and digitalization. To initiate the next logical step to a higher level of automation in terminals and to reduce the lead-time needed for the identification and verification processes of freight trains, the concept "Intelligent Video Gates" (IVG) is introduced within the framework of the H2020 Shift2Rail initiative and FR8HUB project. The project has been bi-sectional, first describing functional and technical requirements and the selection of components and secondly carrying out a technical proof of concept (PoC) and introducing a roll-out and implementation plan (RIP) within a Swedish and German context. This paper presents the main findings from the project, literature review, survey of similar studies and a case study simulating the expected effects of the concept.

Keywords: Intermodal Transports; Rail Freight; Emerging Technologies; Automation; Digitalisation; Shift2Rail

Full paper:
https://www.researchgate.net/publication/339875825_Intelligent_Video_Gate_-_A_Conceptual_Application_of_Emerging_Technologies_in_Rail_Freight_Transports

1091 Lightweight Running Gear frame for High-Speed application

Eduardo de la Guerra[a]*, Francisco José García[a], Javier Fernández[a], Víctor Meroño[a], Marta Cerdeira[a], José Carlos Miguel[a]

a Talgo, Pº del Tren Talgo 2, Las Rozas E-28290, Spain
** edelaguerra@talgo.com*

Abstract

The railway industry are looking to increase the capacity of the railway system, bringing flexibility in order to align capacity and demand, to increase availability, reliability and energy efficiency reducing life cycle costs (LCC) and an improvement of the passenger comfort and the attractiveness of the rail transport. One of the lines of action to solve the above challenges is the introduction of new running gear structures, being one the structure most sensible of the train due to safety reasons, the introduction of composites in running gear frame is also a showcase for the potential of this new material for railway application. The reduction of the mass on the running gear frames could reduce track wear and hence cost together with the increase of capacity.

Keywords: running gear; lightweight; efficiency; composites; independent rotating wheel bogie

1119 Automatic detection of railway masts using air-borne LiDAR data

M.R.M.F. Ariyachandra[a]*, Ioannis Brilakis[b]

a PhD Candidate, Department of Engineering, University of Cambridge, Cambridge CB2 1PZ, United Kingdom
b Reader in Construction Engineering, Department of Engineering, University of Cambridge, Cambridge CB2 1PZ, United Kingdom
** mfa47@cam.ac.uk*

Abstract

The cost and effort of modelling existing rail infrastructure from point clouds currently outweigh the perceived benefits of the resulting model. The time required

for generating a geometric railway information model is roughly ten times greater than laser scanning it. Hence, there is a persistent need to automate this process. The preliminary step is automatically detecting masts from air-borne LiDAR data, as their position and function is critical to the subsequent detection of other elements. Our method tackles the challenge above by leveraging the highly regulated and standardized nature of railways. It starts with reducing the arbitrary positioning and orientation of the point cloud; and then restricting the search for masts relative to the track centerline. The method verifies the masts' presence with RANSAC algorithm and delivers detected masts as 3D objects. The method was tested on 18 km railway point cloud and achieves an overall detection rate of 94%.

Keywords: geometric Digital Twin (gDT); Point Cloud Data (PCD); Rail Infrastructure

Full paper:
https://www.researchgate.net/publication/339353286_Automatic_detection_of_railway_masts_using_air-borne_LiDAR_data

1145 Scalable Fault Detection in Railway Systems based on Compressive Sensing and Neural Network Techniques

Markos Anastasopoulos[a]*, Anna Tzanakaki[a,b], Dimitra Simeonidou[a], Garry Bosworth[c], Taratajcio Michal[c], Bryan Nleya[c], Abiodun Oludimu[c], Helen Yu[c]

a University of Bristol, Merchant Venturers Building, Woodland Road,, Clifton BS8 1UB, UK
b National and Kapodistrian University of Athens, Panepistimiou 30, Athens
c Network Rail, The Quadrant Milton Keynes, MK9 1HA, UK
** m.anastasopoulos@bristol.ac.uk*

Abstract

To support scalable fault detection over high frequency sampling monitoring systems we propose for the first-time a two-stage framework combining compressive sensing (CS) and Neural Network (NN) techniques. In the first stage, CS is adopted to reduce the volume of information that needs to be acquired and transmitted to the Railway Management System (RMS). Once the monitored information becomes available at the RMS, in the second stage the fault detection problem is solved in the compressed space using NNs. The performance of the proposed scheme is examined over actual datasets captured at 10KHz sampling rate and numerical results show that abnormal operational patterns can be always detected using just 1% of the original samples.

Keywords: Fault detection, Compressive Sensing, Neural Networks, High Frequency Sampling, Railway Systems

Full paper: https://1drv.ms/b/s!Alk9glalz5cmhLx0Y7KCtD3Qtg9QzQ?e=dtWRtd

1173 Emulation of various radio access technologies for zero on site testing in the railway domain – The Emulradio4rail platforms

Marion Berbineau[a], Juan Moreno[b], Sofiane Kharbech[c], Ying Yang[d], Alessandro Vizzari[e], Raul Torrego[f], José Soler[d], Laurent Clavier[c], Rédha Kassi[c], Franco Mazzenga[e], Romeo Giuliano[e], Val Iñaki[f], Christophe Gransart[a], Virginie Deniau[a], Yann Cocheril[a], Kristina Svensson[g], Armano Carillo[g]

a University Lille Nord de France, IFSTTAR, COSYS, LEOST, Villeneuve d'Ascq, F-59650
b Área de Ingeniería, Metro de Madrid S.A., Madrid. juan.moreno@metromadrid.es
c Univ. Lille, CNRS, UMR 8520 - IEMN, F-59000 Lille, France
d Technical University of Denmark, 2800 Kgs.Lyngby, Denmark

e Radiolabs, Consorzio Università Industria Laboratori di Radiocomunicazioni, Corso d'Italia 19, 00198 Rome, Italy
f IK4-Ikerlan Technology Research Centre, 20500, Arrasate-Mondragon, Spain
g Eurnex, Berlin
** marion.berbineau@ifsttar.fr*

Abstract

In order to assess the reliability, availability, and maintainability of wireless links for the rail sector in the laboratory, it is necessary to develop measurement platforms able to emulate real railway radio environments. This type of testing platform should combine very new approaches, the so-called system in the loop (SITL) and hardware in the loop (HITL). It allows connecting directly and coupling at radio frequency level (RF) the real equipment to be tested, the radio emulators (physical systems), and the simulators able to mimic the railway network and the railway channels' behavior, including interferences. The Emulradio4rail platforms will support multiple emulation instances such as LTE, Wi-Fi, and SatCom networks. The paper will present the architecture of the platforms under development and preliminary assessments.

Keywords: Channel emulator, Open Air Interface, Train to Ground communications, LTE, Satellite, Wi-Fi

1.30 Scientific and technical session 30: New technologies for railways

167 Evaluation of neutral section phase commutation strategies in a 25kV / 50Hz railway network

J. Pascal[b]*, T. Letrouvé[a], H. Caron[b], R. Coupat[b]

a SNCF Innovation & Research, 1-3 Avenue François Mitterrand, Paris 93574, France
b SNCF Industrial and Engineering General Management – Electric Traction, 6 Avenue François Mitterrand, Paris 93574, France
** jules.r.pascal@gmail.com*

Abstract

Powering the neutral sections of the AC railway network by switching the section from a phase to another might affect a train's control unit. An Energetic Macroscopic Representation (EMR) of two lines isolated by a neutral section and different switching strategies are developed. The result is an alternative voltage source taking into account the interaction with the load and the transient effects of a commutation from a phase to another. The goal is to evaluate the influence a given strategy and the parameters of a line can have on the transient state occurring during a commutation.

Keywords: Neutral section, commutation, EMR, railway, AC railway network

286 SIGALi – multifunction battery energy storage for railway signalling and station

Vincent Cluzel[a], Matthieu Appenzeller[b], Myriam de Lignieres[c], Bogdan Vulturescu[d]*

a SNCF Network, Maintenance Dept., 4 Angèle Martinez-Koulikoff, La Plaine Saint Denis 93210, France
b SNCF Network, Signalling R&D Dept., 6 avenue François Mitterrand, La Plaine Saint Denis 93574, France
c SNCF Mobility, Ile de France Stations Expoitation Dept. 10 rue Camille Moke, La Plaine Saint Denis 93212, France
d SNCF Innovation&Research Dept., 1-3 avenue François Mitterrand, La Plaine Saint Denis 93212, France
** bogdan.vulturescu@sncf.fr*

Abstract

Resilience and safety are the keywords for railway systems. In France, signalling, telecom and stations power supplies backups are independent one each other. They are designed in different manners: most of the backups are gensets (for telecom and signalling stations), some important control centers have lead-acid battery backups and only less than 5% of the stations, the most important ones, have redundant power supply from national energy grid. The main goal of this research is one hand to install lithium-ion battery energy storage for signalling in order to replace old, noisy and pollutant gensets by a redundant backup, on the other hand to mutualize it with the station. The multifunction storage installed in "Sarcelles St Brice" station bring new services for station (backup, peak-shaving, flexibility...) and have to deal with many constraints from signalling. The installation, the necessary research, results and feedback experience are detailed in this paper, from technical, economical and project management point of view.

Keywords: signalling resilience, multifunction lithium battery energy storage, railroad station backup and new electrical services, assets pooling

402 Multiphysics Simulation of a Battery Electric Train Operation

Sebastian Reimann[a]*, Franz Jost[a], Peter Gratzfeld[a]

a Karlsruhe Institute of Technology, Institute of Vehicle System Technology, Institute of Rail System Technology, Rintheimer Querallee 2, Building 70.04, Karlsruhe, 76131, Germany
** sebastian.reimann@kit.edu*

Abstract

The changeover from diesel driven multiple units to battery electric multiple units is a challenge for operators due to the limited range of these trains. Therefore, in this paper a tool is developed and described that simulates the entire operation of a battery electric train. The tool contains a model of the track, the vehicle, the timetable and the environment. The model of the track is built on elevation profiles, radius information and speed limitation. The vehicle model is derived from an electric multiple unit suitable for local and commuter train operation. To do parametric studies or model different train units it is easily possible to change vehicle properties. Modeling the timetable and the environment allows the simulation of an entire operation day. The overall simulation model was validated and is consistent. Finally examples show the simulation possibilities and features of the tool.

Keywords: electromobility, battery electric train, battery train operation, simulation

Full paper: https://publikationen.bibliothek.kit.edu/1000106014

406 Positive experiences in the strategy against rail corrugation and railway rolling noise

Rakel Robles[a], Nekane Correa[a]*, Olatz Oyarzabal[a], Javier Santamaria[a], Javier Astarloa[b]

a Department of Mechanical Engineering, University of the Basque Country UPV/EHU, Escuela de Ingeniería de Bilbao, Plaza Torres Quevedo 1, 48013 Bilbao, Spain
b Euskal Trenbide Sarea-Red Ferroviaria Vasca ETS-RFV, Barrio Lebario, 48220 Abadiano, Spain
** nekane.correa@ehu.eus*

Abstract

One of the threats to the environmental advantages of railway transport is its emission of rolling noise, particularly when it derives from recursive rail corrugation. This paper presents a set of positive experiences of the authors in the management of rail corrugation, with an aim of controlling and delaying its emergence and growth. Special attention is given to the method of corrugation management carried out on a metro-type line in the north of Spain, where the corrugation appeared prematurely. Different measures are proposed for the management of corrugation, such as the implementation of High Positive Friction modifier (HPF) and corrections on the rail track. It is verified that the injection of HPF into the wheel tread is an effective method to reduce the velocity of corrugation development in this line. The vertical antirresonance in the track is the wavelength fixing mechanism of the corrugation in this line.

Keywords: rail corrugation; railway noise; track; High Positive Friction modifier (HPF); preventive grinding

565 Health Monitoring Of a Railway Track Switch Actuator Based On Continuous-Time Parameter Estimation Method

Saikat Dutta[a]*, Ramakrishnan Ambur[a], Moussa Hamadache[a], Osama Olaby[a], Jou-Yi Shih[a], Edwart Stewart[a], Roger Dixon[a]

a Birmingham Centre for Railway Research and Education, School of Engineering, University of Birmingham, Birmingham, B15 3TT, UK
** s.dutta@bham.ac.uk*

Abstract

The maintenance of the Railway track switches, which are exposed to environment, are very critical as any failure in the switch system may lead to accidents. With the increase of the capacity in the network, availability of switches is very important which limits the schedule maintenance process. Parameter estimation techniques can be used to estimate and detect the gradual degradation of the system. In this research, a Simplified Refined Instrumental Variable based continuous time parameter estimation method is used to monitor the condition of a railway track switch actuator. This approach will lead to reduce the number of scheduled maintenance of the switch system. In the present study, a switch system with electro-mechanical actuator, which is in operation in the UK rail network, has been modelled using the multibody model. This technique is tested with changing switch parameters and it detects changes in the system parameters such friction, stiffness elements.

Keywords: Railway Track Switch; Parameter Estimation; Continuous Time Systems; Railways; Health Monitoring

Full paper: https://research.birmingham.ac.uk/portal/en/publications/health-monitoring-of-a-railway-track-switch-actuator-based-on-continuoustime-parameter-estimation-method(1da7c244-7310-4e51-a570-d5b5a55f228c).html

589 Hardware In the Loop environment for test and validation of railtrain control components

A. Coupeau[a], P. Prieto[a], A. Parra[a], D. Cagigas[a], B. Heriz[a], M. Allende[a], E. Trancho[a]

a Tecnalia Research and Innovation, Industry and Transport Unit, Parque Científico y Tecnológico de Bizkaia, c/ Geldo, Edif. 700, 48160 Derio (Spain)
** alvaro.coupeau@tecnalia.com*

Abstract

A Hardware-in-the-Loop test environment is designed and built. Two real-time, time-synchronized National Instruments PXI systems running VeriStand with custom extensions, where the Train Control and Monitoring System can be fully tested. The purpose of the paper is to collaborate with the development of virtual homologation for railway environments, based on a simulation framework. Modelling and simulation have been recognized as a method for teaching in terms of risk mitigation for functional aspects. The usage as evidence-based tool for validation of real-world scenarios in certification procedure is a slightly unknown area with a lack of standardization compared with the automotive industry. It compares requirements, definitions and design with the realization. To exchange partly the realization for components, complete functionality or even the surrounding environment and physics contradicts this purpose. The adoption of virtual homologation methods will improve the efficiency of the processes, reducing costs of development and validation in vehicle.

Keywords: Railway, real time systems, digital control, hardware in the loop, homologation

720 Data-driven structural assessment of railway bridges by Empirical Green Functions and Fragility Curves

Francisco Javier Morales-Gámiz[a]*, Francisco Antonio García-Villena[a], José Solís-Hernández[a], Noemí Jimenez-Redondo[a]

a CEMOSA, Benaque 9, Málaga 29004, Spain
** javier.morales@cemosa.es*

Abstract

Most of the railway bridges in Europe were built during the twentieth century with designs in which the boundary conditions are far from the current conditions. The new scenario in terms of higher speeds and loads, particularly linked to the TEN, requires an in-depth review of structural condition of the old bridges and a prognosis of their behaviour for the new conditions. This paper describes two complementary methodologies for the determination of the current and future structural condition of railway bridges based on the use of data and statistical approaches without the need of complex simulation models, developed within the Shift2Rail IN2TRACK project. These methodologies aim at supporting the decision process of infrastructure managers at the time of evaluation of the needs of refurbishment or re-strengthening in this type of infrastructures in an efficient and reliable way.

Keywords: Empirical Green Function; Fragility Curves; railway; bridges; structural assessment; performance based-analysis

Full paper: https://www.researchgate.net/publication/339789078_Data-driven_structural_assessment_of_railway_bridges_by_Empirical_Green_Functions_and_Fragility_Curves

823 First Natural Air Cooling On-roof Traction Transformer for railway rolling stock

André-philippe Chamaret[a]*, Arnaud Jouguet[a], Bogdan Vulturescu[b], Toshihiro Noda[c], Taro Okabe[d]

a SNCF Mobilités, Rolling Stock Engineering Center, 4 allée des gémeaux, LE MANS, 72100, France
b Innovation & Research Department, 1/3 avenue François Mitterrand, La Plaine Saint-Denis, 93212, France

c MITSUBISHI ELECTRIC CORPORATION,Ako factory, 651Tenwa, 678-0256 Ako-city, Japan
d MITSUBISHI ELECTRIC CORPORATION, 2-7-3 Marunouchi Chiyoda-ku Tokyo, 100-8310, Japan
** andre.chamaret@sncf.fr*

Abstract

Energy savings are one of the priorities for the SNCF group. Until 2025, the objective is to increase energy performance by 20% and carbon performance by 25%. To contribute and reach this goal, SNCF experts for energy work on different studies and solutions to apply for rolling stock. A lot of technologies can be used for energy efficiency and reduction of CO2 in railway services, UIC (2016). The main transformer is generally the least efficident part of the traction system. Moreover, maintenance costs and noise emission are important considerations. This article proposes a new type of traction transformer to improve the level of service and comfort on board for passengers.

Keywords: Railway, Rolling Stock, Energy efficiency, Propulsion System

882 Development and Evaluation of New Concepts and Systems for Railway Switches and Crossings

Ramakrishnan Ambur[a]*, Saikat Dutta[a], Jou-Yi Shih[a], Sakdirat Kaewunruen[a], Edward Stewart[a], Roger Dixon[a], Clive Roberts[a], Lukáš Raif[b], Miquel Morata[c], Christopher Ward[d], Otto Plášek[e], Stefan Knittel[f], Martin Kohout[g]

a Birmingham Centre for Railway Research and Education, Gisbert Kapp building, University of Birmingham, Birmingham, B15 2TT, UK.
b DT - Výhybkárna a strojírna a.s., Dolní 3137/100, 796 01 Prostějov, Czech Republic.
c COMSA, Av. Roma 25-27, 08029 Barcelona, Spain.
d Wolfson school of Mechanical, Electrical and Manufacturing Engineering, Loughborough University, Loughborough, LE11 3TU, UK.
e Faculty of Civil Engineering, Institute of Railway Structures and Constructions, Brno University of Technology, Veveří 331/95, 602 00 Brno, Czech Republic.
f Rhomberg Sersa Rail Group, Mariahilfstrasse 29, 6900 Bregenz, Austria.
g University of Pardubice, Faculty of Transport Engineering, Department of Transport Means and Diagnostics, Section of Rail Vehicles, Studentská 95, 532 10 Pardubice, Czech Republic.
** ramakrishnan.ambur@gmail.com*

Abstract

The Shift2Rail/Horizon2020 project "Switch and Crossing Optimal Design and Evaluation" (S-CODE) is a partnership of nine organizations who have come together to consider radical solutions for the future of railway switching. The project used horizon scanning and backcasting techniques to identify potential game-changing technologies and concepts that may feature in future switch designs. Technical development and evaluation work streams have elaborated and prototyped these elements, allowing evaluation of their suitability both in isolation and as integrated sub-system solutions. The project is currently developing subsystem demonstrators and recommendations for technological elements to be included in future switching solutions. This paper presents a subset of the concepts and some of the technological developments being considered across the different technical work streams. The paper considers: condition monitoring and fault-tolerant control, wheel/rail interface optimization, locking and actuation mechanisms, Neoballast, and self-healing concrete and composite bearers, in the context of three novel S&C concepts.

Keywords: Switches and Crossings (S&C); Railway tracks; S-CODE project

Full paper:
https://research.birmingham.ac.uk/portal/en/publications/development-and-evaluation-of-new-concepts-and-systems-for-railway-switches-and-crossings(a3e7a904-a904-49b6-ab6f-227c096dd945).html

893 Hybrid High-Speed railway Carbodies: the next generation of light rolling-stock

Eduardo de la Guerra[a]*, Carlos Eraso[b], Javier Arrabal[b], Miguel Seco[c], Roberto Guzmán[d]

a Talgo, Pº del Tren Talgo 2, Las Rozas E-28290, Spain
b Aernnova, C/Leonardo da Vinci 13, Miñano E-01510, Spain
c TECNALIA Research & Innovation, Industry and Transport Division, Mikeletegi Pasealekua 7, Donostia-San Sebastián E-20009, Spain
d FIDAMC, Foundation for the Research, Development and Application of Composite Materials, Av. Rita Levi Montalcini, 29, Getafe E-28906, Spain
** edelaguerra@talgo.com*

Abstract

The railway industry are looking to increase the capacity of the railway system, bringing flexibility in order to align capacity and demand, to increase availability, reliability and energy efficiency reducing life cycle costs (LCC) and an improvement of the passenger comfort and the attractiveness of the rail transport. One of the lines of action to solve the above challenges is the introduction of new carbody structures since carbodies are one the heaviest component in the train. The weight saving potential (ca. 30%) of the use of new hybrid carbodies mixing materials and technologies in the structures would result in reduced power consumption, lower inertia, less track wear and the ability to carry greater payloads.

Keywords: carbody; lightweight; efficiency; composites; railway

966 Towards a European mobility with rail as backbone - a review of research roadmaps in transport

Jacqueline Kommers[a], Celestino Sánchez Martín[a], Tom Zunder[b], Mark Robinson[b], Armando Carrillo Zanuy[a]*

a Eurnex e. V., Hardenbergstr. 12, 10623 Berlin, Germany
b Newcastle University, Newcastle Upon Tyne, NE1 7RU, United Kingdom
** acarrillo@eurnex.eu*

Abstract

There is evidence to sustain that railways, if efficiently used, are the most environmentally friendly mean of transportation which can satisfy the growing demand for transport in a sustainable manner. Hence, the European Technology Platform (ETP) for rail transport, ERRAC, has its roadmap devoted to achieve railways being the backbone of European mobility. Other ETPs in transport (air, road, maritime, logistics, etc.) also have roadmaps that guide them to achieve their desired future scenarios, which are not necessarily aligned with the main objective of ERRAC. The present paper identifies gaps and mismatches between the different roadmaps of the ETPs in transport. To do so, a literature review and experts' consultation has been developed. The results point at gaps in four main areas:

- Adapting to citizen's needs;
- the influence of short-term policy;
- an absent multi-modal mind-set in all transport sectors; and
- the need for tailored and on-demand mobility in railways.

Keywords: European transport; roadmaps; rail transport; gap analysis

1147 Multi-technology Wireless Access for Railway Cabin Services: Planning and Performance Evaluation

Markos Anastasopoulos[a]*, Anna Tzanakaki[b,a], Tamas Weszely[c], Olivier Langlois[d], Marius Iordache[d], Jean-François Pheulpin[d] and Dimitra Simeonidou[a]

a University of Bristol, , Merchant Venturers Building, Woodland Road,, Clifton BS8 1UB, UK
b National and Kapodistrian University of Athens, Panepistimiou 30, Athens
c PURELIFI Ltd
d ALSTOM - Systems Platform 48, rue Albert Dhalenne - 93400 Saint-Ouen - France
** m.anastasopoulos@bristol.ac.uk*

Abstract

This study proposes a communication platform based on LTE, Wi-Fi and LiFi technologies for the provisioning of cabin services in railway systems. To identify the optimal mix of these technologies and the location that they can be installed, an optimization framework based on Integer Linear Programming has been proposed. Numerical results indicate that under low loading conditions a WiFi network is sufficient to handle the generated traffic. However, as traffic increases, additional access points based on LiFi technology need to be installed in order to address service requirements. The performance of the proposed cabin network was examined using a theoretical model based on networks of queues. Numerical results show that the introduction of LiFi technology can drastically improve the connectivity performance in terms of network/access-point failure and call dropping.

Keywords: Cabin Network Planning, Reliability, Multi-technology Wireless Access, Railway System

Full paper: https://1drv.ms/b/s!Alk9glalz5cmhLxzL1IWTQaVN6shWg?e=8gjsdY

1151 Comparative Analysis of Autoencoder Neural Networks for Fault Detection in Railway Systems

Agelos Stavropoulos[a], Markos Anastasopoulos[b]*, Anna Tzanakaki[a,b], Olivier Langlois[c], Marius Iordache[c], Jean-François Pheulpin[c] and Dimitra Simeonidou[b]

a University of Bristol, Merchant Venturers Building, Woodland Road,, Clifton BS8 1UB, UK
b National and Kapodistrian University of Athens, Panepistimiou 30, Athens
c ALSTOM - Systems Platform 48, rue Albert Dhalenne - 93400 Saint-Ouen - France
** m.anastasopoulos@bristol.ac.uk*

Abstract

A comparative study between different Neural Network models enabling fault detection in railway systems has been carried out. Using actual measurements collected over an operational tramway system it has been shown that Fully Convolutional Neural Network can be effectively used for the detection of abnormal operational patterns keeping the false positive error to minimum.

Keywords: Autoencoder Neural Networks, Fault detection, Railway System

Full paper: https://1drv.ms/b/s!Alk9glalz5cmhLx1mR8a1U4aCoeNuQ?e=uIPwul

1.31 Scientific and technical session 31: Insights into system resilience

145 FORESEE: Future proofing strategies FOr resilient transport networks against Extreme Events

Iñaki Beltran-Hernando[a]*, J. M. Isoird[a], Jose Diez[b], Bryan Adey[c], Erlinda Biescas-Gorriz[d], Daniel Castro-Fresno[e], Clemente Fuggini[f], Federico Di Gennaro[g], Noemi Jiménez-Redondo[h], William Hynes[i], Manfred Bogen[j]

a Fundación Tecnalia Research & Innovation, Astondo Bidea, Edificio 700, Derio 48160, Spain
b European Road Federation, Place Stephane 6B, Brussels 1050, Belgium
c Institute of Construction and Infrastructure Management, HIL F 25.2, Stefano-Franscini-Platz 5, 8093 Zurich, Switzerland
d Telespazio Vega UK, 350 Capability Green, Luton, Bedfordshire LU1 3LU,United Kingdom
e GITECO Research Group, University of Cantabria,, Avda. de los Castros 44, 39005 Santander, Spain
f RINA Consulting, angolo, strada 7, Via Gran S. Bernardo, 20089, 20089 Rozzano Milano, Italia
g AISCAT, Via G. Donizetti 10 – 00198 Roma, Italia
h CEMOSA, Calle Benaque 9, 29004 Málaga, Spain
i Future Analytics Consulting Ltd. 23 Fitzwilliam Square (South) Dublin 2, D02RV08 Ireland
j Fraunhofer IAIS Schloss Birlinghoven D-53754 Sankt Augustin, Germany
** inaki.beltran@tecnalia.com*

Abstract

The objective of this paper is to introduce the H2020 FORESEE project, that provides cost effective and reliable tools to improve transport infrastructure networks' resilience against extreme events and their cascade effects, the ability to reduce the probability of occurrence, magnitude and/or duration of possible disruptive events that may affect the security and/or the quality of the services provided by infrastructure operators. New technologies are being developed such as permeable pavements, slope stabilization systems, drainage and culvert designs and engineering of links, also generating new methodologies, resilient schemes and guidelines, combination of GIS, BIM and satellite technologies with terrestrial sensors, synthetic shakemap scenarios, methods for hybrid data assessment and design of SHM algorithms for damage evaluation. Infrastructure design, construction, remediation, operation & maintenance, management & contingency plans will be reviewed to incorporate resilience concepts in order provide guidelines and effectively support decisions of infrastructure owners & operators and further stakeholders.

Keywords: Resilience monetization; Transport infrastructure networks; cascade effects; governance, Extreme events; FORESEE

Full paper: https://doi.org/10.5281/zenodo.3707808

191 Identification of Indicators, Metrics and Level of Service for the Resilience of Critical Transport Infrastructure

C. Fuggini[a]*, F. Bolletta[a]

a RINA Consulting S.p.A., Via Gran S. Bernardo palazzo R – Rozzano 20089, Italy
** clemente.fuggini@rina.org*

Abstract

Today's society is becoming increasingly dynamic from the point of view of mobility, therefore ensuring the full functionality of transport networks is becoming increasingly complex. Among various approaches to tackle this challenge, the emerging concept of Resilience has been recently shown to be applicable to transport networks as well. Adopting a resilient approach since the first phase of evaluation and planning of an infrastructure is certainly an efficient solution than to

work on improving infrastructures that have not been designed with the idea of resilience in mind. However, even if an existing critical transport infrastructure has not been designed with a resilient approach, it is still possible, during the operational phase, to introduce resilient elements by means of updating risk management plans, with resilience indicators, so that to keep the same level of service the infrastructure has to provide, whilst securing the business continuity requirements.

Keywords: Resilience, Critical Infrastructure, Level of Service, Indicators, Metrics, Business Continuity

363 Identification and prioritization of resilience measures for road infrastructures

K. Anastassiadou[a]*, U. Bergerhausen[a], F. Roth[b], M. Deublein[b]

a Federal Highway Research Institute (BASt), Brüderstrasse 53, 51427 Bergisch Gladbach, Germany
b EBP Schweiz AG, Zollikerstrasse 65, 8702 Zollikon, Switzerland
** Anastassiadou@bast.de*

Abstract

This paper presents a methodology for the optimization of the response and recovery processes for an all hazard resilience management of road infrastructures after the occurrence of a disruptive event. The developed methodology enables road owners and operators to identify, assess and prioritize measures to improve the resilience of their infrastructures. A qualitative approach for measuring resilience is proposed, with a range of specific measures based on predefined resilience criteria and dimensions. The assessment process consists of a range of questions within each criterion, and to which scores are to be assigned. A practical handbook describing the developed methodology together with a simple software application is provided as a final output. The outcomes of this study help to achieve a more effective and efficient resilience management and action planning strategy.

Keywords: resilience management; resilience assessment; road infrastructure, disruptive events; impact assessment

428 The need for data management plans to enable the resilience analysis of transport infrastructure systems

Ignacio Robles Urquijo[a]*, M. Antonia Perez Hernando[b], Bryan T. Adey[c]

a WSP Spain Apia, Albert Einstein n6, Santander 39011, Spain
b University of Cantabria, Avda. Los Castros sn, Santander 39005, Spain
c Swiss Federal Institute of Technology, Stefano-Franscini-Platz 5, 8093 Zurich, Switzerland
** ignacio.robles@wsp.com*

Abstract

To be helpful in developing recommendations to support the standardization of infrastructure resilience assessment, members of the FORESEE project have studied the data requirements of a case study through its lifecycle phases, and asset management perspectives. This paper introduces key results in these analysis, including concepts and objectives for infrastructure data management plans, to accomplish future resilience governance optimizations and enable the broad variety of assessment methods.

Keywords: Infrastructure resilience; asset management; governance; data management plan; machine learning; structural health monitoring

Full paper: https://www.research-collection.ethz.ch/handle/20.500.11850/404261

443 Assessing and enhancing resilience to extreme weather for transport infrastructure in Germany

K. Anastassiadou[a]*, R. Holst[a], J. Kasper[b], F. Simons[b], M. Denhard[c], J. Winkler[c], M. Holtkämper[d], M. Reinhardt[d]

a Federal Highway Research Institute (BASt), Brüderstrasse 53, 51427 Bergisch Gladbach, Germany
b Federal Waterways Engineering and Research Institute (BAW), Kußmaulstr. 17, 76187 Karlsruhe, Germany
c Deutscher Wetterdienst (DWD), Frankfurter Straße 135, 63067 Offenbach am Main, Germany
d Federal Railway Authority (EBA) Heinemannstraße 6, 53175 Bonn, Germany
** Anastassiadou@bast.de*

Abstract

Transport infrastructure is exposed every year to different kinds of risks and disruptive events caused by natural hazards which can permanently impair its availability and safety. In order to maintain the functionality and operation of transport infrastructure during and after an extreme weather events, appropriate methods and concepts are required which enable a holistic, conceptual and systematic assessment of system resilience. This paper presents current results from the investigations by departmental research facilities and executive agencies in the "BMVI Network of Experts", which was initiated in 2016 by the German Federal Ministry of Transport and Digital Infrastructure (BMVI). New concepts and methods have been developed to quantify the availability and safety of transport infrastructure elements and to and enhance transport resilience to extreme weather. By providing measures and practical guidelines to prioritise them, operators will be supported in improving the performance of transport infrastructure under unfavourable weather conditions.

Keywords: transport infrastructure; resilience; extreme weather; availability; safety; critical infrastructure

457 SAFEWAY: an integral IT solution to improve the resilience of inland transport infrastructure

Belén Riveiro[a]*, Pedro Arias[a], Ana Sáchez-Rodríguez[a], Mario Soilán[a]

a Applied Geotechnologies Research Group, University of Vigo, Campus Universitario Lagoas-Marcosende, Vigo and 36310, Spain
** belenriveiro@uvigo.es*

Abstract

European TEN-T guidelines recommends to give due consideration to risk assessments and adaptation measures during infrastructure planning, in order to improve resilience to natural extreme events, and also man-made disasters. There has been important efforts in this direction, and many scientific and technological advances have been reported. SAFEWAY project was conceived as an IT solution for the management of infrastructures during their life-cycle, contributing to disaster management by: 1) improvement of prediction, monitoring and decision tools to contribute anticipating, preventing and preparing critical European transport infrastructures for the damage impacts of extreme events; 2) optimize response by considering new IT tools into emergency plans, together with real-time optimal communication to end users 3) improving precision when adopting mitigation actions contributing to the resistance & absorption of the damage impact. This paper revises the state of the art of existing projects and research related to SAFEWAY components, and the SAFEWAY methodology.

Keywords: risk assessment, remote sensing, crowdsourcing, predictive models, infrastructure information modelling

562 Future-proofing decision making at the UK Department for Transport: Building resilience against future uncertainty

Ian Sillett[a]*, Barry Meehan[a], Michael Hobson[a], Phil Blythe[a]

a Great Minster House, 33 Horseferry Road, London, United Kingdom, SW1P 4DR
** ian.sillett@dft.gov.uk*

Abstract

This paper describes the UK Department for Transport's (DfT) work to 'futureproof' its' decision-making processes. Recent developments in technology, digitally enabled business models and consumer demographics have and will impact on demand, and lead to dramatic changes in transport. In response, transport policy makers must account for the high levels of uncertainty associated with the future transport system. DfT have therefore created the Transport Futures programme to ensure policy-making considering future uncertainty is consistent and enable all policy-makers to consider what the future may mean for their work, without making predictions. Here we describe a set of successful internal pilot projects. Futureproofing decision-making is essential to ensure cleaner, safer and more efficient journeys now and into the future utilising and shaping the future technologies underpinning this.

Keywords: Government; Policy; Futureproofing; Investment; Uncertainty; Decision Making

872 Guideline to measure service provided by, and resilience of, transport infrastructure

Bryan T. Adey[a], Claudio Martani[a]*, Clemens Kielhauser[a], Ignacio Robles[b], Natalia Papathanasiou[a], Marcel Burkhalter[a], Iñaki Beltran-Hernando[c]

a Institute for Construction and Infrastructure Management, ETH Zürich, Stefano-Franscini-Platz 5, 8093 Zürich, Switzerland
b WSP Spain, Parque Científico y Tecnológico Avenida Albert Einstein, Nº 6. 39011, Santander, Cantabria, Spain
c Tecnalia, Parque Tecnológico de Bizkaia, C/ Astondo Bidea, E-48160, Derio Bizkaia, Spain
** martani@ibi.baug.ethz.ch*

Abstract

In order to optimally allocate resources to help ensure that transport infrastructure networks continue to provide acceptable levels of service immediately, or as fast as possible, following the occurrence of extreme events, the resilience of the infrastructure need to be estimated. In this paper, a guideline is presented, based on (Adey et al., 2019), that allows managers to measure the resilience of infrastructure networks. The guideline emphasizes that to this scope it is required to define clearly: (i) the transport system, and the way to consistently measure (ii) the service and (iii) the resilience. Particular attention is paid on the fact that resilience can be measured with various degrees of precision depending on the specific problem to be addressed, the time-frame at disposition and the expertise available. Guide are then given on how to do this either using simulation, indicators, or the percentage of fulfilment of the resilience indicators.

Keywords: Infrastructure management; level of service; resilience; simulations; indicators; guideline

Full paper: https://www.research-collection.ethz.ch/bitstream/handle/20.500.11850/403298/Adey.et.al_TRA2020.pdf?sequence=1&isAllowed=y

933 Airports at Climate Change Risk: An Assessment Methodology

Efthymia Koliokosta[a], Athena Roumboutsos[a]*

a University of the Aegean, Department of Shipping, Trade & Transport, Greece
** athena@aegean.gr*

Abstract

Climate change presents a real threat to airport infrastructure and operations. Sea level rise and extreme precipitation followed by storm surges and flooding are the most significant events that may affect airports. Adaptation concerns considerable investments, which need to be prioritized based on the level of risks faced. The present article describes a methodology for assessing climate change risks due to sea level rise and extreme precipitation. Based on the proposed methodology selected airports around the world are ranked in terms of climate change risk. Results highlight the magnitude of climate change hazards and provide a decision support tool for airport owners/operators and investment planners.

Keywords: climate change; airports; risk; vulnerability; assessment; impact; ranking; rating

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

1018 Improving road network resilience: from weak links identification to effective post-disaster recovery

Rostislav Vodák[a,b], Michal Bíl[a]*, Zuzana Křivánková[a], Jan Kubeček[a]

a CDV – Transport Research Centre, Líšeňská 33a, 636 00 Brno, Czech Republic
b Faculty of Science, Palacký University, Olomouc, Czech Republic
** michal.bil@cdv.cz*

Abstract

Road networks is vital parts of modern societies. Road network constitutes a highly nonlinear system with many hidden linkages. One of the main aims is thus road network resilience, its improvement within a preparedness phase and a post-disaster recovery. The main problem is how to achieve that in a system of a nonlinear nature. We present two approaches which can be used in both phases in order to increase road network resilience. We first introduce a method which enables the identification of the combinations of interrupted links with the largest impact on the road network. The results can be combined with the system of online data informing about the current state of a road network. The system is currently available in the Czech Republic. We consequently draw attention to the post-disaster recovery when there is a need to have reasonable results for various criteria in a reasonable time.

Keywords: resilience; robustness; weak links; recovery time; disaster; database

1138 Implementing resilience in critical transport infrastructure systems

Savina Carluccio[a]*, Oliver Pritchard[b], Áine Ní Bhreasail[a], Louis Andrews[a]

a Arup, 13 Fitzroy Street, London W1T 4BQ, United Kingdom
b The Resilience Shift, 13 Fitzroy Street, London W1T 4BQ, United Kingdom
** savina.carluccio@arup.com*

Abstract

Critical transport infrastructure systems play a pivotal role in supporting society through provision of essential connectivity services to end-users, alongside enabling economic growth. To be able to deal with an increasingly complex and interconnected world and uncertain future, critical transport systems need to be more sustainable and resilient. Ensuring that critical functions and services are delivered to end-users and maintained in the face of shocks and stresses is the resilience value delivered by the infrastructure. To be successfully implemented, resilience needs to be built/enhanced/embedded across the whole infrastructure lifecycle. This paper presents a summary of international research undertaken to identify tangible, practical and relevant actions, tools, approaches, physical measures and useful resources that decision-makers and practitioners can turn to when looking to implement infrastructure resilience. Finally, a value-based approach is presented as a useful means to build a compelling case for investment in infrastructure resilience.

Keywords: resilience; transport; critical infrastructure; system; whole lifecycle; value chain

1.32 Scientific and technical session 32: Infrastructures for the era of automation

284 Infrastructure modifications to support the introduction of the automated driving

Jan Ritter[a]*, Bernhard Kollmus[a], Tom M. Gasser[a]

a Federal Highway Research Institute, Bruederstrasse 53, 51427 Bergisch Gladbach, Germany
** ref-v4@bast.de*

Abstract

The foreseeable introduction of highly automated vehicles raises the question which infrastructure measures could support the exploitation of the potential benefits of this new technology for the traffic sector. While the legal framework has been implemented in Germany for the market introduction of automated systems up to level 3 according to SAE J3016, generally accepted recommendations for the adaption of the road infrastructure have not yet been established. As basic research the needs for infrastructure measures are analysed in a scenario-based approach. The evaluation of possible infrastructure measures shows that constructive or physical infrastructure modifications are in most cases costly and only feasible in the long- or middle term. Most issues, however, can be solved by provision of real-time data on upcoming infrastructure-status. A backend-based digital HD reference map for Automated and Connected Vehicles could be a core element of future strategies to develop the current infrastructure further.

Keywords: automated and connected driving; road infrastructure; digital infrastructure, high definition reference map, road markings

340 Road infrastructure challenges for automated vehicles

Kris Redant[a], Hinko van Geelen[b]*

a Belgian Road Research Centre, Woluwedal 42, 1200 Brussels, Belgium
b Belgium Road Research Centre, Woluwedal 42, 1200 Brussels, Belgium
** h.vangeelen@brrc.be*

Abstract

Automated vehicles pretend to be the magical solution to major parts of traffic related problems. Road traffic safety and mobility are expected to benefit from the introduction of machine driven vehicles. People having difficulties today accessing public or private transport might become a new target audience in the future automated transport society. The automotive industry and tech companies are investing huge amounts of money in the development of automated vehicles. It seems though that vehicles with a different degree of autonomy will co-exist for decades to come. How road design guidelines should evolve to support the introduction of automated vehicles looks an underexposed topic today. In our paper, we discuss the challenges for road infrastructure in the process towards a successful and safe co-existence of automated vehicle and non-automated vehicles. The main subjects we will address: road design concepts, road design guidelines, road structure, road equipment, and road works.

Keywords: Autonomous vehicles, CAV, Road design, road structure, road equipment, road works

426 Effects of Truck Platooning on Bituminous Road Pavement of High-level Roads

Sandra Ulrich[a]*, David Reisenbichler[a], Wolfgang Schildorfer[b], Gottfried Rothensteiner[c]

a ARNDT IDC GmbH & Co KG, Lehargasse 7/2/13, 1060 Wien, Austria
b FH OÖ Forschungs & Entwicklungs GmbH, Wehrgrabengasse 1-3, 4400 Steyr, Austria
c ANDATA GmbH,Hallburgstraße 5, 5400 Hallein, Austria
** sandra.ulrich@arndt-idc.com*

Abstract

Truck platooning is seen by many as one of the first commercial automated driving use cases to be deployed at least at a low automation level (SAE-Level 1-2). Benefits like fuel consumption reduction, efficiency improvements and safety increases are promising. However also concerns from NRAs are to be taken serious whether or not exact lateral track following will lead to increased pavement rutting. As research on the correlation of lateral track offset, air drag benefits and pavement rutting for the platooning use case is limited, this study sets out to analyse the counter effects. Cooperative forms of connected truck platooning somehow hold the promise of effective cooperation between platoons and infrastructure operators allowing for demand driven traffic management. Following this, the actual expected effects on pavement rutting and the lifecycle are assessed to provide NRAs with new data sets for adequately adapting their strategies for traffic management and pavement management.

Keywords: platooning, rutting, pavement, performance-based pavement design, freight, CCAM, CACC

445 Zero crashes, zero congestion, and zero emissions – Future Research in Traffic Management

Caroline Alméras[a], Christine Buisson[b], Johan Olstam[c], Ioannis Papamichail[d], Wolfgang Ponweiser[e], Peter Wagner[f]*

a ECTRI, Rue du Trône 98, 1050 Brussels

b Univ. Lyon, ENTPE, IFSTTAR, LICIT, Lyon, F-69518, France
c Swedish National Road and Transport Research Institute (VTI), Olaus Magnus väg 35, 581 95 Linköping, Sweden
d Dynamic Systems and Simulation Laboratory, Technical University of Crete, Chania, 73100, Greece
e Center for Mobility Systems,Dynamic Transportation Systems, AIT Austrian Institute of Technology GmbH, Giefinggasse 2, 1210 Vienna, Austria
f German Aerospace Center, Institute for Transportation Systems, Rutherfordstrasse 2, 12489 Berlin, Germany
** Peter.Wagner@dlr.de*

Abstract

This text is the result of the Thematic Group Traffic Management of the ECTRI – European Conference of Transport Research Institutes. As a position paper, it states the challenges that the European Research Agenda will have to face if the following goals for a future transportation system are considered:

- User-aware mobility
- Zero accidents and zero emissions
- Minimum space, time, energy & costs for transport

It describes in a concise manner the research approaches needed to achieve the realization of these goals.

Keywords: Traffic Management; Zero Emissions; Zero Crashes; Zero Congestion

Full paper: http://www.ectri.org/wp-content/uploads/2020/03/TRA2020_TG_TM_PositionPaper4TRA_V3.pdf

517 Enabling automated driving by ICT infrastructure: A reference architecture

Michael Buchholz[a]*, Jan Strohbeck[a], Anna-Maria Adaktylos[b], Friedrich Vogl[b], Gottfried Allmer[b], Sergio Cabrero Barros[c], Yassine Lassoued[c], Markus Wimmer[d], Birger Hätty[d], Guillemette Massot[e], Christophe Ponchel[e], Maxime Bretin[e], Vasilis Sourlas[f], Angelos Amditis[f]

a Universität Ulm, Institut für Mess-, Regel- und Mikrotechnik, Albert-Einstein-Allee 41, D-89081 Ulm, Germany
b Autobahnen- und Schnellstraßen-Finanzierungs-Aktiengesellschafft (ASFINAG), Rotenturmstraße 5-9, Wien 1011, Austria
c IBM Ireland Limited, IBM House, Shelbourne Road, Ballsbridge Dublin 4, Ireland
d NOKIA Solutions and Networks GmbH, Werinherstraße 91, D-81541 München, Germany
e Airbus CyberSecurity SAS (AIRBUS), Boulevard Jean Moulin 1 ZAC de la clef Saint Pierre, Elancourt 78990, France
f Institute of Communication and Computer Systems (ICCS), Patission Str. 42, Athens 10682, Greece
** michael.buchholz@uni-ulm.de*

Abstract

Information and communication technology (ICT) is an enabler for establishing automated vehicles (AVs) in today's traffic systems. By providing complementary and/or redundant information via radio communication to the AV's perception by on-board sensors, higher levels of automated driving become more comfortable, safer, or even possible without interaction by the driver, especially in complex scenarios. Additionally, communication between vehicles and/or a central service can improve the efficiency of traffic flow. This paper presents a reference architecture for such an infrastructure-based support of AVs. The architecture combines innovative concepts and technologies from different technological fields like communication, IT environment and data flows, and cyber-security and privacy. Being the basis for the EU-funded project ICT4CART, exemplary implementations of this architecture will show its power for a variety of use cases on highways and in urban areas in test sites in Austria, Germany, and Italy, including cross-border interoperability.

Keywords: Cooperative Automated Driving; Infrastructure Services; MEC Server and Hybrid Communication; System Architecture; IT environment; Cyber-security and Privacy

Full paper: http://dx.doi.org/10.18725/OPARU-26023

538 ODD requirements and other consequences of automated vehicles to physical and digital infrastructure

Sandra Ulrich[a]*, Risto Kulmala[b], David Reisenbichler[a], Walter Aigner[c], Merja Penttinen[d]

a ARNDT IDC GmbH & Co KG, Lehargasse 7/2/13, 1060 Wien, Austria
b Traficon Ltd, Länsiportti 4, 02210 Espoo, Finland
c HiTec Marketing, Lothringerstraße 14/6, 1030 Wien, Austria
d VTT Technical Research Centre of Finland Ltd, Vuorimiehentie 3, Espoo, Finland
** sandra.ulrich@arndt-idc.com*

Abstract

The development of automated driving functions in vehicles and road network operation automation is progressing steadily. However, research on effects to physical and digital infrastructure due to automated functions and vehicles is still limited. As amendments to infrastructure are costly and timely there is a strong need for research for them to be planned accordingly. Therefore, the project MANTRA analyses concrete consequences of selected automated vehicle functions as well as requirements resulting from their operational design domain (ODD) definition to infrastructure up until the year 2040 in response to the CEDR Automation Call 2017. Most significant automated functions and use cases have been selected following the thorough analysis of their potential deployment. Their interplay with infrastructure, in particular their requirements through their ODD, and following consequences are tackled. The resulting requirements for infrastructure give road authorities and operators a guideline for future infrastructure investments and amendments.

Keywords: CAD, Automated, Infrastructure, ODD, Road Authorities

Full paper:
https://www.researchgate.net/publication/339883355_ODD_requirements_and_other_consequences_of_automated_vehicles_to_physical_and_digital_infrastructure

555 An approach for systematic assessment of infrastructure automation readiness from a traffic performance perspective

Johan Olstam[a,b]*, Fredrik Johansson[a], Chengxi Liu[a], Iman Pereira[a]

a Swedish National Road and Transport Research Institute (VTI), SE-581 95 Linköping, Sweden
b Linköping University, Department of Science and Technology (ITN), 60174 Norrköping, Sweden
** johan.olstam@vti.se*

Abstract

Road authorities need tools to assess potential impacts on traffic performance due to the introduction of automated vehicles. Extended traffic modelling tools offer possibilities to estimate impacts on traffic performance metrics such as travel time, delay and capacity. However, there are large uncertainties related to the future behavior of automated vehicles, and these need to be carefully handled. The aim of this paper is to present a systematic and sound approach that can be used by road authorities to assess the automation readiness of a specific infrastructure. We

present a definition of automation readiness from a traffic performance point of view, and an approach for how to estimate the automation readiness for a specific road design taking the uncertainties in the development of automated vehicles into account. The developed approach is applied to both macroscopic and microscopic use cases, demonstrating the applicability of the approach for automation readiness assessment.

Keywords: Automation ready; Automated vehicles; Traffic planning; Infrastructure; Road design

Full paper: http://vti.diva-portal.org/smash/get/diva2:1412679/FULLTEXT01.pdf

598 Data needs, requirements and providers to create a concept for a data-sharing platform to support Road Operators' efforts to realize digitalization and to support cooperative automated driving

Kerry Malone[a]*, Max Schreuder[a], Frank Berkers[a], Katharina Helfert[b], Martin Boehm[b], Lena Radics[b], Christian Lüpges[c], Christian Kleine[d], Matthias Mann[d], Mark Tucker[e], Emmanouil Kakouris[e]

a TNO, Sustainable Urban Mobility & Safety, Anna van Buerenplein 1, 2595 DA Den Haag, The Netherlands
b AustriaTech, Raimundgasse 1/6, A-1020 Vienna, Austria
c AlbrechtConsult GmbH, Theaterstra. 24, 52062 Aachen, Germany
d HERE Kennedyplein 222, 5611 ZT Eindhoven, The Netherlands
e Roughan & O' Donovan Innovative Solutions, Arena HOUSe Arena Road, Sandyford, Dublin 18, Ireland
** Kerry.malone@tno.nl*

Abstract

The digitalisation of road networks and the rapid developments in automated driving will affect the core activities that National Road Authorities (NRAs) carry out, offer new business opportunities and provide NRAs with new and more efficient ways to achieve goals for road safety, traffic efficiency, the environment and customer service. Ultimately NRAs will digitise their road networks, opening up new opportunities which will in turn change the way NRAs interact with existing but also new stakeholders. Based on three use cases, the paper develops a future view of the process flow in each use case, and identifies a first draft of the data requirements and data quality criteria in providing the use cases.. The use cases are provision of High-Definition maps for automated mobility, distribution of digital traffic regulations, and infrastructure support for cooperative automated driving. The results presented are in draft version, subject to change before finalization.

Keywords: digitalization; digitization; connected and cooperative automated driving; security; digital infrastructure; data requirements; data quality criteria

Full paper: https://32b45a2b-9547-4eca-9049-bd2192a42b0d.filesusr.com/ugd/1cba1b_0b407d7f682b41458191f5823a42e81f.pdf

712 Infrastructure support for automated driving: Further enhancements on the ISAD classes in Austria

Jacqueline Erhart[a]*, Manfred Harrer[a], Stefan Rührup[a], Siegfried Seebacher[a], Yannick Wimmer[a]

a ASFINAG Maut Service GmbH, Am Europlatz 1, 1120 Vienna, Austria
** Jacqueline.erhart@asfinag.at*

Abstract

In the emerging sector of Cooperative, Connected and Automated Driving (CCAD), the development of vehicle functions is often in the focus. However, road infrastructure can play a key role in enabling and supporting automated driving. A classification scheme for infrastructure support for automated driving (ISAD) has recently been introduced, which groups the availability of static and dynamic infrastructure information together with communication capabilities into classes. In this paper, this classification is applied to the Austrian motorway network and exemplifies how different classes of infrastructure support can be provided on a road network, ranging from static and dynamic map data to the latest technology for microscopic traffic perception and the integration with the C-ITS deployment. Such an infrastructure classification can be regarded as a tool to systematically define road sections where automated driving functions can operate under their operational design domain (ODD) and to guide infrastructure upgrades.

Keywords: road classification; infrastructure support for automated driving; ISAD; Cooperative, Connected and Automated Driving (CCAD); autonomous driving

Full paper:
https://www.researchgate.net/publication/339339109_Infrastructure_support_for_automated_driving_Further_enhancements_on_the_ISAD_classes_in_Austria?ev=project

805 Validation Approach of an C-ITS infrastructure – based solution

Andrea Steccanella[a], Maria Gkemou[b]*

a Electrical / Electronics – Safety & Driver Assistance Systems, CRF S.C.p.A., Via Sommarive, 18, 38123,Trento (TN) - Italy,
b Hellenic Institute of Transport, Centre for Research and Technology Hellas, Egialias 52, Marousi 15125, Athens, Greece
** mgemou@certh.gr*

Abstract

SAFE STRIP (SAFE and green Sensor Technologies for self-explaining and forgiving Road Interactive aPplications) EU funded project aims to develop a low-cost integrated solution, installed directly on the road surface, able to collect the information of forthcoming dangers that the vehicles cannot evaluate on their own through state-of-the-art sensors. Reliable and punctual data, with lane level accuracy, are gathered and specific warnings (like low grip surface due to ice) are disseminated through Infrastructure to Vehicle (I2V) communication. All the vehicles benefit from the solution: modern vehicles equipped with ADAS functionalities but also private users connected to the infrastructure through smartphone applications. The current manuscript presents in short the technological solution towards evaluation, the multi-layered validation approach anticipated by the Consortium for delivering a prototype of an as much as possible high technological readiness and the technical validation results in hand evidencing its robustness prior being tested with users.

Keywords: C-ITS; smart infrastructure; I2V (Infrastructure to Vehicle); validation

870 Scenario-based approach in Connecting Austria for the development and validation of connect, cooperative, (semi-)automated driving in the case of intersections

Andreas Kuhn[a]*, José Carmona[a], Alexander Schirrer[b], Stefan Jakubek[b], Thomas Hoch[c], Klaus Pollhammer[d], Karin Hirschmann-Kraschl[e], Wolfgang Schildorfer[f]

a ANDATA GmbH, Hallburgstraße 5, 5400 Hallein, Austria
b University of Technology Vienna, Getreidemarkt 6, 1060 Vienna, Austria
c Software Competence Center Hagenberg, Softwarepark 21, 4232 Hagenberg, Austria
d Swarco Futurit GmbH, Mühlgasse 86, 2380 Perchtoldsdorf, Austria
e Siemens Mobility GmbH, Strassganger Straße 350, 8054 Graz, Austria
f Logistikum, Wehrgrabengasse 1-4, 4400 Steyr, Austria
** andreas.kuhn@andata.at*

Abstract

The validation of automated, connected driving is a complex issue. A lot of intrinsic conflicts will make it difficult to fulfill and prove all expected and promised benefits and advantages for automated driving. Hence sophisticated methods and procedures are necessary for the safe and effective implementation of traffic automation. Scenario, data and simulation-based approaches promise to be the methods of choice. The given paper intents to demonstrate such a holistic, scenario-based approach for the example of energy efficient truck platooning, which can be seen as a special form of connected, cooperative, (semi-)automated driving. The content of the paper is taken from Connecting Austria, the Austrian lead project for automated driving, which puts the focus on the infrastructure aspects and support for automated, connected driving to induce more cooperative driving behaviors for improved traffic safety and efficiency. The development and validation approach is demonstrated upon the example of a complex combination of real-world intersections.

Keywords: platooning; cooperative, connected, automated driving; validation of automated driving; test fields; scenario management; traffic automation

1039 Internet of Logistics: A New Opportunity for the Digitalization of Logistics

Claudio Diotallevi[a], Thomas van Bunningen[a], Martin Aronsson[b], Behzad Kordnejad[c]* Jan Bergstrand[d], Mats Åkerfeldt[d]

a Ericsson,Torshamnsgatan 21, Stockholm 164 80, Sweden
b PhD, RISE Research Institutes of Sweden AB, Box 1263, Kista 164 29, Sweden
c PhD, KTH Royal Institute of Technology, Brinellvägen 32, Stockholm 10044, Sweden
d Swedish Transport Administration, Borlänge 781 89, Sweden
** behzad.kordnejad@abe.kth.se*

Abstract

This paper explores the applicability of the Semantic Web technologies to the logistics domain, as an open, flexible and efficient approach to share the digital information. The Semantic Web is a framework of technical standards and information management tools that provides a method to store and publish digital data, securely, easily searched, cross-referenced and processed by computers. The proposed approach is introduced within the framework of the H2020 - Shift2rail initiative and FR8HUB project and defined as "Internet of Logistics", since it aims at creating a common, distributed and interoperable data exchange infrastructure. It overcomes the limitations of traditional supply chain communication systems based on one2one messages (e.g. EDI), and the complexity associated to ad-hoc IT system implementations that are required to build interfaces between legacy systems, enabling new possibilities for the digitalization of processes and operations in the freight sector.

Keywords: Digitalization; Information Management; Internet of Logistics, Shift2Rail

Full paper:
https://www.researchgate.net/publication/339875835_Internet_of_Logistics_A_New_Opportunity_for_the_Digitalization_of_Logistics

1125 On the framework for optimal traffic management in the era of connectivity and driving automation

Aleksandr Belov[a]

a New York University Abu Dhabi, Saadyiat Island, Abu Dhabi, 129188, United Arab Emirates
** aleksandr.belov@nyu.edu*

Abstract

Advances in technologies promise to open new possibilities to enhance traffic management approaches with individual routing, scheduling, and slot-reservation control schemes, but it is still not clear how to implement them in practice and to which degree they can improve traffic network efficiency. In this research, we revise the problem of inefficiency of selfish road users behavior usually referred to as "Price of Anarchy" (PoA). We extend the notion of PoA to the main aspects of human driver behavior: departure time choice, route choice, and driving behavior. Further, we show that in many situations the PoA cannot be eliminated by traditional traffic management techniques. Based on the deep analysis of the core reasons for the PoA we propose a framework for optimal traffic management, which allows approximating the best possible network utilisation in given conditions. Further possible improvements of the network utilization achievable with the driving automation are also discussed.

Keywords: traffic management; connected and automated vehicles; network performance; price of anarchy; system optimal traffic assignment

1.33 Scientific and technical session 33: Aviation – market and technology trends

45 Intermodal connection management with passengers' trajectories

Erik Grunewald[a]*, Florian Rudolph[a]

a DLR German Aerospace Center, Lilienthalplatz 7, 38126 Braunschweig, Germany
** erik.grunewald@dlr.de*

Abstract

In the course of an intermodal journey, there are varying compensation policies covering topics like missed connections, delays or denied boarding on the intra-modal level. The risks of an inter-modal journey usually lie with the travellers. This study examines how an integrated solution can be offered with the focus on transfer situations for air passengers commuting by public transport. For this purpose, in a first step, the concept of the digital twin is transferred to the traveller, creating a virtual image of his journey, the so-called passenger trajectory. In the second step, scheduled departures and arrivals are blended with these passenger trajectories, resulting in a detailed service demand for all relevant infrastructures and means of transport. The third step is data enrichment with real-time information and forecasts that keep track of demand. Digitisation of passengers' trajectories, system wide information exchange and real-time based situational awareness improve resource utilization as well as intermodal connectivity.

Keywords: intermodality; connectivity; passenger management; priorities

Full paper: https://elib.dlr.de/134338/

173 Does innovation give incentives to innovate in air transport?

I. Laplace[a], C. Roucolle[a]*, T. Denis[b]

a Ecole Nationale de l'Aviation Civile, Université de Toulouse, 7 avenue Edouard Belin, 31055 Toulouse Cedex 4
b Université Panthéon - Assas, France
** chantal.latge-roucolle@enac.fr*

Abstract

The objective of this empirical paper is to study which factors give incentives to an airline to operate a disruptive innovated aircraft on a route. In particular, we want to address if competitors' behaviours impact airline's choice in terms of innovation use. We consider as innovation the introduction of the Airbus 380 (A380) and assess the probability for an A380's owner to use this aircraft type on a route, given its own features as well as route's characteristics. The routes where the A380 has been operated during the last 10 years constitute our panel dataset. We use the OAG database to collect information regarding airline supply in capacities. A discrete choice model applied to this panel is used. We show that the incentive to use the innovation for an airline is driven by its competitors' use of the same innovation on the route, or even to the threat that competitors use this innovation on the route. Our model also confirms that congestion issues at airports are significant drivers for adopting the A380 innovation. However, economic recessions and fuel price increases would not be in favor of the A380 adoption. We show that the incentives to use innovation decrease as the market power of the competitors increases on the route. These results highlight the importance of airlines' market positioning on their strategic choices of innovation.

Keywords: A380, airline innovation, airline competition, incentives, discrete choice model

357 Forecasts of future scenarios for airport noise based on collection and processing of web data

Marco Pretto[a]*, Pietro Giannattasio[a], Michele De Gennaro[b], Alessandro Zanon[b], Helmut Kuehnelt[b]

a Dipartimento Politecnico di Ingegneria e Architettura, University of Udine, Via delle Scienze 206, Udine, 33100, Italy
b AIT Austrian Instutute of Technology GmbH, Center for Low-Emission Transport, Giefinggasse 2, Vienna, 1210, Austria
** pretto.marco@spes.uniud.it; marcopretto@hotmail.it*

Abstract

This paper presents an analysis of short-term (2025) scenarios for noise emission from civil air traffic in airport areas. Flight movements and noise levels at a given airport are predicted using a web-data-informed methodology based on the ECAC Doc.29 model. This methodology, developed by the authors in a previous work, relies on the collection and processing of air traffic web data to reconstruct flight events to be fed into the ECAC model. Three new elements have been included: i) topographic information from digital elevation models, ii) a fleet substitution algorithm to estimate the impact of newer aircraft, and iii) a generator of flight events to simulate the expected traffic increase. The effects of these elements are observed in 2025 scenarios for the airports of London Heathrow, Frankfurt and Vienna-Schwechat. The results quantify the noise reduction from new aircraft and its increment due to the air traffic growth forecast by EUROCONTROL.

Keywords: web data; airport noise; ECAC Doc.29 model; aircraft fleet; future air traffic; scenario analysis

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

358 Disruptive and sustainable innovation at airports: the case of hydrogen

I. Laplace[a]*, E. Malavolti[a,b]

a Ecole Nationale de l'Aviation Civile, Université de Toulouse, 7 avenue Edouard Belin, 31055 Toulouse Cedex 4
b Toulouse School of Economics, Université de Toulouse, 21 Allée de Brienne, 31000 Toulouse
** isabelle.laplace@enac.fr*

Abstract

Innovation labs seems to become part of airports business models. Interestingly, the type of innovations developed are completely different from one platform to another. This suggests that a classification could be helpful, especially when public investment is also concerned. We propose in this paper, in the light of the case study of the hydrogen production at Toulouse Blagnac airport, a methodology to classify the innovations at airports. This classification is supported by a literature review on sustainable and disruptive innovations theories, which helps us identifying factors that drive and characterize these innovations and checking the relevancy of these factors for our case study.

Keywords: disruptive innovation; sustainable innovation; airport; hydrogen

481 Modelling sustainability futures for aviation: How much can evolutionary technology roadmaps and sustainable fuel solutions contribute?

Antoine Habersetzer[a]*, Kay Olaf Plötner[a], Christoph Schneider[b], Marcia Urban[a]

a Bauhaus Luftfahrt, Willy-Messerschmitt-Str. 1, 82024 Taufkirchen, Germany
b Flughafen München GmbH, Nordallee 25, 85356 München
** antoine.habersetzer@bauhaus-luftfahrt.net*

Abstract

Climate change is becoming an ever more pressing issue, but the aviation industry is still missing a viable long-term pathway to comply with sustainability goals beyond year 2050. This explorative paper proposes a holistic methodology to assess different sustainability scenarios, and presents first results from scenario modelling. Besides discussing different sustainability goals, we evaluate possible mitigation options, namely, aircraft efficiency improvements, and sustainable aviation fuels. Our scenario analysis also comprises different growth assumptions for air travel demand. Our first results suggest that a decarbonisation of aviation is possible by the mid-century, and this with manageable increases of fuel cost. Yet, this will only be achievable with a combined strategy of strong aircraft efficiency improvements and a massive expansion of sustainable aviation fuel production, as well as under optimistic framework conditions. These initial results open up intriguing avenues for policy discussions and for future research.

Keywords: aviation; climate change mitigation; sustainability; scenario modelling, system dynamics

703 SAFEMODE - Strengthening Synergies Between Aviation and Maritime in the Area of Human Factors Towards Achieving More Efficient and Resilient Modes of Transportation

Simone Pozzi[a], Rafet Emek Kurt[b], Barry Kirwan[c], Osman Turan[b]*

a Deep Blue SRL, Piazza Buenos Aires, 20, Rome 00198 , Italy
b University of Strathclyde, 100 Montrose Street, Glasgow G4 0LZ, United Kingdom
b Eurocontrol, Centre du Bois des Bordes CS 41 005, Brétigny-sur-Orge 9122, France
** o.turan@strath.ac.uk*

Abstract

Human operators play crucial roles in the safe, resilient and efficient conduct of maritime and air transport operations. Consequently, Human factors are often reported as one of the main causes of maritime and airline accidents. Therefore, the importance of addressing human factors is recognised by researchers and regulators as a major area to address. Human factors aspects will only become more prominent in the future, with a number of factors - like increasing automation, remotely operated ships and aircraft, multicultural crews, mixed types of traffic to be managed together, and so on - transforming all the transport modes and introducing unknown risks into the equation. This paper introduces the H2020 SAFEMODE project, which aims to strengthen the previously established synergies between aviation and maritime sectors and to further enhance the developed methodologies in order to address the emerging need of better addressing human factors in transport safety, while acknowledging the specifics of each sector. This will assure safety for travelling European citizens and businesses alike, well into the future.

Keywords: Transport Safety; Human Factors; Aviation; Shipping; accidents; human risk modelling

813 Impact assessment of EU funded research projects: Trends in aviation transport

Alkiviadis Tromaras[a], Aggelos Aggelakakis[a], Afroditi Anagnostopoulou[b]*

a Hellenic Institute of Transport, Centre for Research and Technology Hellas, 6km Charilaou Thermis Rd.,Thessaloniki 57001, Greece
b Hellenic Institute of Transport, Centre for Research and Technology Hellas, G. Kassimati 1, Piraeus 18531, Greece
** a.anagnostopoulou@certh.gr*

Abstract

This paper presents an impact assessment of the research projects funded by the European Union in the area of transport aviation. Aligned with the challenges of FlightPath 2050 initiative, this study aims to develop composite indicators in an attempt to present the impact of the EU funded research projects both in terms of development and sustainability. In this context, the focus of this paper is given on the impact assessment of the EU funded projects in an attempt to describe how EU funding has distributed to establish new knowledge and/or explored the feasibility of implementing a new or improved technology, process, service or solution. Key findings are presented offering a broader view of projects' results exhibit that development and sustainability are the essential characteristics of EU funded projects in the sector of aviation transport.

Keywords: impact assessment; transport aviation; sustainability; EU-funding; research projects

817 On the use of value of information for optimal sensor configuration

Sergio Cantero-Chinchilla[a,c]*, Juan Chiachío[b], Dimitrios Chronopoulos[a], Arthur Jones[a], Federico Martín de la Esclera[c], Yasser Essa[c]

a Institute for Aerospace Technology & The Composites Group, University of Nottingham, Nottingham, NG7 2TU, U.K.
b Department of Structural Mechanics & Hydraulics Engineering, University of Granada, Granada, 18001, Spain
c Aernnova Engineering Division S.A., Madrid, 28034, Spain
** Sergio.CanteroChinchilla1@nottingham.ac.uk*

Abstract

Condition-based maintenance is based on reliable and effective structural health monitoring systems able to provide accurate health related information. The reliability and accuracy of such systems are highly dependent on the number and position of sensors. As a rule, the larger the number of sensors, the more and better information can be obtained. However, a practical solution is required to find a healthy balance between the cost of the monitoring system and the information. To address rigorously such optimization problem, this paper proposes the use of the value of information and the expected information gain as optimality criterion. The methodology is illustrated using a stiffened plate-like structure with a bounded damaged area and ultrasonic guided-waves as SHM technique. The results reveal the value of information as a rational index to provide optimal ultrasonic sensor configuration.

Keywords: Value of information; Bayesian inverse problem; Optimal sensor configuration; Structural health monitoring; Ultrasonic guided-waves

936 Internal versus external European air market realities: The competitive divide

Darren Ellis[a]*

a Cranfield University, Martell House, Cranfield MK43 0AL, United Kingdom
** darren.ellis@cranfield.ac.uk*

Abstract

This paper looks at how ongoing attempts to improve air market competitiveness in Europe are challenged by the differing internal and external realities that exist. Data from a Delphi study underpin the paper. The European internal multilateral single air market has encouraged the proliferation of pan-European low cost carriers (LCCs) unhindered by national borders, which have stimulated increased competition and driven down airfare prices. Europe continues to progressively expand its regional single air market to include neighbouring countries, while also externally pursuing horizontal agreements with other countries based on a community carrier concept. However, the bilateral system continues to dominate the wider global airline industry. Europe remains the multilateral exception to the general rule in international aviation that bilateralism is the norm. Despite efforts to address this competitive divide, aeropowers like Russia are reluctant to embrace extensive change, while major European flag carriers resist unfettered competition from outside the bloc.

Keywords: Single air markets; European aviation; bilateral system; multilateralism; liberalization

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

955 Experimental and Numerical Analysis of a Novel Wing-In-Ground Vehicle

M. van Sluis[a], A.G. Rao[b]*, G. Eitelberg[b]

a Delft University of Technology, Mekelweg 5, 2628CD Delft, Netherlands
b Delft University of Technology, Mekelweg 5, 2628CD Delft, Netherlands
** A.GangoliRao@tudelft.nl*

Abstract

The AeroCity concept was developed to provide high-speed ground transportation at a much lower cost than the existing high-speed railway. Utilizing the Wing-In-Ground (WIG) effect, the AeroCity vehicle does not require complex infrastructure. In the current work, the aerodynamic characteristics of the AeroCity vehicle are examined by means of a combined wind-tunnel experiment and CFD analysis. The results from the CFD analysis match, in a qualitative manner, well with the findings of the windtunnel experiment. Surface streamlines and boundary layer measurements correspond to a good extend with the numerical data. However, a discrepancy of the force measurements of both datasets, prevents a complete validation of the aerodynamic characteristics of the AeroCity windtunnel model. It is found that the separation bubble over the side-plates is captured in an insufficient way by the CFD model and in turn, is responsible for an under-prediction of the drag at higher free-stream velocities.

Keywords: Aerocity, Ground-Effect, WIG, Aerodynamics, CFD

1024 Sloshing Wing Dynamics – Project Overview

Francesco Gambioli[a]*, Apostolos Chamos[b], Sarah Jones[a], Pheobe Guthrie[a], Jonathan Webb[a], Jens Levenhagen[c], Philipp Behruzi[d], Franco Mastroddi[e], Arnaud Malan[f], Stephen Longshaw[g], Alex Skillen[g], Jonathan Cooper[h], Leo Gonzalez[j], Salvatore Marrone[k]

a Airbus Operations Ltd, Filton, Bristol BS34 7PA, United Kingdom
b EASN-TIS, Terweidenstraat 28, Budingen 3440, Belgium
c Airbus Defense & Space, An der Bundesstraße 31, 88039 Friedrichshafen, Germany
d ArianeGroup, Airbus Allee 1, 28199 Bremen, Germany
e Universita La Sapienza, Via Eudossiana 18, 00184 Rome, Italy
f University of Cape Town, Rondebosch, Cape Town 7701, South Africa
g UK Research and Innovation Science and Technology Facilities Council, Daresbury Laboratory, United Kingdom
h University of Bristol, University Walk, Bristol, BS8 1TR, United Kingdom
j Universidad Politechica de Madrid, Madrid, Spain
k CNR-INM, Via di Vallerano 139, 00128 Rome, Italy
** francesco.gambioli@airbus.com*

Abstract

The SLOshing Wing Dynamics (SLOWD) project aims to investigate the modelling of fuel sloshing physics to reduce the design loads on aircraft structures. This goal will be achieved through investigating the damping effect of sloshing on the dynamics of flexible wing-like structures carrying liquid (fuel) via the development of experimental set-ups complemented by novel numerical and analytical tools. The primary focus of the project is the application of modelling capabilities to the wing design of large civil passenger aircraft (subject to EASA CS-25 type certification), which are designed to withstand the loads occurring from atmospheric gusts, turbulence and landing impacts. The timeframe of the project is three years, starting in September 2019.

Keywords: Fluid-Structure Interaction; Aviation; Certification

1124 Drones assisting both intelligent transport systems and road weather forecast

Kari Mäenpää[a]*, Virve Karsisto[b]

a Finnish Meteorological Institute, Tähteläntie 62, Sodankylä 99600, Finland
b Finnish Meteorological Institute, Erik Palménin aukio 1, Helsinki 00560, Finland
** kari.maenpaa@fmi.fi*

Abstract

The paper will introduce the Arctic Airborne 3D-project use case, in which Unmanned Aerial Vehicles (UAVs) are used in ITS (Intelligent Traffic Systems) to improve the safety of the road users and the accuracy/validity of road weather forecasts. The use case has an automatically operating UAV measuring between two road weather stations or in the vicinity of the road weather stations. The aim is to find methods to expand the accurate road weather station observation area with UAV-measurements. Parameters that can be identified from the standard UAV are evaluated and then chosen for observation. This includes road safety information in addition to road weather data. Finnish Meteorological institute (FMI) will use at least a hyperspectral camera and an RGB-camera as on-board devices. Few early tests will be presented in this paper.

Keywords: Unmanned Aerial Vehicle, road weather, AA3D, ITS

1.34 Scientific and technical session 34: Novel views on risk and safety management

396 BRT and tram accident statistics databases - Targeted recommendations for developing safer infrastructures

Céline Avril[a]*, Jean-Michel Passelaigue[b]

a Cerema, 25, avenue François Mitterrand, 69500 Bron, France
b STRMTG, 1461, rue de la Piscine ,38400 Saint-Martin d'Hères, France
** celine.avril@cerema.fr*

Abstract

In view of their rapid growth, national accident statistics for the various public transport systems using dedicated lanes are becoming necessary. Properly understanding accident mechanisms and causes enables good and bad development practices to be identified and shared. This is useful not only for the authorities responsible for organising mobility and for the relevant transport operators, but also for government agencies tasked with road safety and urban integration. Rich feedback can also be valuable in shifting regulations and guidelines. This feedback is powered by the accident databases. Various national event recording tools exist in France : one database concerns the tram system, the second was developed to monitor accidents involving BRT systems. It was created recently, and is inspired by the tram system database. This article presents the history of both databases and their data, and their aims and implementation. It also discusses the limits and evolution of the two databases.

Keywords: Database; Tramway; BRT routes; Accidents

Full paper:
https://www.researchgate.net/publication/339875358_BRT_and_tram_accident_statistics_databases_-_Targeted_recommendations_for_developing_safer_infrastructures

516 Spatial and Spatiotemporal Analyses of Traffic Crashes

Michal Bíl[a]*, Richard Andrášik[a], Jiří Sedoník[a]

a CDV - Transport Research Centre, Líšeňská 33a, 636 00 Brno, Czech Republic
** michal.bil@cdv.cz*

Abstract

Reliable identification of hazardous road locations (hotspots) of traffic crashes is a safety issue which has to be addressed. Since hazardous hotspots are places with a significantly high number of traffic crashes, cluster analysis based on the KDE+ can be applied to find these locations. Although the KDE+ method was primarily introduced for data with GPS coordinates, we also extended the framework to cover the non precisely located data, e.g. rounded up to a relative linear station ing system (LRS). Another natural extension of the KDE+ method is to allow a spatiotemporal analysis. A spatiotemporal version of the KDE+ method was deve loped to evaluate spatiotemporal behavior of traffic crash hotspots. This approach can be utilized in research focused on spatiotemporal evolution of traffic crash patterns within a road network. The results for the Czech road network were visualized in web-map application www.kdebourame.cz. The KDE+ software is available as a freeware from www.kdeplus.cz.

Keywords: Kernel density estimation Monte Carlo; Clustering; Hazardous locations; Hotspots

845 Sustainable asset protection in transport and logistics under accelerated changes in risk landscapes forced by near-future climate states

Christoph Matulla[a]*, Katharina Enigl[a,b], Sebastian Lehner[a,b], Matthias Schlögl[a,c], Alessandra Angelini[d], Audrey Macnab[e], Philip Evans[e], Gavin W. Roser[e], Samuel W. Muchemi[f], Gerald Fleming[f], Sarah L. Grimes[g], Walter Dabberdt[h], Franz Schmid[i], Pekka Leviakangas[j]

a Climate Impact Team (CIT), Zentralanstalt für Meteorologie und Geodynamik, Hohe Warte 38, 1190 Vienna, Austria
b Institute of Meteorology and Geophysics, University of Vienna, Universitätsring 1, 1010 Vienna, Austria
c Institute of Mountain Risk Engineering (IAN), University of Natural Resources and Life Sciences, Peter-Jordan-Straße 82, 1190 Vienna, Austria
d Institute of Spatial Planning, Technical University Vienna, Augasse 2-6, 1090 Vienna, Austria
e The European Freight and Logistics Leaders' Forum (F&L), Avenue Louise 146, 1050 Brussels, Belgium
f Public Weather Services (PWS), World Meteorological Organization (WMO), 7 bis, Avenue de la Paix, CH-1211 Geneva 2, Switzerland
g Marine Meteorology and Ocean Affairs, World Meteorological Organization (WMO), 7 bis, Avenue de la Paix, CH-1211 Geneva 2, Switzerland
h National Center for Atmospheric Research (Emeritus), Boulder, Colorado USA 80303
i Federal Water Engineering Agency, Federal Ministry of Sustainability and Tourism, Stubenring 1, 1010 Vienna, Austria
j Department of Industrial Engineering and Management, University of Oulu, Pentti Kaiteran katu 1, 90014 Oulu, Finland
** christoph.matulla@zamg.ac.at*

Abstract

This paper presents two major objectives of multifarious collaborations investigating anticipatory asset protection strategies under accelerated climate change. The viability of these efforts is guaranteed by pairing up the scientific community (CITa, University of Viennab, BOKUc, TU Viennad) with notable stakeholders (F&Le, WMOf,g, BMNTh). Two accomplishments in strengthening

sustainability in implementing protection measures and securing major infrastructure-investments under climate change are illustrated. First, we present new procedures allowing to consider future risk-map-evolutions in corporate level decision-making as well as their application at the example of Austria's most comprehensive public-protection project since WWII. Second, we outline the design of a survey targeted assessing needs of stakeholders in the transportation domain with respect to climate impacts. Together, these measures contribute to strengthening transportation system resilience in the face of climate change by safeguarding the implementation of efficient and effective adaptation measures.

Keywords: climate change; hazard-development corridors; sustainability; decision-making; asset protection

884 Integrating risk management in the preservation planning of road networks: an approach towards efficient decisions

Inês Balinho do Ó[a]*, Luís de Picado-Santos[b]

a CERIS, Instituto Superior Técnico, Universidade de Lisboa, Portugal
b CERIS, Instituto Superior Técnico, Universidade de Lisboa, Portugal
** ines.balinho.do.o@gmail.com*

Abstract

Asset management has become increasingly complex with the need to make preservation decisions more efficient. It results that the tools used by decision makers to support the decision-making process have to be more comprehensive and include new features and techniques. However, the success of pavement preservation plans depends on being able to foresee the risks that can be taken. Current pavement management systems have been successful in supporting the planning process, but mostly focused on the tactical features rather than on managing, for instance, the financial risks incurred. To ensure investments efficiency and sustainability, it is necessary to ensure that the necessary tools to manage the risks are present. The technical issues that need to be addressed to include risk management in decision support tools are discussed throughout this paper, addressing the gap regarding the methods that can be used to include risk management aspects in the analysis of preservation investments.

Keywords: preservation planning; risk management; optimization; network-level

Full paper:
https://www.researchgate.net/publication/339796855_Integrating_risk_management_in_the_preservation_planning_of_road_networks_an_approach_towards_efficient_decisions

961 Risk analysis in the implementation of the city logistics systems

Kinga Kijewska[a], Maja Kiba-Janiak[b], Stanisław Iwan[a]*, Krzysztof Małecki[c]

a Maritime University of Szczecin, Faculty of Economics and Engineering of Transport, Pobożnego 11, 70-515, Szczecin, Poland
b Wroclaw University of Economics, Faculty of Economics, Management and Tourism, Nowowiejska 3, 58-560 Jelenia Góra
c West Pomeranian University of Technology, Faculty of Computer Science, Szczecin, Poland
** s.iwan@am.szczecin.pl*

Abstract

Understanding risk management entails understanding the fundamental factors of project risk. The project risk is often the same, regardless of the nature of the

project. Nevertheless, the specificity of city logistics systems influence on the specificity of the risk management during the implementation of the measures in this area. The paper is focused on the risk management in the city logistics measures implementation. Authors pay the special attention on the importance of the human factor in the management of the risk. The principles of risk management in the city logistics projects are presented. Next, based on the reference model of risk management in terms of urban freight transport measures', Authors highlight the risk factors related to the implementation of telematics tools for freight monitoring and planning/routing. The tool can be utilize by any city logistics stakeholder, who is going to implement this kind of solutions.

Keywords: urban freight transport, city logistics, risk management, telematics measures

1012 Electrical accident risks in electric vehicle service and repair – accidents in Finland and a review on research

Vesa Linja-aho[a]*

a Metropolia University of Applied Sciences, Leiritie 1, Vantaa 01600, Finland
** vesa.linja-aho@metropolia.fi*

Abstract

The rising number of hybrid and hybrid electric vehicles with high voltage lithium ion batteries poses a variety of new safety risks. Although the risk for an electric shock for passengers is negligible even in severe accidents and the fire safety is generally better than in cars with internal combustion engine only, the high voltage battery poses new risks for car mechanics, breakdown recovery staff, and rescue personnel. Electrical work in electrical installations in buildings and electricity distribution networks is globally strictly regulated, while the electrical work in electric vehicles is not. There exists little or no scholarly systematic research on the risks, accidents and close calls available and there is a growing need for systematically collecting evidence and best practices. The arc flash accident risk in electric vehicle repair is probably belittled and the risk of an electric shock is overstated, but further research is needed on the topic.

Keywords: electric vehicles; electrical work safety; fire safety; battery safety

Full paper:
https://www.researchgate.net/publication/339875411_Electrical_accident_risks_in_electric_vehicle_service_and_repair_-_accidents_in_Finland_and_a_review_on_research

1042 Estimating the risk of traffic incidents using causal analysis

Jorma Kilpi[a]*, Johan Scholliers[b], Sami Koskinen[b], Pirkko Kuusela[a]

a VTT Technical Research Centre of Finland Ltd, Tekniikantie 1, Espoo, FI-02044 VTT, Finland
b VTT Technical Research Centre of Finland, Visiokatu 4, Tampere, 33720, Finland
** jorma.kilpi@vtt.fi*

Abstract

Traffic management centres aim to keep the traffic flowing regardless of traffic disturbances. This paper presents a new method for quantitative incident analysis via causality and observations. It is applied to estimate the risk of vehicular traffic tunnel closures in the city of Tampere, Finland, where the tunnel on a national main road bypasses the city centre. A tunnel closure rapidly causes traffic jams on alternative routes in the city. Also, traffic incidents near the tunnel may propagate

and cause tunnel closures. We restrict our analyses to the westbound direction of the traffic on the main road. We combine various open data sources providing information about traffic and driving conditions. The analysis is based on a probabilistic and statistical framework augmented with causal reasoning. We have identified several event paths from congestion after the tunnel to the tunnel closing, as well as approximate capacity limits near selected critical locations.

Keywords: Traffic Management Centre (TMC); big data; analysis of causality, traffic incident detection, traffic tunnels, congestion

Full paper: https://cris.vtt.fi/en/publications/estimating-the-risk-of-traffic-incidents-using-causal-analysis?utm_source=email

1071 Maritime risk assessment in Finland: Analysis of grey literature

Ketki Kulkarni[a]*, Osiris A. Valdez Banda[a], Pentti Kujala[a]

a Aalto University, School of Engineering, Department of Mechanical Engineering, Espoo, Finland
** Ketki.kulkarni@aalto.fi*

Abstract

Baltic Sea is an important socio-economic zone for the Baltic region. It is a crucial means of transportation for goods and services. The transportation systems necessitate cooperation among the Baltic countries. Any accident in any area can have significant consequences to the ecosystem and economies of many other neighboring countries. Hence maritime safety and risk management is an important area of research. There are several reviews of scientific work in maritime risk management. However, these reviews often do not include consultancy and industrial research. This paper reviews some of the key research initiatives in Finland focusing on the Baltic Sea in the last 15 years that are not published as scientific articles, but as open access project reports or tools. We analyze this "grey" literature for their underlying methodology and aspect of risk management considered. We also gauge the potential applicability of these works to global maritime risk assessment (MRA).

Keywords: maritime risk management; maritime safety; accident prevention; grey literature; Baltic Sea

Full paper: https://www.researchgate.net/publication/339899694_Maritime_risk_assessment_in_Finland_Analysis_of_grey_literature

1083 Civil liability for damages caused by a software failure

Idoia Elizalde Salazar[a]*

a Universitat Pompeu Fabra, Ramón Trias Fargas 25-27, Barcelona, 08005, Spain
** idoia.elizalde@upf.edu*

Abstract

The use of robots in different industries is growing and its use will have a lot of benefits. However, we cannot affirm that robots will be perfect and therefore no accidents will occur as a consequence of a robot failure. This paper identifies two

different causes of robots' malfunction: hardware and software failures. It seems clear that an accident as a consequence of hardware defect would be solved through the application of the Directive concerning liability for defective products. Nevertheless, it is more questionable that software failure would be solved through that Directive. The paper explains why software should be considered product and, therefore the Directive applicable. But, in any case, we have to take into account that not all software failures may be considered as the result of a defective product.

Keywords: robots, civil liability rules, programmer, software failures, hacked software, learning machine

1102 Enhancing Transport Safety: Transfer of Best Practices from Aviation to Maritime

Osman Turan[a]*, Rafet Emek Kurt[a], Volkan Arslan[b], Daniele Caruso[a], Ozcan Arslan[c]

a University of Strathclyde, Department of Naval Architecture, Ocean and Marine Engineering, 100 Montrose Street Glasgow G4 0LZ
b Lloyd's Register EMEA, 2nd Floor, The Sion, Crown Glass Place, Nailsea, Bristol, BS48 1RB
c Istanbul Technical University, Maritime Faculty, Sahilyolu Cad. 34940 Tuzla/Istanbul/TURKEY
** o.turan@strath.ac.uk*

Abstract

The SEAHORSE, an industry oriented EU funded FP7 project, addresses maritime safety, focusing on human factors and organizational issues through Resilience Engineering principles and by transferring the well proven practices and methodologies from air transport to marine transport in an effective, collaborative and innovative manner. The SEAHORSE project, which is the first project that EU funded under technology transfer, clearly demonstrated that different transport modes can and should work together to share the best practices with practical impact on safety. This novel outcome could lead to stronger cooperation between different modes of transport and the sharing of best practices across sectors. The Paper summarises the gaps between the two transport sectors as far as human factors related safety is concerned while presenting the Transfer Methodology of best practices from one transport sector to another. The Paper further describes some of the solutions and then presents the successful implementation examples of best practices on real ship operations by using SEAHORSE methodology.

Keywords: Maritime Safety; Resilience; Human Factors; Workarounds; Checklist; Procedure Improvement System; Safety Culture; Seahorse Project; Aviation; Transfer of Technology

1184 SafePASS – Transforming Marine Accident Response

Evangelos Boulougouris[a]*, Dracos Vassalos[a], Fotios Stefanidis[a], Giannis Karaseitanidis[b], Lazaros Karagiannidis[b], Angelos Amditis[b], Nikolaos Ventikos[b], Dimitris Kanakidis[c], Dimitris Petrantonakis[c]

a Strathclyde University, 16 Richmond Street, Glasgow G1 1XQ, United Kingdom
b National Technical University of Athens, 9 Iroon Polytechniou Str., Athens, 157 80, Greece
c EXUS Software ltd, 25 Old Broad Street, London EC2N 1PB, United Kingdom
** evangelos.boulougouris@strath.ac.uk*

Abstract

The evacuation of a ship is the last line of defence against human loses in case of emergencies in extreme fire and flooding casualties. Since the establishment of the International Maritime Organisation (IMO), Maritime Safety is its cornerstone with the Safety of Life at Sea Convention (SOLAS) spearheading its relentless efforts to

reduce risks to human life at sea. However, the times are changing. On one hand, we have the new opportunities created with the vast technological advances of today. On the other, we are facing new challenges, with the ever-increasing size of the passenger ships and the societal pressure for a continuous improvement of maritime safety.

Keywords: marine accident response; ship evacuation; lifesaving appliances; pedestrian dynamics; dynamic route finding; risk modelling; passenger ships

Full paper: https://www.researchgate.net/publication/339510126_SafePASS_-_Transforming_Marine_Accident_Response

1.35 Scientific and technical session 35: Innovations in logistics and freight

121 Enhanced data management techniques for logistics planning and scheduling in real time – Advances in LOGISTAR project

Leire Serrano[a]*, Enrique Onieva[a], Naia Merino[a], Antonio David Masegosa[ab], Pablo Fernandez[a], Iñigo Lopez[a], Jenny Fajardo[a], Pilar Elejoste[a]

a DeustoTech, Faculty of Engineering, University of Deusto, Avda. Universidades, 24, 48007 Bilbao, Spain
b IKERBASQUE, Basque Foundation for Science, 48011, Bilbao, Spain
** leire.serrano@deusto.es*

Abstract

LOGISTAR aims to allow effective planning and optimizing of transport operations in the supply chain by taking advantage of horizontal collaboration, relying on the increasingly real-time data gathered from the interconnected environment. For this, a real time decision-making tool and a visualization tool of freight transport will be developed, with the purpose of delivering information and services to the various agents involved in the logistic supply chain, i.e. freight transport operators, their clients, warehouse or infrastructure managers. LOGISTAR will address several advances beyond the State of the Art in the field of smart algorithms: Artificial Intelligence focused on prediction, parallel hybrid metaheuristics for optimization, automated negotiation and constraint satisfaction problem solving techniques. LOGISTAR involves 15 partners: University of Deusto, Univesity Collegue Cork, Consejo Superior de Investigaciones Cientificas, Dunavnet, Semantic Web Company, Software AG, dbh Logistics, Genegis, MDS Transmodal, Preston Solutions, Ahlers, Consorzio Zailog, Nestlé UK, United Biscuits, Codognotto.

Keywords: interconnected freight transport; artificial intelligence for supply chain operations; supply chain modelling; smart algorithms for interconnected logistics; big data for synchromodality

132 Mobility hubs as a prerequisite for intermodality and sustainable transport solutions

Cilli Sobiech[a]*, Maria Schnurr[a], Thomas Nyström[a], Stephanie Schemel[b]

a RISE AB, Lindholmspiren 3A, Gothenburg 417 56, Sweden
b Arup, Joachimsthaler Straße 41, Berlin 10623, Germany
** cilli.sobiech@ri.se*

Abstract

Mobility hubs – intermodal transport stations – can meet current and future mobility demands and support the transition to a sustainable, low carbon transport system,

based on a variety of mode choices. But despite being a key to intermodal travel, they have not developed as they could. A mobility hub framework proposed in this paper can help decision makers finding a solution that both meets user needs and increases the overall efficiency of transport systems. Together with two Swedish municipalities, a Swedish gas station operator and architect-engineers, exemplary sites were studied where mobility hubs could be located, and concepts were developed in order to prepare municipalities for the implementation of a mobility hub. Future adaptivity was taken into consideration for the concept development, in order to outline scalability and adaptivity to future needs and technologies reducing the risks for premature obsolescence.

Keywords: mobility hub; mobility services; intermodality; seamless transport; development framework; future adaptive design

143 Reinforced logistics: Automated tour planning with reinforcement learning

Marco Kemmerling[a]*, Marc Haßler[a], Sophie Hallstedt[a], Alexia Fenollar Solvay[a]

a Institute of Information Management in Mechanical Engineering, RWTH Aachen University, Dennewartstrasse 27, Aachen 52068, Germany
**marco.kemmerling@ima-ifu-rwth-aachen.de*

Abstract

In times of ever-growing and flexible demand for freight transports, the ability to quickly create efficient tour plans becomes increasingly important. Currently, this process is often carried out manually and requires trained personnel with years of experience. Due to the increasing number of goods to be shipped, as well as short reaction and planning times, this task becomes more and more complex and time-consuming. In this paper, we present a novel approach for automated tour planning based on reinforcement learning methods. This enables us to learn on the basis of historical tour data, react flexibly to changes in transport conditions, and create tours similar to the ones created by human planners. Our focus is on short-range business-to-business transports, where the delivery areas are not as densely populated with customers as within the consumer transport sector.

Keywords: tour planning; reinforcement learning; machine learning; vehicle routing; logistics; freight transport

Full paper: https://publications.rwth-aachen.de/record/783446

313 Public transport facilities as logistic hubs

Fabian Dorner[a]*, Clemens Raffler[b], Roland Hackl[b], Julia Schmid[b], Martin Berger[a]

a Technische Universität Wien, Forschungsbereich Verkehrssystemplanung, Karlsplatz 13, 1040 Wien, Austria
b tbw research GesmbH, Schönbrunner Straße 297, 1120 Wien, Austria
** fabian.dorner@tuwien.ac.at*

Abstract

The increasing number of parcel deliveries as a result of the rapid growth in online shopping and low transport costs lead to growing environmental problems in cities. In search of sustainable city logistics solutions, city-hubs can help to consolidate parcel delivery and promote the use of environmentally friendly vehicles for the last mile. However, suitable areas in central urban locations are scarce. This paper introduces and examines the concept of using depots and garages of public transport providers as city-hubs in the urban core of Vienna, Austria. A case study

on the concept focuses on parcel delivery, which aims at answering the question whether the parallel operation of parcel handling and public transport services is possible and if so, which adjustments are necessary for a successful implementation. We therefore present the main findings of a stakeholder consultation, asking for the current needs and prerequisites from a local CEP shippers' perspective and give insight into the site analysis designed to select the most profitable and feasible location of a logistic hub shared with public transport providers.

Keywords: parcel delivery, city hubs, public transport facilities

Full paper:
https://www.researchgate.net/publication/339899843_Public_transport_facilities_as_logistic_hubs

323 Analysis of Measures on the Modal Share in Freight Transport: An Example of Gigaliners in Germany

Liedtke Gernot[a,b]*, Sonntag Herbert[c]

a DLR Berlin. 2, Institut für Verkehrsforschung, Rutherfordstr. 2, 12489 Berlin, Germany
b TU Berlin, Department of Commercial Transport, Salzufer 17-19, 10587 Berlin, Germany
c TH Wildau, Verkehrslogistik, Hochschulring 1, 15745 Wildau, Germany
** gernot.liedtke@dlr.de*

Abstract

The paper analyses the effect of long trucks or Gigaliners on the modal share in freight transport within the German territory. They are divided in direct and indirect effects. The direct effect of changed transport tariffs is calculated using aggregate price elasticities of the demand. Indirect effects result from economies of scale in railway transport systems. To compute the indirect effects, it is assumed that railways set cost-oriented prices and react to demand reductions in form of lower transport frequencies. The indirect effects amplify the direct effects and could result in a significant decrease of single wagonload transports. In order to avoid the negative effects of long trucks on the railways, innovations and supportive policies must be implemented in the railway sector.

Keywords: Freight traffic, rail freight transport, mode choice model, price elasticities, break-even effect, Gigaliner

330 Freight distribution in urban areas: A method to select the most important loading and unloading areas and a survey tool to investigate related demand patterns

Marco Diana[a], Miriam Pirra[a]*, Andree Woodcock[b]

a Politecnico di Torino - DIATI, Corso Duca degli Abruzzi 24, 10129 Torino, Italy
b Coventry University, Priory Street, Coventry, CV1 5RY, United Kingdom
** miriam.pirra@polito.it*

Abstract

Cities all around the world are observing increasing levels of urban freight activities owing to the growth of internet shopping combined to the traditional distribution to shops, creating additional problems in terms of congestions and environmental impacts. This study, developed within the European Project SUITS framework, aims at creating a tool that can help Local Authorities to investigate a specific aspect characterizing and influencing the mobility, namely the observation of freight flows from the demand side. This led to the design, implementation and testing of a tool

to understand which are the most relevant unloading areas in an urban settings by processing the GPS traces of a fleet of logistic vehicles, followed by a survey of retailers and shops in such areas to observe load and unload activities. The application shows how combining the use of transport data with a paper-based survey could be exploited to understand a local problem.

Keywords: freight distribution; urban mobility; GPS traces; cluster analysis; spatial clustering; DBSCAN

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

417 Innovative Elements of the Swiss Multimodal Freight Policy

Martin Ruesch[a]*

a Rapp Trans Ltd, Max-Högger-Strasse 6, 8048 Zurich, Switzerland
** martin.ruesch@rapp.ch*

Abstract

Well-functioning logistics and freight transport systems are crucial for a prosperous economy and a thriving society. Forecasts show that freight transport in Switzerland will increase by 40% until 2040. Switzerland is facing challenges regarding freight transport as congestion, insufficient truck parking, conflicts between passenger and rail freight, environmental burdens etc. Key elements of the multimodal Swiss freight transport policy are the heavy vehicles fee, the extension of the freight railway network, the railway reform and regulations regarding modal shift. Accompanying measures are truck management on motorways, truck parking along motorways, enforcement of heavy vehicles regulations, the night/weekend driving ban and the prohibition of cabotage. The impacts of the Swiss multimodal freight policy and the experiences made are positive. Some of the measures could also be interesting for other countries. This paper describes the freight transport development, the forecast for 2040 and the characteristics and impacts of the Swiss freight policy.

Keywords: Freight Transport; Multimodality; Policy; Logistics

471 Combining tourism and freight transport on Douro's Inland Waterway

António Lobo[a]*, Marco Amorim[ab], Carlos Rodrigues[a], António Couto[a]

a Faculty of Engineering of the University of Porto, Research Centre for Territory, Transports and Environment, Rua Dr. Roberto Frias, s/n, 4200-465 Porto, Portugal
b University of Stuttgart IAT, Institute of Human Factors and Technology Management, Nobelstraße 12, 70569 Stuttgart, Germany
** lobo@fe.up.pt*

Abstract

The main goal of the project Douro's Inland Waterway 2020 is to transform this waterway into a safe and sustainable alternative for freight transport in the North and Centre Regions of Portugal, contributing to the European Transport Purposes for 2020. Currently, freight transport on the Douro River is merely occasional. The waterway's transformation to accommodate regular trading routes implies both a strong infrastructural investment and a viable coexistence with tourism navigation. As a mountain river regulated by five hydropower dams, the Portuguese Douro has some capacity bottlenecks related to the locks and the width and depth of the navigation channel. This work presents the main results obtained by an agent-

based simulation model, developed to evaluate the waterway's capacity against the prospective growth of freight and tourism activities. The results show that the coexistence between freight and passenger transport is feasible, although putting the waterway operating near its maximum capacity.

Keywords: Douro's Inland Waterway; freight transport; tourism; capacity

514 Urban Factories – Establishing resource-efficiency in production logistics systems in cities

F. Kreuz[a]*, M. Bucherer[b], M. Juraschek[c], U. Clausen[a]

a Institute of Transport Logistics (ITL), TU Dortmund University, Leonhard-Euler-Str. 2, 44227 Dortmund, Germany
b Institute of Industrial Building and Construction Design (IIKE), Technische Universität Braunschweig, Pockelsstraße 3, 38106 Braunschweig Germany
c Chair of Sustainable Manufacturing and Life Cycle Engineering, Institute of Machine Tools and Production Technology (IWF), Technische Universität Braunschweig, Langer Kamp 19B, 38106 Braunschweig, Germany
** kreuz@itl.tu-dortmund.de*

Abstract

Cities are a hotspot for resource consumption and related impacts. This is induced, among others, by transportation, production and the use of products and services. Industrial production is commonly associated with negative impacts, e.g. on the environment or traffic. Through positive integration of production sites into urban surroundings, negative impacts can be eliminated, and even positive impacts achieved. To reach a higher degree of integration of different utilizations in cities, resource-efficiency, new conceptual approaches are required for urban factories, city authorities and further stakeholders. For this purpose, a methodology has been developed that describes the planning processes of the involved disciplines and their interdependencies concerning content and timing. Subsequently, an analysis of Urban Factories within a reference framework called the factory-city-system and its key resources is carried out in an exemplary case study. Measures to enhance resource-efficiency are thus identified, exemplarily described and examined regarding their potential to raise resource-efficiency.

Keywords: Urban Factories; Urban Logistics; Sustainable Development, Resource-Efficiency

Full paper: http://dx.doi.org/10.17877/DE290R-20983

520 AutoTruck and helyOS: Enabling highly efficient yard operation by automation

Gunter Nitzsche[a]*, Sebastian Wagner[a], Nikolay Belov[a], Carlos Eduardo Viol Barbosa[a]

a Fraunhofer-Institute for Transportation and Infrastructure Systems IVI, Dresden, Germany
** gunter.nitzsche@ivi.fraunhofer.de*

Abstract

The paper shows a new approach for highly efficient yard operation by automation with a new control centre software approach for gated areas, called helyOS. This software is currently developed in different research projects. This paper describes the concept of helyOS along with its capabilities, features and possible future extensions. Its first-time application is the fully automated, electrically driven AutoTruck – a distribution truck, which can drive autonomously within a distribution

centre. By this example, the authors show how helyOS can aid an efficient handling of automated vehicles.

Keywords: Autonomous Driving, Yard Automation, Web Service, Path Planning, Control Centre

Full paper: http://publica.fraunhofer.de/documents/N-581119.html

578 Impacts of increasing maximum truck weight – Case Finland

Heikki Liimatainen[a]*, Markus Pöllänen[a], Lasse Nykänen[b]

a Transport Research Centre Verne, Tampere University, P.O. Box 600, FI-33014 Tampere University, Finland
b Vediafi Oy, Valimotie 13A, FI-00380 Helsinki, Finland
** heikki.liimatainen@tuni.fi*

Abstract

Finnish government allowed high capacity vehicles (HCV) with a maximum weight limit of 76 tonnes to operate on Finnish roads in October 2013. This paper aims to analyse how HCVs have affected the Finnish road freight transport sector based on a continuous time series data from 2013 to 2017. The analysis shows that there has been a significant upward trend in the average payload weight and a transition from 7-axle to 8- and 9-axle articulated vehicle combinations, which allow the higher weights. Truck mileage of 225 million km has been avoided from October 2013 until the end of 2017 and avoided mileage corresponded in 2017 to approximately 4% of total truck mileage in Finland. This equals around 126 million € cost savings in 2017 and 0.1 Mt of CO2 emissions reduction in road freight, even after taking into account that there has been some modal shift from rail to road.

Keywords: high capacity vehicles; road freight transport; CO2 emissions; transport costs

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

Full paper: https://etrr.springeropen.com/articles/10.1186/s12544-020-00403-z

593 The future of urban freight transport: Shifting the cities role from observation to operative steering

Thomas Otte[a]*, Alexia Fenollar Solvay[b], Tobias Meisen[c]

a Institute of Information Management in Mechanical Engineering (RWTH Aachen University), Dennewartstr. 27, 52062 Aachen, Germany
b HotSprings GmbH, Am Kraftversorgungsturm 3, 52070 Aachen
c Chair of Technologies and Management of Digital Transformation (University of Wuppertal), Rainer-Gruenter-Str. 21, 42119 Wuppertal
** thomas.otte@ima.rwth-aachen.de*

Abstract

Urban freight transport is characterised by an increasing frequency of shipments into urban spaces. These shipments are carried out by a variety of freight carriers that operate independently and keep their operative information within their organisations. However, an unfortunate chaining of independent shipment operations affects the urban transportation network negatively. Establishing a data-based cooperation between these companies promises benefits for both the companies and the overall transportation network. In this context, an impartial and fair mediator is needed to bring together the data of each actor at a central point

in order to steer the urban freight transport from a system perspective. This paper lays the fundament to prepare cities for taking over this responsible task. By creating a data foundation for the operative steering of the urban freight transport system, it contributes to national and supranational objectives regarding the sustainable development and a worldwide pioneering role for Europe.

Keywords: urban logistics; smart city; freight transport; data-driven; decision support systems; sustainability

Full paper: http://doi.org/10.18154/RWTH-2020-02971

728 Expectations for Finnish road infrastructure in semi-automated truck platooning - Project results

Veikko Pekkala[a]*, Mika Sorvisto[b], Rauno Heikkilä[a]

a University of Oulu, Pentti Kaiteran katu 1, PL 8000, Oulu, Finland
b Oyj Ahola Transport Abp, Indolantie 33, 67600 Kokkola, Finland
** veikko.pekkala@oulu.fi*

Abstract

Aim of the Platooning Finland -project (19-Nov-2018 - 31-Dec-2019) was to outline possibilities, prerequisites and effects of semi-automated truck platooning in Finland. Main interest areas concerned road infrastructure, weather conditions, drivers' perspective, and road situations. The project was carried out in collaboration with University of Oulu, Oyj Ahola Transport Abp, Oy Attracs Ab and Scania CV Ab. Finnish Transport Agency (Traficom) was part of the project management team. Information was collected by data logging, observations and interviews and was based on three-truck journeys in platoon formation in live operating environments. Journeys were performed on different road types under winter and summer conditions. Expected results showed:

- Suitability of Finnish road types for semi-automated truck platooning
- Arrangements supporting the assembly of semi-automated truck platoons
- Effects of weather, road topography, and other traffic
- Truck drivers' perspective on semi-automated truck platooning
- Effects of different factors on fuel consumption in semi-automated truck platooning

Keywords: road infrastructure; semi-automated truck platooning

819 Shipper expectations from intermodal freight transport

George Panagakos[a]*, Harilaos N. Psaraftis[a]

a Department of Technology, Management and Economics, Technical University of Denmark, Bygningstorvet 1, 2800 Kgs Lyngby, Denmark
** geopan@dtu.dk*

Abstract

The paper identifies the priorities of the shippers (cargo owners and freight forwarders) in relation to intermodal freight logistics in the northern part of the Scandinavian-Mediterranean TEN-T core network corridor. In addition to a literature search on the characteristics and pre-conditions that shippers consider necessary for efficient and effective intermodal transport, the paper analyses shippers' responses to a specially designed questionnaire to assess their experiences with intermodality, the factors driving it and their attitude towards measures proposed for its promotion. On average, the sample companies find their intermodal experiences more than satisfactory. The level of satisfaction appears higher in

Germany, as well as among forwarders. Contrary to previous findings, competitive pricing seems to be the most important characteristic. Among proposed measures, infrastructural aspects such as improved accesses to multimodal terminals/ports and strengthened capacity of facilities/links attract the highest attention. Addressing the right decision-makers is essential in designing activities promoting intermodality.

Keywords: Freight transport; Intermodality; Shipper needs; Freight forwarders; Infrastructural improvements; Baltic Sea

Full paper:
https://files.dtu.dk/u/xxhmUikYZlLVGGZR/TRA2020_Paper_on_shipper_needs_extended_abstract.pdf?l

886 LCV's in Urban Logistics: are AECS vehicles conceivable?

Kartik Varma[a]*, François Combes[a]

a IFSTTAR,F-77447 Marne la Vallée Cedex 2, France
** kartik.varma@ifsttar.fr*

Abstract

This paper presents an overview of changes expected in the role of LCV's in Urban Logistics due to technological changes. It is divided into the following sections; Urban population and logistics; Light commercial vehicles and their use in urban logistics; Transition to Autonomous, Connected, Electric and Shared (AECS); and Regulation of vehicles. Section 1 (Introduction) outlines the scope of this document, definitions and a literature review. 'Urban population and logistics' sheds light on cities and logistics within them. 'Light commercial vehicles and their use in urban logistics' compares the current and future (expected) usage. 'Transition to AECS' describes changes expected in LCV's due to the next wave of technological change. 'Regulation' sheds light on regulatory measures related to AECS vehicles with a focus on LCV's. Through a review of literature and trends, we hypothesize that such a transition is conceivable as there exist scenarios where it adds value. However, these scenarios are complex and much further research is needed to be able to shed more light.

Keywords: Autonomous; Light Commercial Vehicles; Urban Logistics

Full paper:
https://www.researchgate.net/publication/339876022_LCV's_in_Urban_Logistics_are_AECS_vehicles_conceivable

998 Can robots solve logistics problems in a hospital environment?

Jonne Holmén[a], Riikka Siuruainen[b]*, Jaakko Porokuokka[b], Olli-Pekka Brunila[a], Vappu Kunnaala-Hyrkki[a]

a South-Eastern Finland University of Applied Sciences, Pääskysentie 1, Kotka, 48220, Finland
b Laurea University of Applied Sciences, Ratatie 22, Vantaa, 01300, Finland
** riikka.siuruainen@laurea.fi*

Abstract

This paper assesses the potential of introducing an automated logistics system for small waste components produced in a hospital environment. As the hospitals are very multifaceted transport systems, some of the causes of the complexity are identified as the different sources of material flow, varied waste components, regulations, operations in public and restricted environments, work routines of the

personnel and transportation equipment being used. The benefits of such a system would be manifold. In addition to improving the efficiency of the hospital's internal logistics, it could enable a safe transport, storage and recycle of hospital waste. This paper discusses whether autonomous mobile robots can help to improve hospital logistics and bottlenecks.

Keywords: mobile robot; healthcare; robotics; automation; logistics

1.36 Scientific and technical session 36: Railways safety and reliability visions

80 DC high-speed circuit-breakers – tests versus operation in real conditions

Artur Rojek[a]*

a Railway Institute,Chlopickiego 50,04-275 Warsaw,Poland
** arojek@ikolej.pl*

Abstract

High-speed circuit-breakers (HSCB) are one of the basic elements of short-circuit and electric shock protection in DC circuits. They appear in transport (trams, trolleybuses, metro and railways) in electric power supply facilities and in vehicles. They are used in energy storage, industrial processes and wherever there is a necessity to switch off large DC currents values and/or a voltage higher than 1 kV DC is used. Currently, the most commonly used type of HSCB are magnetic blowout switches. Before starting their operation, they undergo numerous tests in compliance with the ones in force, the results of which determine their parameters. In real-life conditions, HSCB often work in circuits that differ in parameters from those used in laboratory tests. It can have a significant impact on the protection level, equipment protection and people's safety as well as durability and reliability of the circuit breakers themselves. The article presents examples of phenomena affecting the work of HSCB recorded during tests and examples of standards which are not always compliant with the actual HSCB working conditions.

Keywords: high-speed circuit-breaker, short circuit protection, electric shock protection, breaking time, overvoltage, arc voltage, high-speed circuit-breakers tests

166 Testing of the control unit of a train for the phase commutation on a HIL platform

J. Pascal[b]*, T. Letrouvé[a], H. Caron[b], R. Coupat[b], Jean-François Piguet[c], Thierry Furnot[c]

a SNCF Innovation & Research, 1-3 Avenue François Mitterrand, Paris 93574, France
b SNCF Industrial and Engineering General Management – Electric Traction, 6 Avenue François Mitterrand, Paris 93574, France
c SNCF Embedded Energy Monitoring and Control, 25 ter Quai Pierre Sémard, 69924 Oullins, France
** jules.r.pascal@gmail.com*

Abstract

Powering the neutral sections of an AC railway network has several advantages. It can be done by shortly switching the section from one phase to another. This solution though might affect the control unit of the trains crossing the section and trigger protections based on the pantograph's voltage. Testing the reaction of the control unit to a prototype of the switching system on the field is constraining and

expensive. HIL (Hardware-In-the-Loop) simulations integrate physical elements to the simulation loop. It makes the testing of the control unit of a train safer and cheaper by making it control a simulated model of a train crossing a neutral section.

Keywords: Neutral section, commutation, Hardware-In-the-Loop, control unit, train, railway

297 Condition monitoring of track surroundings: Maintenance in the scope of digitalisation and automation

Felix Heizler[a]*, Timo Strobel[a], Hamidreza Tavakolinik[a], Pavel Klasek[b], Corinna Salander[b]

a Institute of Machine Components, Pfaffenwaldring 9, 70569 Stuttgart, Germany
b German Centre for Rail Traffic Research, August-Bebel-Straße 10, 01219 Dresden, Germany
** felix.heizler@ima.uni-stuttgart.de*

Abstract

Due to the upward tendency towards rail transport automation, there are numerous sensors installed on rail vehicles including video cameras. These may not only be used for obstacle detection on the track but also for monitoring the track surroundings. Within the research project Condition Monitoring of Track Surroundings, a technology is developed to gain additional information about the condition of the rail infrastructure from video data along the railway route, which is recorded during regular operation. It enables to identify deviations of objects in the track surrounding, which are analysed and classified. Based on this, necessary maintenance actions are automatically generated. This allows for an easier, more objective, independent and digital process for track surrounding maintenance planning. Once it is validated, the system can replace the observation and reporting role of the train driver in order to enable the deployment of automatic train operation systems.

Keywords: infrastructure; track surroundings; 3D-modeling; maintenance management; digitalisation; automatic train operation

487 Earthwork asset management using Petri Net models

Jose Solís-Hernández[a]*, Noemi Jiménez-Redondo[a], Iñigo Mingolarra-Garaizar[a], Sunny Modhara[b]

a Centro de Estudios de Materiales y Control de Obra S.A., Calle Benaque 9, Málaga, 29004, Spain
b Network Rail, The Quadrant, Elder Gate, Milton Keynes, Bucks, MK9 1EN, United Kingdom
** jose.solis@cemosa.es*

Abstract

The railway infrastructure in the UK has a total of around 191,000 earthwork assets. The objective of this study is to develop a strategic model using the Petri Net methodology to evaluate how effectively different intervention strategies are able to offset the effect of asset degradation on a portfolio of earthworks assets, under budget and resource constraints. Therefore, the model developed in this study enables the selection of work volumes at the portfolio level which are able to sustain asset performance levels at the lowest whole life cost. The input information used is based on data provided by Network Rail addressing the state of earthworks in the UK. The work performed in this study is divided in three sections: data analytics to investigate degradation patterns in the network; modelling of the dynamic behaviour of earthworks in the network; and post-processing and optimisation of the intervention strategies analysed.

Keywords: earthworks; asset management; Petri Nets; data analysis; railway infrastructure; optimisation

543 Analysis and comparison of simulated and real train driving in an Automatic Train Protection (ATP) system environment

Tomas Rosberg[a]*, Birgitta Thorslund[a], Anders Lindström[a]

a VTI, Olaus Magnus väg 35, Linköping 58195, Sweden
** tomas.rosberg@vti.se*

Abstract

This paper presents the differences between the train traffic simulation tool RailSys and real train traffic with focus on Electrical Multiple Units (EMU) and the Swedish automatic train protection (ATP) system ATC, on a single-track line. Braking, acceleration, different types of resistance and running times have been investigated. From this study it can be concluded that the margins to unconditional ATC braking is high and that the braking differs depending on the signal target. Compared to RailSys, the measurements show significantly lower acceleration and retardation, which results in differences between measured and simulated running time. This is the first step exploring how capacity, signal systems, and driving behaviour interact and will be followed by investigations of the next generation signaling system ERTMS.

Keywords: ATP; ATC; ERTMS; simulation; driving behaviour; signalling

600 Detecting anomalous behavior of railway switches under real operation conditions: workflow and implementation

Daniela Narezo Guzman[a]*, Edin Hadzic[b], Henk Samson[b], Serge van den Broek[b], Jörn C. Groos[a]

a German Aerospace Center (DLR), Institute of Transportation Systems, Berlin/Braunschweig, Germany
b Strukton Rail, 3600BA Maarssen (Utrecht), Netherlands
** Daniela.NarezoGuzman@dlr.de*

Abstract

Railway switches are crucial assets since they enable trains to change tracks without stopping. Larger parts of the infrastructure are compromised when certain switches fail. Regular inspections, maintenance and repairs are required to increase switch reliability, making them costly assets. Monitoring systems help determining the condition of assets. Nowadays nearly thousand switches in the Netherlands are remotely monitored by Strukton Rail. The current version of this monitoring system has helped to identify degrading and failing switches, but it also generates false alarms. There is room for improvement in how the monitoring system supports asset managers in making decisions regarding the asset. Here, we present a workflow that exploits switch monitoring data under real operation conditions. The running workflow implements a machine-learning model for automatic detection of anomalous switch functioning. Models for predicting switch degradation and failure evolution, and for identifying failure types are under development and remain to be implemented.

Keywords: intelligent systems; infrastructure; railway engineering; algorithms; asset management

Full paper: https://elib.dlr.de/132828/

755 A look into the JEC Well-To-Wheels study version 5

Matteo Prussi[a], Laura Lonza[b], Marta Yugo[c]*, Heather Hamje[d], Luis de Prada[e]

a JRC, via Enrico Fermi 2749, 21027 Ispra, Italy
b JRC, via Enrico Fermi 2749, 21027 Ispra, Italy
c Concawe, Boulevard du Souverain 165, 1160 Brussels, Belgium
d Concawe, Boulevard du Souverain 165, 1160 Brussels, Belgium
e EUCAR, Avenue des Nerviens 85, 1040 Brussels, Belgium
** marta.yugo@concave.eu*

Abstract

The JEC consortium - a collaboration among the European commission's Joint Research Centre, EUCAR and Concawe - has conducted a major update of their joint Well-to-Wheels (WTW) study exploring the energy use and greenhouse gas (GHG) emissions of different combinations of fuels and powertrains in the European context. Looking at the 2030 timeframe and following a three-steps approach, the WTW v5 report cover: (1) JEC Well-to-Tank (WTT) including 252 different fuel production pathways, including their technology (TRL) and market (CRL) maturity levels. A specific section is devoted to quantification of the production costs (2) JEC Tank-to-Wheel (TTW) v5 explores the vehicles use and goes beyond passenger cars by extending the analysis to regional and long haul Heavy Duty vehicles (current NEDC and 2025+ WLTP). (3) The JEC WTW v5 finally integrates a selection of fuels routes and vehicles, presenting the results in terms of MJ or g CO2eq/km distance travelled.

Keywords: JEC; Well-To-Wheels; Well-To-Tank; Tank-To-Wheels; fuel; powertrains; WLTP

859 Rail Voltage Control by System Weakening in Electrified Railways

Mehmet Turan Söylemez[a]*, Süleyman Açikbaş[b]

a Istanbul Technical University,Control and Automation Engineering Department, Maslak, Istanbul, Turkey
b HI-SIM Technology & Engineering, Istanbul Technical University Technopolis, Maslak, Istanbul, Turkey
** soylemezm@itu.edu.tr*

Abstract

Controlling rail voltage especially in DC electrified railways is an important issue for safety and economic reasons. A new possibility has started to arise in controlling the rail voltages with the increased usage of current limiting function in the railway vehicles. In some cases, it could actually be possible to isolate (weaken) catenary/3rd rail of a problematic area in order to reduce the rail voltages in that area. The vehicles in the weakened area would withdraw less current, resulting in less rail voltages. This idea forms the departure point of this paper. The paper covers the advantages and disadvantages of different techniques that can be used in controlling rail voltages and uses a realistic case study to illustrate the results with the help of a rail system simulation tool.

Keywords: traction simulation, rail voltage reduction, power system sectioning, system weakening

Full paper: http://web.itu.edu.tr/soylemezm/tra2020/soylemez_acikbas.pdf

946 An overview of natural hazard impacts on rail transport in the Czech Republic

Vojtěch Nezval[a,b]*, Michal Bíl[b]

a Department of Physical Geography and Geoecology, University of Ostrava, Ostrava, 710 00, Czech Republic
b CDV – Transport Research Centre, Brno, 636 00, Czech Republic
** vojtech.nezval@cdv.cz*

Abstract

Extreme weather and natural disasters, such as landslides or floods negatively affect transport systems. We analysed data on rail failures in the Czech rail transport in order to obtain incidents related to natural hazards and its impacts to rail transport. Between 2010 and 2017, total of 17,306 incidents were identified. The most mentioned in the data were thunderstorms, which caused rail device failures, power outages or tree-falls onto railway tracks and/or overhead power lines. 65.6 % of the incidents ended within three hours. Total train delay exceeded 285,000 minutes and total direct damage EUR 1,400,000 over the monitored period. However, this is the lowest limit because information on damage and train delays was not included in all data. Furthermore, we identified the most affected locations using Kernel density function in ArcGIS environment. Some of the largest railway junctions are within the identified locations.

Keywords: rail transport, natural hazard, weather, train delay, Czech Republic

962 A new concept for people movers on secondary railway lines

W. Sebron[a]*, P. Krebs[a], H. Tschürtz[a]

a Vienna Institute for Safety and Systems Engineering (VISSE), University of Applied Science Vienna, Favoritenstrasse 226, 1100 Vienna, Austria
** walter.sebron@fh-campuswien.ac.at*

Abstract

This paper introduces a safety concept for autonomous on-demand people mover systems intended for single-track secondary railways lacking grade separation. The considerations in this paper are backed by an ongoing research project, which is publicly funded by the MA231. This paper discusses the assumptions and first general findings of the project, taking a closer look at the concept itself and the contributing systems. Among different possibilities, safety was given highest priority in the project, which can result in availability problems. Therefore, ideas for availability improvements within the new concept are currently being investigated and substantiated by simulation. Based on this paper, further reports on results of the project are in preparation.

Keywords: autonomous driving; safety; availability; railway; on demand; system of systems

1013 Level crossings ranking by integrated risk analysis for typical hazards

Anna Franco[a], Crsitiano Marinacci[a]*, Stefano Ricci[a]

a Sapienza Università di Roma, DICEA, 00184 Roma, Italy
** stefano.ricci@uniroma1.it*

Abstract

The paper starts from the introduction of the safety management systems, as tools for the continuous improvement of rail safety performances and for the processes to identify the most effective measures to prevent accidents. The focus is on the level crossings, largely representing the most dangerous elements of the railway networks. The scope is the setup of an effective methodology for ranking the level crossings in view of the prioritization of actions to reduce the risks on intersections between rail and road. The methodology will act as a strategic tool for the maximization of effectiveness of safety-related investments. The proposed approach is basing on risk analysis methods, focused on significant variables for typical hazards, customized for the level crossings' operation. The proposed method allows determining an up-gradable ranking process, which qualifies and sorts single level crossings according to typical hazards, addressing viable times and modes for their mitigation.

Keywords: Railway, Safety, Level Crossing, Risk Analysis, Hazards

Full paper:
https://docs.google.com/a/uniroma1.it/viewer?a=v&pid=sites&srcid=dW5pcm9tYTEuaXR8c3RlZmFub3JpY2NpfGd4OmFlNDI5MjM0NzM3YzBlOA

1.37 Scientific and technical session 37: Best practices for infrastructure safety and reliability

118 Safety management at road work zones – Current practices and best-practice recommendations

András Várhelyi[a]*, Bernd Strnad[b]*, Philip Temmerman[c], Ludo Kluppels[c], Stijn Daniels[c]

a Lund University, Box 118, 221 00 Lund, Sweden
b Kuratorium für Verkehrssicherheit, Schleiergasse 18, 1100 Vienna, Austria
c Vias institute, Haachtsesteenweg 1405, 1130 Brussels, Belgium
** andras.varhelyi@tft.lth.se*

Abstract

Accidents nearby work zones are a persistent road safety problem in many European countries. The Conference of European Directors of Roads (CEDR) has initiated and finances the IRIS project (Incursion Reduction to Increase Safety in road work zones) with the aim to collect and share information about best practices in temporary traffic management at road works. An analysis of work zone accidents and a review of best practices were made. Psychological issues to improve safety at work zones were studied by a literature review. Interviews with stakeholders were carried out in eight European countries to gather information on guidelines, standards and procedures in temporary traffic management. Best practice findings cover organizational/management issues, work zone safety reviews, establishment/de-establishment of a road work zone, informing/warning and guiding road users through work zone areas, speed management, protecting devices for road workers' and road users' safety and incursion warning systems.

Keywords: Road work zone; Safety; Best practice; Review

Full paper:
https://www.researchgate.net/publication/339738960_Safety_management_at_road_work_zones_-_Best-practice_recommendations

141 Effect of roundabout design on the behaviour of road users: A case study of roundabouts in Oman

Putu Mandiartha[a]*, Majid Al Jahdhami[a], Atef Badr[a], Graham Hayne[a], Colin Duffield[b], Russell Thompson[b]

a Military Technological College, Al Matar Street, Muscat 111, Oman
b The University of Melbourne, Parkville, Melbourne, VIC 3010, Australia
** putu.mandiartha@mtc.edu.om*

Abstract

This paper explores the relationships between the behaviour of road users, road environment, traffic characteristic and law enforcement. The objective of this study was to investigate the relationship between geometric designs of a roundabout on the characteristics of traffic passing through the roundabout. A case study research of Oman's roundabouts was conducted through continuous 24 h observations of traffic characteristic passing the case study roundabouts at the selected days. The relationship between roundabout design and traffic characteristics was quantified, focusing on the behaviour of users measured through traveling speed on different types of roundabout geometric design. The layout design of the roundabout had a significant effect on user behaviour. This layout design included the skewness and the legs positioning of the roundabout. The results also highlight the importance of setting the design purpose of roundabout construction whether the design is driven by traffic calming purposes or traffic routing.

Keywords: geometric design; roads; roundabout; safety; speed; traffic

Full paper:
https://www.researchgate.net/publication/339446494_Effect_of_roundabout_design_on_the_behaviour_of_road_users_A_case_study_of_roundabouts_in_Oman

158 Improvement of road safety on rural roads by using suitable safety barriers

Susanne Schmitz[a]*, Linda Meisel[a]

a Federal Highway Research Institute, Brüderstraße 53, 51427 Bergisch Gladbach, Germany
** schmitzs@bast.de*

Abstract

Safety barriers can deliver an important contribution to approach the aim of "vision zero". One main requirement for this task is the correct choice of suitable and safe barrier systems that fit the boundary conditions on-site. Usually the national guidelines for the application of safety barriers offer the required basic principles. However, the characteristics of some road types are far away from any standard. That is why some procedural guidelines are needed, to decide whether a construction is suitable for a special boundary condition or not. Therefore some considerations were made with the aim to support the correct choice of suitable and safe barrier systems especially for constricted space conditions like trees close to the roadside. In addition a future option for tested barrier systems for such special-purpose solutions is drafted. The ideas and concepts developed in this context are described in the present paper.

Keywords: road safety; safety barriers; special installation situations; trees at roadside; European guidelines

294 Reliability assessment of ageing infrastructures for practitioners: A cross-modal approach

Julia Sorgatz[a]*, François Marie Nyobeu Fangue[a], Rolf Rabe[b], Andreas Panenka[a]

a Bundesanstalt für Wasserbau (BAW), Kussmalstr. 17, 76187 Karlsruhe, Germany
b Bundesanstalt für Straßenwesen (BASt), Brüderstraße 53, 51427 Bergisch Gladbach, Germany
** julia.sorgatz@baw.de*

Abstract

This paper provides insights into the development process of a cross-modal approach for the reliability assessment of transport infrastructures. In Germany, increasing socio-economic pressure calls for proactive and sustainable maintenance strategies. Since all the responsible administrations of the road, railway and waterway infrastructure are faced with similar challenges, a common approach is been sought to address the planning and prioritisation of maintenance interventions. Thus, cross-modal thinking is considered an important asset to integrate the existing, often empirical knowledge across the governmental entities. At present, research and development activities are focused on adapting and establishing methods for the analysis, modelling and simulation of the reliability of new and existing structures. This paper presents the current status of the development process illustrated by selected applications to civil engineering structures in the German infrastructure portfolio.

Keywords: structural reliability, maintenance management, condition assessment, reliability indicators, criticality

Full paper: https://hdl.handle.net/20.500.11970/107018

597 CEDR Transnational Research Programme Call 2016 Water Quality: Environmentally Sustainable Roads

Peter Coenen[a]*, Rianne Dröge[a], Lian Lundy[b], Tone Muthanna[c], Jes Vollertsen[d], Peter Tromp[a]

a Netherlands Organisation for applied scientific research TNO, Princetonlaan 6, Utrecht NL-3584 CB, The Netherlands
b Middlesex University, The Burroughs, Hendon, London NW4 4BT, United Kingdom
c Norwegian University of Science and Technology (NTNU),Trondheim NO-7491, Norway
d Aalborg University, Thomas Manns Vej 23, Aalborg 9220, Danmark
** peter.coenen@tno.nl*

Abstract

Road construction, operation and maintenance may cause negative impacts on the surrounding ecological system. Policymakers, national road authorities and environmental protection agencies are increasingly required to make decisions on when and how highway runoff should be treated. As a contribution to addressing these concerns, the Conference of European Directors of Roads (CEDR)'s Transnational Research Programme "Water Quality" funded three projects to synthesise and share current and new knowledge on the water quality aspects on European roads. This will improve the decision making in term of reducing the impacts of the road- and traffic-related pollutants of European water bodies. The main objectives of this research programme are to improve and exchange the European know-how, develop user-friendly tools that can be used by practitioners at the National Road Administrations, and evaluate the performance of different drainage systems to reduce conventional pollutants and new-emerging chemicals including microplastics. Outputs will improve decision making in term of reducing the impacts of road- and traffic-related pollutants on European surface and ground water bodies.

Keywords: Highway pollution, surface water, microplastics, risk assessment, mitigation, de-icing, vulnerability scoring system

679 Bridge maintenance, inspection and monitoring: A comprehensive review of research and innovation in Europe

Konstantinos Gkoumas[a]*, Fabio Marques dos Santos[a], Ferenc Pekár[a]

a European Commission, Joint Research Centre (JRC), Via Enrico Fermi 2749, 21027, Ispra (VA), Italy
** konstantinos.gkoumas@ec.europa.eu*

Abstract

Europe's transport infrastructure is of crucial importance to the economic growth of its countries, facilitating mobility and transportation. In this context, bridges are important structures, due to their complexity and safety requirements, since failures can lead to significant human and economic losses. Due to their ageing, they require effective maintenance in order to continue safe operation during the entire life cycle. This paper focuses on a comprehensive analysis of European research and innovation in bridge maintenance, inspection and Structural Health Monitoring (SHM). More than 50 European funded projects are critically assessed for what regards their development level and the possible uptake. The projects span across sensing technology, bridge safety, improvement of maintenance methods, materials and components, periodic manual inspection of the structures, natural or man-made hazards and their impact on bridges. The analyses are integrated with related findings from international research and Intellectual Property application fillings.

Keywords: bridge; maintenance; SHM; research; innovation; knowledge management

681 A Decision Support Tool for strategic asset management of infrastructure on the TEN-T network

Nikola Tanasic[a]*, Julie Clarke[b], Lorcan Connolly[c], Marieke van der Tuin[d], Stephen Wells[e], Luigi Rocco[f], Rade Hajdin[a]

a Infrastructure Management Consultants GmbH, Zürich, Switzerland
b Gavin & Doherty Geosolutions Ltd., Rathfarnham, Dublin 14 D14 X627, Ireland
c Roughan & O'Donovan Ltd., Sandyford, Dublin 16, Ireland.
d Delft University of Technology, Department of Transport & Planning, the Netherlands
e VIRTUS IT, London, United Kingdom
f Network Rail, Milton Keynes, United Kingdom
** nikola.tanasic@imc-de.com*

Abstract

Reliable and proactive asset management is becoming increasingly important for transport infrastructure owners in the face of ageing assets, increasing traffic demand and changing weather patterns due to climate change. Current strategic asset management practice is assisted by various decision support methodologies and tools, but there are certain limitations to existing approaches. The EU-funded SAFE-10-T project is addressing these shortcomings through the development of a Decision Support Tool (DST) for effective and reliable management of bridges, tunnels and earthworks along Europe's TEN-T network. Within the DST, one can evaluate temporal risk of failure of an infrastructure in multi-modal road, rail and inland waterway networks. This paper discusses required input data for this evaluation and the process of data ingestion into the DST. To showcase implementation in asset management practice, the DST is applied to a demo project located in the vicinity of the Port of Rotterdam.

Keywords: asset management; decision support; bridges; tunnels; earthworks; TEN-T network

Full paper:
https://www.dropbox.com/s/ljb4d318e1a97u0/TRA2020_0311019_Tanasic.pdf?dl=0

812 Continuous Road Health Monitoring – How Street View Videos with Computer Vision Improve Safety and Generate Savings for Cities and Road Authorities

Markus Melander[a]*, Iiro Salkari[a], Ilari Pihlajisto[a], Mikko Haavisto[a]

a Vaisala Oyj, P.O. Box 26, FI-00421 Helsinki, Finland
** markus.melander@vaisala.com*

Abstract

Data is needed in road asset management. This paper presents a new approach to road information collection to bring road safety and maintenance related information services to the modern era. Decreasing maintenance budgets and increasing demand to have roads in good condition is not simple equation. For example, the visibility of road signs, potholes and the condition of road markings have never had as much influence to vehicles as today. This raises the question, how to even maintain the current road infrastructure and pavement condition not to mention meeting the future standards and needs. This paper shows how Transport Authorities and Road Operators can increase efficiency and effectiveness of maintenance processes by continuous road health monitoring with computer vision, and how they can simultaneously provide valuable information for connected and autonomous vehicles. We will also discuss where using computer vision is feasible: from a technology perspective it can mimic the human eye in identifying road defects, condition and infrastructure deterioration, and it can directly produce all that information in a digital format.

Keywords: Computer vision, Road health monitoring, Artificial intelligence, Maintenance, ITS

924 The role of numerical tests in assessing road restraint system functionality

Budzynski Marcin[a]*, Jamroz Kazimierz[a], Wilde Krzysztof[a], Witkowski Wojciech[a], Jelinski Lukasz[a], Bruski Dawid[a]

a Gdansk University of Technology, Department of Civil Engineering and Environment, Narutowicza 11/12 Street, 80-233 Gdansk, Poland
** mbudz@pg.edu.pl*

Abstract

Key to understanding the needs and building road infrastructure management tools to prevent and mitigate run-off-road accidents is to identify hazards and their sources which are a result of wrong design, construction, and installation of road restraint systems. Building such tools requires advanced studies with field tests, simulations and models to demonstrate the effects of selected parameters on road user safety. The research work included building numerical models which were validated with crash tests and mathematical models to assess the effects of selected parameters on the safety and functionality of devices. Twenty five field tests were the basis for conducting 670 numerical tests. Preliminary results of numerical tests are also presented looking at selected problems such as barriers on curves, presence of kerbs and obstacles within barrier working width. The methodology will help with an optimal selection of parameters leading to improved safety as regards errant vehicles.

Keywords: road safety; road restraint systems; roadside; numerical tests; crash tests; road infrastructure

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

1001 Reduction of Skid Resistance due to Cumulative Traffic Volume: A case study in Northeast Thailand

Avirut Chinkulkijniwat[a]*, Suksun Horpibulsuk[a]

a Center of Excellence in Innovation for Sustainable Infrastructure Development, School of Civil Engineering, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand
** avirut@sut.ac.th*

Abstract

Skid resistance value (SRV) is an important parameter for road safety concern. In this study, three main types of aggregates typically used in pavements in Thailand, being limestone, granite and basalt were used to make asphalt concrete. The standard dense-grade asphalt concrete mixtures of 9.5 and 12.5 mm maximum aggregate sizes were designed and constructed at the studied sites (12 project sites located in 6 provinces). The SRVs were measured at every 50,000 passenger car unit (pcu) by the British pendulum tester for 3–4 years after the end of construction. Based on the statistical analysis of the test results, the SRV35 decreases as the CTV. Results from statistic test showed that the aggregate type plays an insignificant role on the reduction rate of SRV35. Based on the test results, the SRV at various cumulative traffic volumes can be predicted using an initial SRV (after the end of construction) as prime parameters. The model will be recommended for Thailand asphalt surface when Basalt is main aggregate.

Keywords: skid resistance; asphalt concrete; skid reduction

1075 Effectiveness of blue wildlife warning reflectors for avoiding wildlife accidents on rural roads

Jean Emmanuel Bakaba N.[a]*

a German Insurance Association, Insurers Accident Research, Wilhelmstraße 43/43G, 10117 Berlin, Germany
** e.bakaba@gdv.de*

Abstract

In a study published in 2007 on the effectiveness of white, red and acoustic reflectors, no discernible effect on accidents involving wildlife was ascertained. After this study was published, experts increasingly stated that blue reflectors had a positive impact on wildlife accidents. The new study is the first prospective and randomized crossover study planned, conducted and analyzed to examine the effectiveness of wildlife warning reflectors. On each of the stretches of road in the study, the occurrence of wildlife accidents was recorded both with and without wildlife warning reflectors. In addition, the other question of whether, for example, infrastructural, road space-related, land use-specific or animal-specific parameters can have a significant impact on wildlife accidents was also examined. A reduction in wildlife accidents after wildlife warning reflectors were installed on all stretches of road in the study was neither discernible nor statistically demonstrated. That also applies to each reflector type observed.

Keywords: wildlife accidents; wildlife warning reflectors; accident costs; animal behavior; wildlife crossings; wildlife fencings

Full paper: https://udv.de/en/publications/compact-accident-research/effectiveness-blue-wildlife-warning-reflectors

1.38 Scientific and technical session 38: Waterborne – pushing technology forward

79 Tools and Applications for the Holistic Ship Design

Apostolos Papanikolaou[a]*, Maarten Flikkema[b], Stefan Harries[c], Jochen Marzi[a], Romain Le Néna[d], Sverre Torben[e], Antti Yrjänäinen[f]

a Hamburgische Schiffbau-Vesuchsanstalt, Germany
b MARIN, Netherlands
c Friendship Systems, Germany
d Naval Group, France
e Kongsberg Maritime (frm Rolls-Royce Marine), Norway
f ELOMATIC, Finland
** Papanikolaou@hsva.de*

Abstract

The present paper introduces an innovative, holistic approach to ship design and the development of integrated design software platforms and tools, which are used in practical applications. The paper demonstrates a subset of HOLISHIP's functionality by brief presentations of typical case studies. HOLISHIP is the joint effort of 40† European maritime RTD stakeholders, funded by the Horizon 2020 EU framework. In the era of the 4th industrial revolution, the project sets out to substantially advance ship design by the introduction of a fully computerized, multi-disciplinary optimisation approach to ship design and life-cycle operation. The approach enables the exploration of the huge design space in relatively short time, the distributed/multi-site working and the virtual reality testing, thus it is a strong asset for the development of innovative maritime concepts in response to the needs of the 21st century.

Keywords: Holistic ship design; Multi-criteria optimisation; Design software platform; Life-cycle assessment

Full paper:
https://www.researchgate.net/publication/339390067_Tools_and_Applications_for_the_Holistic_Ship_Design

224 Design and demonstration of an Energy Saving Device for a ship with Controllable Pitch Propeller

Maarten Flikkema[a]*, Bart Goorden[b], Cosimo Cervicato[c], Michiel Verhulst[a], Bart Schuiling[a], Geerhard Janse[a], Anton Voermans[b],Berend de Bot[b], Tom van Terwisga[a], Alberto Portolano[c], Dario Bocchetti[c]

a MARIN, Haagsteeg 2, Wageningen 6709PM, The Netherlands
b Wärtsilä Netherlands, James Wattlaan 23, Drunen 5151DP, The Netherlands
c Grimaldi, Via Marchese Campodisola,13 80133 Naples, Italy
** M.Flikkema@marin.nl*

Abstract

Energy Saving Devices (ESDs) can be retrofitted to ships to influence the hull – propeller interaction, improving the performance. ESDs were studied in FP 7 project GRIP for ships with Fixed Pitch Propellers (FPPs). In Horizon 2020 project LeanShips partners MARIN, Wärtsilä and Grimaldi studied ESDs for ships with Controllable Pitch Propellers (CPP). Using numerical simulations, a Pre Swirl Stator (PSS) was

designed. Model tests confirmed the performance improvement. Dedicated speed trials before and after installation of the ESD on a car carrier were done. Based on the combined set of simulations, model test results and full scale trials it can be concluded that the performance improvement due to the ESD is up to 3.8% at 16 knots and 2.4% at 19 knots. A payback period of 1.3 years was calculated if the ESD is installed during a scheduled dry docking. MARIN and Wärtsilä have shown the possibility to numerically predict the performance of an ESD with acceptable accuracy.

Keywords: Horizon 2020, Energy Saving Device, Controllable Pitch Propeller, Energy Efficiency, Fuel Saving, Car Carrier

Full paper: https://www.marin.nl/design-and-demonstration-of-an-energy-saving-device-for-a-ship-with-controllable-pitch-propeller

241 Efficiency-boosting Phase Change Material (PCM) based Energy Storage for Marine Environments

Loic de Francqueville[a]*, Alexander Sukhaseum[b], Nicolas de Guyenro[a]

a Hutchinson Research and Innovation Center, Rue Gustave Nourry, 45120 Chalette sur Loing, France.
b Hutchinson AVS, 61 Rue Marius Aufan, 92309 Levallois-Perret Cedex, France
** loic.de-francqueville@hutchinson.com*

Abstract

On-board a ship, there is a need for hot utilities such as hot water for showers, cabin heating, etc.. Part of this heat is already harvested at the engine exhaust. However, the balance between heat availability and demand is seldom well-fitted. An energy storage system (ESS) would enable optimizing energy usage. This is what was developed in the European-funded LEANSHIPS project. Heat storage is based on phase change material (PCM), to store energy under phase change latent heat. As compared to sensible heat, it enables much higher energy density. An ESS demonstrator was designed, manufactured and tested. Heat can be stored up to 175°C using a 170L tank filled with 152°C PCM balls. Heat charge and discharge performances are fully compatible with a daily usage. Very performant insulation was demonstrated so that energy losses can be minimized (13% heat losses in 12h).

Keywords: energy; heat; storage; PCM; ship; efficiency

595 Demonstrating the use of advanced materials and rethinking the innovation process in shipbuilding – Results of the RAMSSES project

Matthias Krause[a]*, Stéphane Paboeuf[b], Arnold de Bruijn[c], Marcel Elenbaas[d], Dirk Büchler[e], Patrice Vinot[f]

a Center of Maritime Technologies e. V. (CMT), Bramfelder Straße 164, 22305 Hamburg, Germany
b Bureau Veritas Marine & Offshore, 8 boulevard Albert Einstein, 44323 Nantes (BV), France
c Netherlands Maritime Technology, Boompjes 40, 3011 XB Rotterdam (NMT), The Netherlands
d Damen Schelde Naval Shipbuilding, De Willem Ruysstraat 99, 4381 NK Vlissingen (DSNS), The Netherlands
e BaltiCo GmbH,Bützower Str. 1d, Hohen Luckow, Germany
f Naval Group, rue de l'Halbrane, Bouguenais, France
** krause@cmt-net.org*

Abstract

Complicated and expensive approval processes as well as the challenge to efficiently combine new materials and processes with conventional ones are among the main reasons why the benefits of advanced (e.g. lightweight) materials have been exploited to a limited extent till now. The RAMSSES project aims to help overcoming existing barriers. Thirteen demonstrators, driven by industry, are developed, following today's approval methods, and built, aiming towards successful market entry. Various materials, ship types, application areas, and deployment strategies are covered. The demonstration includes the manufacturing of physical structures as well as the development of efficient approval processes which are required during production and other phases of products' lives. Assessment is done to show that regulatory and customer requirements are met. Next to intermediate results from several demonstrators, the paper at hand discusses a set of measures to enhance material innovation in the maritime industry, including a 'smart track to approval'.

Keywords: Material innovation; Shipbuilding; Rules and regulations; Life Cycle Performance Assessment; Composite materials; Ship equipment

Full paper:
https://www.researchgate.net/publication/339827592_Demonstrating_the_use_of_advanced_materials_and_rethinking_the_innovation_process_in_shipbuilding_-_Results_of_the_RAMSSES_project

655 Evaluating the performance of the vessel train concept

H. Meersman[a], E. Moschouli[a]*, C. Sys[a], L. NanwayBoukani[a], E. van Hassel[a], T. Vanelslander[a], E. Van de Voorde[a]

a University of Antwerp, Department of Transport and Regional Economics, Prinsstraat 13, Antwerp, 2000, Belgium
** eleni.moschouli@uantwerpen.be*

Abstract

To improve safety and address current employment challenges in the waterborne transport sector, the VT concept is developed. The VT is a vessel platooning concept that is semi-autonomous and is composed by one Leader Vessel and Follower Vessels that will be connected with each other with sensors. The research examines from a business-economic and societal perspective, whether it is interesting to invest in and use the VT, instead of sailing with a conventional vessel. The business-economic performance of the VT is tested from the perspective of the vessel owner (VO) for the inland navigation trajectory Antwerp – Rotterdam – Duisburg, using a relevant transport model. From a societal perspective, the expected modal shift from road (and possibly rail) to inland waterways and the external cost savings for the society are calculated. If all the actors of the VT project have benefits, the implementation of the VT concept will be decided.

Keywords: vessel train; platooning; semi-autonomous sailing; business-economic performance; societal performance; project evaluation; inland navigation

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

713 Designing a remote-pilotage system: work styles to be considered

Tuisku Salonen[a]*, Mikael Wahlström[a], Hannu Karvonen[a]

a VTT Technical Research Centre of Finland Ltd., Finland
** tuisku.salonen@vtt.fi*

Abstract

Remote pilotage, i.e., helping a vessel to harbour somewhere else than aboard the vessel, is now legally possible on the Finnish shipping fairways. A pilot's official role is to be an advisor to the ship's captain, who, with the crew on board, actively handles the ship and takes responsibility. However, it seems that in many practical cases, the pilot takes the lead and the ship's captain adopts a more passive and submissive work style. This departure from the official practice should be taken into account in the design of a user-centered and safe remote-pilotage solution. Especially for a captain with a submissive work style, a remote-pilotage solution could turn out to be a challenge.

Keywords: Remote-pilotage; Work styles; Maritime safety; User-centered design; Safety-critical work

Full paper:
https://www.researchgate.net/publication/339875331_Designing_a_remote-pilotage_system_work_styles_to_be_considered

816 WATERBORNE: Safe, competitive and eco-friendly shipyards and production sites

Hermann-Josef Mammes[a]*

a Meyer WerftGmbH & Co. KG
** hermann-josef.mammes@meyerwerft.de*

Abstract

The Waterborne sector in Europe is well-developed, diversified and cross-cultural. It is called to tackle societal needs and to adopt emerging technologies will determine the world of tomorrow and the life of future generations. One of the societal challenges to meet is the establishment of an entire production chain of safe, competitive and eco-friendly shipyards and production sites. In this paper, we will explain the impact shipping has on the environment, and present a synthesis of the analysis done by the WATERBORNE stakeholders on safe, competitive and eco-friendly production sites.

Keywords: Waterborne transport; innovation; sustainability; save; eco-friendly; production

902 Some new insights towards goal-based design of Arctic ships

Martin Bergström[a]*, Sabina Idrissova[a], Shamaei Farhang[a], Juri Huuhtanen[a], Fang Li[a], Spyros Hirdaris[a], Baoyu Ni[b], Pentti Kujala[a]

a Aalto University, School of Engineering, Tietotie 1, Espoo 02150, Finland
b Harbin Engineering University, College of Shipbuilding Engineering, No. 145 Nantong St, Harbin, 150001, China
** martin.bergstrom@aalto.fi*

Abstract

Maritime activity in the Arctic is on the increase, driven by the extraction of Arctic natural resources, trans-Arctic shipping, and Arctic tourism. To manage related risks to humans and the polar environment, in January 2017 the International Maritime Organization (IMO) enforced the international code for ships operating in polar waters (Polar Code). The code is fundamentally goal-based, allowing designers to deviate from established prescriptive rules, facilitating design optimization and innovation. However, for designers to be able to implement goal-based regulations, they need relevant and validated design tools. Toward this end, we discuss new insights of relevance on two related topics, namely (a) the assessment of ice loading on ships, and (b) risk assessment in Arctic shipping.

Keywords: Arctic shipping; Goal-based standards, Ship design; Polar Code

970 New, Advanced And Value-Added Innovative Ships - A New Generation of Platform Based Modular Ships

Jorinus Kalis[a]*, Jaap Gebraad[b]

a Damen Shipyards, PO Box 1, 4202AA Gorinchem, The Netherlands
b SEAEUROPE, Rue de la Loi 67, 1000 Brussels, Belgium
** Jorinus.kalis@damen.com*

Abstract

The European maritime technology sector generates an annual turnover of €112.5 billion and creates more than 500,000 direct jobs and more than 400,000 indirect jobs, primarily for European citizens. However, worldwide competition is fierce, and in order to maintain world-leadership in complex, value-added and highly specialised vessels European shipbuilders must develop innovative concepts that are efficient to design and build. NAVAIS develops a platform-based modular product family approach supported by the 3DEXPERIENCE® platform. This concept will increase efficiency in vessel design and flexibility in production networks. NAVAIS focusses on passenger & road ferries and multi-use workboats integrating sustainability in the design of the ships. Key results of the NAVAIS concept are expected to include 30 % higher efficiency in the complete chain from ship design development, production lead-times and cost, testing and approval times for customised vessels and in reduction of rework during the warranty period.

Keywords: ship design; ship building; modularity; product platform; environmental impact reduction

985 Smart Tanker Shipping supported by STM BALT SAFE

Johannes Hüffmeier[a]*, Ulf Siwe[b], George Psarros[c], Luis Sanchez-Heres[a]

a RISE Research Institutes of Sweden, Gibraltargatan 35, Gothenburg 412 79, Sweden
b Swedish Maritime Administration (Sjöfartsverket), Östra Promenaden 7, Norrköping 601 78, Sweden
c DNV GL AS, Veritasveien 1, Høvik 1363, Norway
** johannes.huffmeier@ri.se*

Abstract

The sensitive Baltic Sea region has one of the highest shipping intensities in the world. There are many tanker ships and crossing traffic of passenger ships and narrow passages. shipping accidents happen and may in the worst-case scenario have an extreme impact on the environment. Measures in the field of safety of navigation are needed to reduce accident risks. There is a need to improve the exchange of information between ships and between ships and shore for increased situational awareness and as a catalyst for improved safety of navigation, optimized capacity utilization and just-in-time operations. The project objectives covered are

to improve the safety, efficiency and reduce the environemntal impact of navigation of the tanker shipping segment in the Baltic through STM services.

Keywords: Sea Traffic Management; Route Optimization and Exchange; Safety; Tanker Traffic; Information sharing; Smart Shipping; Tankers; Baltic Sea; STM Services

Full paper:
https://www.researchgate.net/publication/339874906_Smart_Tanker_Shipping_supported_by_STM_BALT_SAFE

996 Impacts of standardized information sharing on maritime safety, efficiency and environment - STM Validation results

Ulf Siwe[a]*, Emelie Tingström[a], José Giménez[b], Lucía Calabria[b], Jorge Lara[b]

a Swedish Maritime Administration, 601 78 Norrköping, Sweden
b Fundación Valenciaport, Avinguda Moll del Turia, s/n, 46024 Valencia, Spain
** ulf.siwe@sjofartsverket.se*

Abstract

Sea Traffic Management, STM, is creating a new paradigm for maritime information sharing, offering tomorrow´s digital infrastructure for shipping. STM is the concept of information sharing in real time, through a secure infrastructure, with standards that create interoperability among various actors such as ships, manufacturers and port actors, allowing information holders to retain own their valuable data and choosing those with whom they wish to share it. The STM Validation project has validated the infrastructure, software and services on 300 ships, in 9 ports and in 5 shore centres. The results of the validation and the identified potentials and challenges are described. Improvements in safety, efficiency and reduction in environmental impact are discussed. The key building blocks for the STM success are triple-helix cooperation, open standards, long-term support from EU, relentless dissemination and flexibility to adopt new developments on digital transformation.

Keywords: digitalization; maritime; safety; efficiency; environment; collaboration

Full paper: https://s3-eu-west-1.amazonaws.com/stm-stmvalidation/uploads/20200313115701/TRA2020_PaperSTM-general-update-Nov-3.pdf

1004 STM Validation Project: Estimating the financial and social impact on safety, efficiency and environmental sustainability

Jorge M. Lara López[a]*, Amparo Mestre[a], Lucía Calabria[a], Julián Martínez[a]

a Fundación Valenciaport, Avinguda Moll del Turia, s/m 46024 Valencia, Spain
** jlara@fundacion.valenciaport.com*

Abstract

The shipping industry is constantly looking for sustainable alternatives to reduce its carbon footprint as well as to decrease accidents and incidents at sea. STM Validation Project proposes to push the maritime industry towards more collaborative and digitalised operational environments; enabling the transition of the sector to the "Industry 4.0" paradigm, where digital and real time connectivity is the driver for increasing efficiency, safety and environmental sustainability. The implemented maritime and port services have been analysed in depth in large-scale test-beds that have been carried out during the project and they have facilitated the basis of calculation of the Cost Benefit Analysis. The goals of the project have

been deeply analysed in terms of social impact through the estimation of externalities as well as the increase of port calls and their potential growth of freight traffic associated for both port terminals and Port Authorities thanks to the efficiency gains.

Keywords: Sustainability; digital technologies; emission reduction; safety; ports; investments

Full paper: https://s3-eu-west-1.amazonaws.com/stm-stmvalidation/uploads/20200313114100/STM-Validation-Project-Estimating-the-financial-and-social-impact-on-safety-efficiency-and-environmental-sustainability.pdf

1044 Interreg Central Baltic EfficientFlow project as a digital STM solution for improving information exchange between ships, ports and hinterland actors

Olena de Andres Gonzalez[a], Heikki Koivisto[b]*, Magnus Sundström[c], Minna M. Keinänen-Toivola[d], Ulf Siwe[e], Jari Mustonen[f], Anders Berg[g]

a Satakunta University of Applied Sciences, Satakunnankatu 23, Pori FI-28130, Finland
b Satakunta University of Applied SciencesSuojantie 2, Rauma FI- 26100, Finland
c Swedish Maritime Administration, Kommendantvägen 60, Norrköping SE-60238, Sweden
d Satakunta University of Applied Sciences, Suojantie 2, Rauma FI-26100, Finland
e Swedish Maritime Administration, Kommendantvägen 60, Norrköping SE-60238, Sweden
f Satakunta University of Applied Sciences, Satakunnankatu 23, Pori FI-28130, Finland
g Swedish Maritime Administration, Kommendantvägen 60, Norrköping SE-60238, Sweden
** heikki.koivisto@samk.fi*

Abstract

Efficient transport solutions play an important role for the Baltic Sea region. The management of the vessel traffic in the fairways of the area is currently done mainly by voice communication. Any unexpected event or situation inevitably cause delays and increased waiting times. Automated information exchange between ships and shore centers by introduction of new ICT tools will ensure efficient traffic flow and enhance safety of vessel traffic. Sea Traffic Management (STM) is a possible answer to the need for improved efficiency in maritime transport and will be tested between ports in Sweden and Finland. The implementing of STM will provide optimizing of the processes, interaction between stakeholders and exchange of information. New Ship and Port ICT application will connect hinterlands and ports to sea traffic and will be tested in ports of Gävle and Rauma within EfficientFlow project during 2018-2020 years.

Keywords: shipping; information exchange; sea traffic management; maritime logistics; safety

Full paper: https://s3-eu-west-1.amazonaws.com/stm-stmvalidation/uploads/20200313114059/TRA2020_031119_de_Andres_Gonzalez.pdf

1.39 Scientific and technical session 39: Exploring shipping and maritime operations

245 The Effects of Automating Navigation on the Economic Viability of a Short Sea Platooning

A. Colling[a]*, C. Kooij[a], R. Hekkenberg[a]

a Delft University of Technology, Mekelweg 2, Delft, 2628CD, The Netherlands
** a.p.colling@tudelft.nl*

Abstract

The Vessel Train, a concept based on the platooning principle, is composed of a fully manned lead vessel and a number of follower vessels. The lead vessel takes over the navigational and situational awareness responsibilities for the follower vessels. This enables automation of the navigational tasks on these follower vessels, which in turn leads to a potential to reduce their crew size and associated cost. This paper uses a crew analysis algorithm to estimate the crew cost reduction that is caused by elimination of navigational tasks on follower vessels. The costs created by different types of lead vessels and the costs created through the implementation of the vessel train technology on the follower vessels are compared to the savings achieved through the crew reduction to enable an assessment of the vessel train concept's economic viability.

Keywords: Vessel Train; Semi-Autonomous Sailing, Crew Task

Full paper:
https://www.researchgate.net/publication/339400892_The_Effects_of_Automating_Navigation_on_the_Economic_Viability_of_Short_Sea_Platooning

260 The HyMethShip Concept: An investigation of system design choices and vessel operation characteristics influence on life cycle performance

Elin Malmgren[a]*, Selma Brynolf[a], Martin Borgh[b], Joanne Ellis[b], Maria Grahn[a], Nicole Wermuth[c]

a Department of Mechanics and Maritime Sciences, Maritime Environmental Sciences, Chalmers University of Technology, Campus Lindholmen, SE-412 96 Göteborg, Sweden
b SSPA Sweden AB, Chalmers Tvärgata 10, SE-400 22 Göteborg, Sweden
c LEC GmbH, Inffeldgasse 21, 8010 Graz, Austria
** elin.malmgren@chalmers.se*

Abstract

One potential method to decarbonize the maritime transport sector is by using onboard carbon capture technologies. One such potential future propulsion system is the "HyMethShip - Hydrogen-Methanol Ship propulsion system using onboard pre-combustion carbon capture" concept. In this study we use life cycle assessment to analyse the impact of system design choices on the overall environmental performance of the system. Using the HyMethShip on a vessel is shown to lower climate impact compared to today's conventional propulsion technologies. The runtime of the carbon capture system and hydrogen leakage are indicated as the main influencers to the environmental performance besides overall system efficiency. The cost of the HyMethShip system is higher than today's liquid fossil fuel options, but lower than when electro-methanol is used in a conventional engine without applying the HyMethShip concept.

Keywords: alternative fuels; carbon utilization; hydrogen; methanol; emission reduction; shipping

Full paper:
https://graz.pure.elsevier.com/files/27259874/Malmgren_et_al_TRA2020.pdf

263 Ship departure time estimation and data sharing practices in Finnish ports

Janne Saarikoski[a], Maria Hänninen[a]*, Eeva Aarnio[b]

a Kotka Maritime Research Association, Keskuskatu 10, 48100 Kotka, Finland
b Haaga-Helia University of Applied Sciences, Ratapihantie 13, 00520 Helsinki, Finland
** maria.hanninen@merikotka.fi*

Abstract

In ship port calls, cost efficiency and minimum duration are important. For that, port actors need up-to-date information on the ship's readiness to sail. The paper focuses on the availability and quality of the ship's estimated time of departure (ETD) information. Based on interviews, a workshop, port information systems and channels observations and regulation analysis, paper studies how the ETD in Finnish ports is generated and how the information flows to its users. The results show that ship clearance process is the key to the official ETD formation. Agent enters ETD into Portnet system, which automatically distributes it to several open channels. However, Portnet does not support updating the ETD or presenting its uncertainty. Port actors follow different media and typically combine a situational awareness spreadsheet for themselves. That requires manual work and poses a risk of "multiple truths". Thus, ETD data sharing should be automated instead of manual processing.

Keywords: maritime traffic; port call; estimated time of departure; data sharing; Portnet

Full paper: https://www.merikotka.fi/wp-content/uploads/2020/02/TRA2020_Saarikoski_final.pdf

275 A fuel cell power unit and hydrogen storage for the research vessel Aranda

Antti Pohjoranta[a]*, Jari Ihonen[a], Fredrik Tommola[a], Uwe Hannesen[b], Mikko Kajava[c], Filip Turcer[c], Silvia Ferrara[d], Henri Karimäki[e], Laurence Grand-Clément[f], Jukka Pajala[g]

a VTT Technical Research Centre of Finland, Tietotie 4C, Espoo, 02150, Finland
b Swiss Hydrogen, Passage du Cardinal 1, CH-1700 Fribourg, Switzerland
c ABB, Merenkulkijankatu 1, Helsinki, 00980, Finland
d OMB Saleri, 38c Rose di Sotto, 25126, Brescia, Italy
e PowerCell Sweden, Ruskvädersgatan 12, SE-418 34, Gothenburg, Sweden
f PersEE, 83 rue Pierre Corneille, Lyon, FR-69003, France
g Finnish Environment Institute, Latokartanonkaari 11, 00790 Helsinki, Finland
** antti.pohjoranta@vtt.fi*

Abstract

The development and technical aspects of a hydrogen fuel cell power system and accompanying hydrogen fuel storage intended for maritime applications is presented. The fuel cells are proton exchange membrane (PEM) type and the power unit has a nominal net AC power output of 165 kW. The hydrogen storage capacity is ca. 80 kg, at a designed 300 bar maximum storage working pressure. For development, testing and safety reasons the fuel cell power system, the related electrical equipment and the hydrogen storage are constructed in a modular fashion, into two modified sea containers with dedicated compartments for each of these three functions. The system is tested both on land as well as on-board the research vessel Aranda, while operating on the Baltic Sea.

Keywords: maritime fuel cell applications; hydrogen; fuel cells; zero-emission shipping; low-noise energy source

Full paper: https://cris.vtt.fi/en/publications/a-fuel-cell-power-unit-and-hydrogen-storage-for-the-research-vess

609 Interoperability of IoT platforms in the port sector

Pablo Giménez[a]*, Miguel Llop[a], Eneko Olivares[b], Carlos E. Palau[b], Miguel Montesinos[c], Miguel A. Llorente[c]

a Valenciaport Foundation, Sede APV - Fase III – Av. del Muelle del Turia s/n, Valencia 46024, Spain
b Universitat Politècnica de València, Camino de vera s/n, Valencia 46022, Spain
c Prodevelop, Plaza Juan de Villarrasa 14-5, 46001 Valencia, Spain
** pgimenez@fundacion.valenciaport.com*

Abstract

International freight transport involves many different public and private companies such as ports, terminals, hauliers companies, shipping lines, freight forwarders, customs, etc. and requires the exchange of documentation and data between them. However, this task is not always easy due to these companies are not able to exchange data easily. Furthermore, in the last years several devices and sensors have emerged that are providing data about all kinds of objects including transport and logistics assets (infrastructure, vehicles, cranes and handling equipment, transport units, etc.). This paper presents INTER-IoT, a framework to provide interoperability of heterogeneous IoT platforms at different layers. This solution was demonstrated in the port and logistic domain with a pilot in the port of Valencia. There were three scenarios focused on access control and traffic, dynamic lighting, and wind gusts detection. In these scenarios, we showed the benefits of exchanging data among IoT platforms from different companies.

Keywords: Internet of Things; IoT; port logistics; interoperability; INTER-IoT

Full paper:
https://www.researchgate.net/publication/339883632_Interoperability_of_IoT_platforms_in_the_port_sector

682 A Day in the life of a Vessel Train – Exploring the Concept

A. Colling[a]*, R. Hekkenberg[a]

a Delft University of Technology, Mekelweg 2, Delft, 2628CD, The Netherlands
** a.p.colling@tudelft.nl*

Abstract

The Vessel Train (VT) is a waterborne transport concept that makes use of the platooning principle. This article aims to provide a picture of a possible practical application, as well as to convey the multifaceted complexity the VT concept development entails. It shadows a trip of a follower vessel that joins into a VT and describes a possible daily routine for the inland sector. The story-line allows to elaborate on changes in the operational tasks as a result of the implementation of a VT. These changes are then further commented upon to provide an awareness of the benefits and challenges that will need to be resolved, in order to allow the VT to be an economically viable transport solution.

Keywords: Vessel Train; Waterborne Platooning

Full paper:
https://www.researchgate.net/publication/339447776_A_Day_in_the_life_of_a_Vessel_Train_-Exploring_the_Concept

717 Models to evaluate container transhipment ports in the Mediterranean Sea

Elen Twrdy[a]*, Milan Batista[a]

a University of Ljubljana, Faculty of maritime studies and transport, Pot pomorščakov 4, SI 6320 – Portorož, Slovenia
** elen.twrdy@fpp.uni-lj.si*

Abstract

Ports in the Mediterranean Sea (Med) have a good geographical position as they are located on the main shipping lines between the Far East and Europe. Ports are the "nerve" centre of the global supply chain and they are more than just the interface between the maritime and land transport. They are complex systems, made up of scores of companies and authorities all with different tasks, therefore, it is important to know the position of each port on the market and what the future developments are. This is the only way ports can adjust their investment plans. This article presents models to evaluate container transhipment ports in the Mediterranean Sea. The models are prepared based on available containers transhipment data and they describe the dynamic of container throughput in selected Med transhipment ports.

Keywords: port; transhipment; hub; containers; Mediterranean Sea

800 Modelling port operations towards environmental impact reduction: The PIXEL IoT infrastructure and models

Miguel A. Llorente[a]*, Miguel Montesinos[a], Ignacio Lacalle[b], Carlos Palau[b], Aristos Halatsis[c], Annie Kortsari[c], Joao Pita Costa[d], Flavio Fuart[d], Charles Garnier[e], Erwan Simon[e]

a Prodevelop, Plaza Don Juan de Villarrasa 14-5, Valencia 46001, Spain
b Universidad Politécnica de Valencia, Cami de Vera S/N, Valencia 46022, Spain
c Hellenic Institute of Transport, Centre for Research & Technology, Hellas, 6th Km Charilaou-Thermi Rd, Thessaloniki 57001, Greece
d XLAB, Pot za Brdom 100 Ljubljana SI-1000, Slovenia
e Centre Aquitain des Technologies de l'Information et Electroniques 1 Avenue du Dr Albert Schweitzer, 33400 Talence, France
** mllorente@prodevelop.es*

Abstract

With the constant growth of maritime traffic, port infrastructures have become more complex, with a clear influence on operations efficiency and their associated environmental impact. While the biggest ports have strict regulations and great investments to tackle the consequences of their activities in the natural spaces they occupy and the adjacent cities, the smaller ports keep being forgotten in public policies and funding programs, preventing efficient combat of the negative environmental impact. This leads small and medium ports to search for cost-efficient strategies to control and prevent their negative impact, while at the same time they improve their productivity to keep competitiveness against bigger ports. The H2020 PIXEL project proposes a novel approach to model and simulate port processes, employing algorithms to perform meaningful predictions over key parameters to improve port efficiency and reduce environmental impact by leveraging a novel IoT infrastructure.

Keywords: environment; IoT; modelling; simulation; algorithms; architecture; environmental impact; carbon footprint; port of the future

1026 VESSL as a tool for macro-analyses at European level. STM Validation Project results calculated by the use of Short Sea Shipping data mining

Jorge M. Lara López[a]*, Lucía Calabria[a], Mark Tanner[a], Julián Martínez[a], José Andrés Giménez[a]

a Fundación Valenciaport, Avinguda Moll del Turia, s/m 46024 Valencia, Spain
** jlara@fundacion.valenciaport.com*

Abstract

Shipping companies are constantly updating their ships' schedules to move cargo from shippers to end customers. The fuel consumption and GHG emissions of ships passing through European waters has always been an important metric to analyse. STM Validation Project proposes a scenario where ship-to-port communications would allow synchronizing port calls in a more efficient way, saving time at ports and allowing a more rational navigation. One of the objectives of the project has been to assess the impact of the implementation of the services at European level. For this purpose, the VESSL tool is able to extrapolate the main results obtained in the project to ships operating Short Sea Shipping and national cabotage lines from the main core and comprehensive ports of the European Union. This tool also contributes to another type of analyses for several projects where the real impact on the sector is measured from accuracy and reliability.

Keywords: Transport economics; Ports; Trans-European Networks, Externalities; Impact assessment; Big data

Full paper: https://s3-eu-west-1.amazonaws.com/stm-stmvalidation/uploads/20200313114101/VESSL-as-a-tool-for-macro-analyses-at-European-level.-STM-Validation-Project-results-calculated-by-the-use-of-Short-Sea-Shipping-data-mining.pdf

1031 Shaping the future port choices: a support tool

Hilda Ghiara[a], Nicola Sacco[a]*, Alessio Tei[b]

a University of Genoa, 17100, Genova, Italy
b Newcastle University, Newcastle Upon Tyne, United Kingdom
** nicola.sacco@unige.it*

Abstract

The modern port sector is characterized by complex decisions that affect the port environment and competitiveness for decades. Despite this, the decision-making process is often characterized by a lack of complete information among potential alternative solutions and on their differentiated impacts. This lack of information is often causing difficulties in developing effective decisions or to include consistent KPIs to compare different initiatives that might achieve similar goals. The proposed research discusses the potential implementation of a decision support system capable of providing a homogenized comparison among different projects. The envisioned system will therefore assist port stakeholders to optimize their decision-making process as well as to consider multidimensional objective functions that will allow those stakeholders to better evaluate the effects of different strategic choices.

Keywords: Decision Support Systems, Port of the Future, Port Development

1056 FIBRESHIP project: Engineering, production and life cycle management for the complete construction of large length fibre-based ships.

Alfonso Jurado[a]*, Cristobal Garcia[a], Eduardo Sanchez[a], Publio Beltran[a]

a Técnicas y Servicios de la Ingeneria TSI S.L., Av. de Pío XII, 44 Bajo Izq., Madrid, Spain
** alfonso.jurado@tsisl.es*

Abstract

Fibre-Reinforced Polymer (FRP) materials are widely used in the construction of small-length vessels due to their light weight and high strength to weight ratio. However, the use of FRP materials in vessels above 50 m length is only allowed to secondary structural elements of the vessel. Hence, it is necessary to promote the creation of new regulatory frameworks to permit the construction of large-length vessels using composite laminates in all parts of the vessel structure to enable the development of this interesting technology for the reduction of weight. FIBRESHIP proposes to create a new market focused on the construction of large-length vessels based uniquely on lightweight composites. The results of this project are attracting considerable interest within the shipping industry as the extensive use of FRP materials in large-length vessels induces an important reduction of the weight with respect to the conventional steel ships. This significant weight reduction decreases the vessel bunkering consumption, increases the payload cargo capacity, and avoids the corrosion phenomena in the vessel among other identified benefits.

Keywords: Composites; FEM; Structural Health Monitoring; Guidelines, Fire resistance; Regulation; Lightweight vessels

1117 Integration of Model-Based Systems Engineering tools in the holistic ship design framework

Georgopoulou Chariklia[a]*, Dimopoulos George[a], Koukoulopoulos Eleftherios[a], van Vugt Hans[b], Macedo Paulo[c], Torben Sverre Rye[c]

a DNV GL, Piraeus, Greece
b TNO-SD, Delft , Netherlands
c Kongsberg Maritime, Ålesund, Norway
** chara.georgopoulou@dnvgl.com*

Abstract

Modern design procedures in maritime transportation are faced by multiple challenges related to technical and operational constraints for safety, energy efficiency, cost effectiveness and environmental performance. These requirements, in combination with a wide range of machinery technologies, result in a complex landscape of solutions which can be successfully explored using Model-Based Systems Engineering (MBSE) approaches. Integrating MBSE tools in the ship design cycle is a complex task that requires specification of the interface between distinct design phases, the identification of parameters to be exchanged and the selection of appropriate protocols to arrive at an automated process. Managing these connections becomes a complex process. In the ECfunded research project HOLISHIP (Horizon 2020), these problems were successfully tackled aiming at the holistic, multi-objective, multi-disciplinary and multi-fidelity optimization of ship design, operation and retrofitting. This paper describes the integration methods and communication protocols used for connecting various MBSE tools within Holiship.

Keywords: Model-Based Systems Engineering; ship machinery modelling and simulation; holistic ship design

1176 When would moderation of ice conditions along the Northern Sea Route trigger serious investment in Polar Code shipping capacity?

Adriaan Perrels[a]*, Timo Vihma[a], Andrea Gierisch[a,b], Jean Baptiste Bernard[c], Tuukka Rautio[a], Dmitry Kovalevsky[d]

a Finnish Meteorological Institute, P.O. Box 503, 00101 Helsinki, Finland
b since 2019 in Danish Meteorological Institute, Lyngbyvej 100, 2100 Copenhagen, Denmark
c Ecole Nationale de Meteorologue, Toulouse, France
d German Climate Services Centre, Fischertwiete 1, 20095 Hamburg, Germany
** adriaan.perrels@fmi.fi*

Abstract

Arctic sea ice retreat is expected to widen the average late summer and autumn window of navigability of the Northern Sea Route (NSR). However, the impacts on navigation are complicated by the large inter-annual and spatial variability and limited predictability of ice conditions along the NSR. Major investments in Polar Code ships is likely to pick up only if the expected value of the benefits of the shorter passage time of the NSR is good enough compared to the extra investment and operational cost of Polar Code ships. However, in that case it is still unclear what would be the most beneficial level of reinforcement (Polar Code class) given the various uncertainties. The proposed paper will deal both with the ice condition prospects and the translation into benefits in trip duration and eventual net exploitation advantages or disadvantages of Polar Code ships as compared to standard ocean going ships.

Keywords: Arctic Sea Ice, Northern Sea Route, Polar Code ships

Full paper:
https://www.researchgate.net/publication/339883296_When_would_moderation_of_ice_conditions_along_the_Northern_Sea_Route_trigger_serious_investment_in_Polar_Code_shipping_capacity

1.40 Scientific and technical session 40: Drivers' and humans' behaviour and their environment

85 Modeling driver behavior in interactions with other road users

Prateek Thalya[a,b]*, Jordanka Kovaceva[a], Alessia Knauss[b], Nils Lubbe[c], Marco Dozza[a]

a Mechanics and Maritime Sciences, Chalmers University of Technology, Sweden,
b Veoneer Research, Veoneer Sweden AB, Vårgårda, Sweden,
c Autoliv Research, Vårgårda, Sweden
** prateek.thalya@veoneer.com*

Abstract

Driver models help improve and evaluate systems for road crash mitigation and avoidance. As systems develop and address increasingly complex scenarios. Driver models also need to be developed to be able to account for the interactions among these road users. Even as we improve driver modeling with control-theory models and actual data-driven implementations, existing driver models fail to sufficiently take interaction among road users into consideration. This paper addresses this insufficiency by proposing a new operational framework to computationally model interactions among road users. For this purpose, we introduce a definition for interaction among road users. The modeling framework is demonstrated by a specific driving scenario: the overtaking of a cyclist when an oncoming vehicle may be present. In this scenario, modeling driver interaction using Unified modeling

language within our framework can lead to improved crash mitigation and avoidance through tailored system activation of automated emergency braking.

Keywords: Driver modeling; road-user interaction; advanced driver-assistance systems; autonomous emergency braking; overtaking

Full paper: https://doi.org/10.31234/osf.io/wu4z9

216 Correlation of driver behaviour and fuel consumption using data from smartphones

Evanthia Michelaraki[a], Armira Kontaxi[a]*, Panagiotis Papantoniou[a], George Yannis[a]

a National Technical University of Athens, Department of Transportation Planning and Engineering, 5 Heroon Polytechniou str., GR-15773, Athens, Greece
** akontaxi@mail.ntua.gr*

Abstract

This research aims to investigate the correlation of driver behaviour and fuel consumption using data from smartphones. To achieve this objective, data collected from 17 drivers who participated in a naturalistic driving experiment for four months in Greece, are analyzed. During the first two months, participants drove in the way they usually did and over the following two months they were asked to improve their driving style. Statistical analyses were carried out using linear and lognormal regression models, which examined whether driving characteristics such as speed, harsh accelerations, harsh braking, smartphone usage affect and can therefore predict fuel consumption. The results substantiate that there is a remarkable reduction in fuel consumption, as the participants improved their driving behaviour. A stronger correlation has emerged between harsh accelerations and fuel consumption, but also speed and braking had a direct impact on fuel consumption.

Keywords: driver behaviour; fuel consumption; before-after; eco-driving; naturalistic driving experiment; lognormal regression

246 Drowsiness analysis under driving simulation monitoring

Sónia Soares[a]*, Sara Ferreira[a], António Couto[a]

a Faculty of Engineering of the University of Porto, Rua Dr Roberto Frias, 4200-465 Porto, Portugal
** soniasoares@fe.up.pt*

Abstract

Drowsy drivers lead to a high number of crashes with invaluable costs to society. Studies have demonstrated that sleepiness induces drivers to produce systematic errors, which can be detectable through adequate monitoring systems. In this context, a Portuguese project is running to study drowsiness under a simulated environment. A literature review was conducted in order to gain knowledge concerning drowsiness detection, evolution and its effects on driving performance. This review was fundamental to guide the design of the simulator experiments that sustained the research. Following this, each experiment comprehends a 75-minute driving session on the driving simulator DriS, under controlled conditions. Additionally, biometric parameters of the driver were monitored and subjective and driving dynamic measures were assessed. In the end, a great data volume was collected and different statistical technics are being applied in order to support the development of algorithms capable to improve the technologies dedicated to warning systems.

Keywords: road safety; driving simulation; driver behaviour; drowsiness

280 Effectiveness evaluation of section speed control in Czech motorway work zones

Jiří Ambros[a]*, Richard Turek[a], Jan Elgner[a], Zuzana Křivánková[a], Veronika Valentová[a]

a CDV – Transport Research Centre, Líšeňská 33a, 636 00 Brno, Czech Republic
** jiri.ambros@cdv.cz*

Abstract

The goal of the section speed control is to increase speed limit compliance in the monitored road sections, decrease speed variance and improve traffic safety. General experience with section speed control on motorways is positive, with significant improvements of both speed and safety performance. The presented study focused on a specific application of section speed control in motorway work zones in the Czech Republic. Effectiveness was monitored (in terms of average speed, speeding and accident rates) in three sections and four time periods (normal operation, work zone, work zone with section speed control, normal operation), which allowed discerning individual effects of work zone and section speed control. Work zones were found to increase accident rates compared to normal operation and decrease with introduction of section speed control. The effects on average speed, speed variance and speeding were positive, although smaller compared to the studies conducted in non-work zone conditions.

Keywords: section speed control; motorway; work zone; effectiveness evaluation; traffic safety

Full paper:
https://www.researchgate.net/publication/339875255_Effectiveness_evaluation_of_section_speed_control_in_Czech_motorway_work_zones

318 Cycling under the influence of alcohol and drugs: current situation and risks

George Yannis[a], Alexandra Laiou[a]*, Anastasios Dragomanovits[a], Ourania Basta[a], Zoi Christoforou[b], Régine Seidowsky[b]

a National Technical University of Athens, 5 Iroon Polytechniou str., Athens GR-15773, Greece
b IFSTTAR, Boulevard Isaac Newton 14, Marne La Vallee Cedex FR-77447, France
** alaiou@central.ntua.gr*

Abstract

Cycling becomes more and more popular, especially among young people who favor active modes of transport. Drinking and drug use is also more common among young people and affect their capability of driving. The objective of this paper is to present the exploration of cycling under the influence of alcohol and drugs conducted in the framework of the research project titled "Velivr'" through a questionnaire survey among IRTAD Group members and a quantitative survey among cyclists in Paris. Results showed that in many countries safe cycling attracts growing attention but the vulnerability of cyclists is not fully realised. The CUI problem is not appropriately addressed through insufficient enforcement and provision for measures to prevent it. All in all, cycling under the influence of alcohol and/or drugs is a problem growing in parallel with cycling itself.

Keywords: Cycling, alcohol, drugs, survey, IRTAD, Velivr

325 Advanced driver monitoring using smartphone applications: The BeSmart project

Apostolos Ziakopoulos[a]*, Armira Kontaxi[a], George Yannis[a], Petros Fortsakis[b], Kleanthis - Nikolaos Kontonasios[b], George Kostoulas[b]

a National Technical University of Athens, Department of Transportation Planning and Engineering, 5 Heroon Polytechniou str., GR-15773, Athens, Greece
b OSeven Telematics Limited, 27B Chaimanta Str., GR-15234, Athens, Greece
** apziak@central.ntua.gr*

Abstract

Driver monitoring involves the observation and recording of crucial driving tasks, such as speeding or distracted driver behavior. The BeSmart project aims to develop an innovative driver monitoring smartphone application and its calibration to real-world performance demands. A 200-driver naturalistic driving experiment spanning 18 months was initiated during May 2019, with different driver types participating. Several parameters are recorded from driver trips, such as speed and position. Processing of the collected big data leads to the pinpointing of less safe driver behavior, such as harsh events, speeding and distraction via smartphone interaction. An initial analysis of car driver trips during the familiarization phase of BeSmart was conducted. 11211 trips from 132 drivers were examined and clustered in three types: Aggressive, Speeding and Average. Generalized Linear Mixed-Effects Models were fitted to the trips of 76 car drivers who made frequent trips in order to model the frequencies of harsh events.

Keywords: road safety; driver monitoring; driver behavior; naturalistic experiment; smartphone application; Generalized Linear Mixed-Effects Models

Full paper: https://www.nrso.ntua.gr/geyannis/publications/

637 Analysis of the impact of nighttime driving to drivers' behavior in rural roads through a driving simulator experiment

Dimosthenis Pavlou[a]*, Eleftheria Kyriakouli[a], George Yannis[a]

a National Technical University of Athens, Department of Transportation Planning and Engineering, 5 Heroon Polytechniou str., GR-15773, Athens, Greece
** dpavlou@central.ntua.gr*

Abstract

Low light conditions, glare, darkness adjustment, age and driver experience and visibility are just some of the factors that may have a negative impact on driving performance and may lead to an increased accident probability. This study aims at analyzing the impact of night-time driving on driver behavior and safety of young drivers, in rural areas, through a driving simulator experiment. A driving simulator experiment was designed and carried out, in which 35 participants went through different driving scenarios in a rural road. Regression methods were used to analyze the impact of driving at night on the mean speed, reaction time and accident probability. Results suggest that night-time driving leads to slight, but significant, decrease of the mean speed, which however cannot outweigh the significant increase of the mean reaction time in case of an accident and therefore resulting to an increased accident probability.

Keywords: driving at night; reaction time; unexpected incident; driving simulator

638 Visibility requirements at intersections: A comparison of capabilities of human drivers and autonomous vehicles

Zsofia Magyari[a]*, Csaba Koren[a]

a University of Gyor, Egyetem ter 1, Egyetem ter 1, 9026 Gyor, Hungary
** mzsofi@sze.hu*

Abstract

Current visibility requirements at unsignalized intersections are based on speeds on the major road and on accepted gaps by human drivers entering or crossing from the minor road. Autonomous vehicles survey their environment with sensors which are different from the human vision in terms of identifying objects, estimating distances or speeds of other vehicles. This paper compares current visibility requirements based on conventional vehicles and those required for autonomous vehicles. Visibility requirements were defined by three vision indicators: distance, angle of view and resolution abilities of autonomous cars and human drivers. These indicators were calculated separately for autonomous vehicles and human drivers for various speeds on the main road and in case of rectangular and 60-degree connection angle. It was shown that the required sight distances are 10 to 40 meters shorter for autonomous vehicles than for conventional ones.

Keywords: intersection; sight distance; autonomous vehicle; speed; accepted gap

668 Driver feedback during naturalistic driving experiments: A review of types, methods and future challenges

Dimitrios Tselentis[a], George Kostoulas[a], Kleanthis - Nikolaos Kontonasios[a], Petros Fortsakis[a]*, George Yannis[b]

a OSeven Single Member Private Company, 27B Chaimanta Str., GR-15234, Athens, Greece
b National Technical University of Athens, Department of Transportation Planning and Engineering, 5 Heroon Polytechniou str., GR-15773, Athens, Greece
** pfortsakis@oseven.io*

Abstract

Providing targeted feedback to drivers can significantly contribute to the improvement of their driving behaviour and overall safety. However, the effectiveness of the driver feedback provided depends on various parameters. This paper constitutes a systematic effort to review the current state-of-the-art in driver feedback research. The most important parameters that should be taken into consideration when designing such feedback experiments are also reviewed and analysed herein. The focus is on the demographics, the types, the means and the time of feedback of the experiments. Novel ways of providing feedback in a naturalistic experimental setting can be designed based on the review at hand.

Keywords: driving behaviour; driver feedback; naturalistic driving experiments; risk factors

702 Driver's involvement and traffic offences by gender and age group in two-passenger car collisions in Spain

Blanca Arenas-Ramírez[a]*, Almudena Sanjurjo-de-No[a], José M. Mira-McWilliams[a], Francisco Aparicio-Izquierdo[a]

a Escuela Politécnica Superior de Ingenieros Industriales de Madrid (ETSII UPM). José Gutiérrez Abascal 2, Madrid, 28006, España.

Instituto Universitario de Investigación del Automóvil Francisco Aparicio Izquierdo. Universidad Politécnica de Madrid. (INSIA UPM)., Campus Sur UPM. Carretera de Valencia (A3) km.7. Madrid, 28031, España
** barenas@etsii.upm.es*

Abstract

Important socioeconomic changes such as population structure, aging, access to labor markets, etc. are expected soon in Europe, which will be reflected on mobility, transport modes, affecting both safety and environmental impact, and providing enough motivation for specific studies. In this study, the hypotheses adopted are: there are differences in the type of accidents and in the law enforcement by driver gender and age. Two approaches are applied to a sample of two-car collisions occurred in the 2004-2013 period in interurban roads in Spain: hypothesis tests and Self Organizing Maps (SOM) clustering technique. Tests are inference tools which provide statistical significance values while SOM, although very useful, is a sophisticated descriptive technique which turns it very powerful in unveiling multivariate patterns. The accident rates remain higher for men. Both genders are influenced by age, with higher rates for young and senior drivers. Men and young drivers are more likely to assume risky behavior than women, with higher speeds and more drug and alcohol use, while women are more easily distracted and incur in more perception faults. These differences can and should be used to establish certain differences in the training and information programs for drivers, with special emphasis on the identified aspects and could motivate campaigns focused on drivers by gender and ages. The results could be a guide for the adoption of specific measures focused for instance, on the group of less law-abiding male drivers, especially in the riskier ones.

Keywords: Safety, accidents, injuries, fatalities, gender, age

753 User-centered development of a driving simulator for training of emergency vehicle drivers and development of Emergency Vehicle Approaching messaging: A simulator study

Anders Lindström[a], Birgitta Thorslund[a]*

a VTI, Olaus Magnus väg 35, 58195 Linköping, Sweden
** birgitta.thorslund@vti.se*

Abstract

There is a large risk of accidents in connection with emergency driving and the need for both better possibilities to train emergency vehicle driving and for systems guiding other road users to the right behavior is apparent. The aim of this study was (1) to initiate user-centered development of a driving simulator for training of emergency vehicle drivers and (2) to collect information about how to best communicate EVA messages. The method used is user-involved, iterative development of both the driving scenario and the driving simulator. 104 participants have tried the simulator and responded to a questionnaire. Most difficult for emergency vehicle drivers are vehicles in front suddenly braking and failure in other drivers noticing them. Desired behaviour in other road users is to yield to the right and brake smoothly. The attitude towards communication of EV driving is positive, regarding both pre-alerting drivers who are approaching an incident scene and sending out EVA-messages.

Keywords: driving simulators; emergency vehicle driving; traffic safety; emergency vehicle driver training; C-ITS

807 Guidelines for the assessment of mobile phone use in traffic

Markus Schumacher[a]*, Mark Vollrath[b], Sofie Boets[c], Uta Meesmann[c]

a Bundesanstalt fuer Strassenwesen (BASt), Section safety concepts, safety communication, Bruederstrasse 53, 51427 Bergisch Gladbach, Germany
b Technische Universitaet Braunschweig, Department of Engineering and Traffic Psychology, Gaussstrasse 23, 38106 Braunschweig, Germany
c VIAS institute, Haachtsesteenweg/Chaussée de Haecht 1405, 1130 Brussels, Belgium
** schumacher@bast.de*

Abstract

A major problem of assessing the impact of mobile phone use on traffic safety is the large diversity of study methods. To estimate prevalence, direct observations in traffic as well as interviews and surveysare used,which in turn are different with respect to the methodological implementation. Based on a review of epidemiological studies on distraction while driving published between 2000 and 2017, a set of guidelines for a common methodology was built. These guidelines cover the main epidemiological research methods and focus on the estimation of prevalence of mobile phone use in traffic by car drivers, cyclists and pedestrians. It is expected that these guidelines will significantly improve the quality of data gathered in further studies and will facilitate crossstudy comparisons on an international level.

Keywords: Mobile Phone; Driver distraction; Bicycle; Pedestrian; Prevalence

810 Naturalistic study of motorcycle training in France: educational content and practices of post-licensing courses.

Tanguy Loubiere[a], Samuel Aupetit[b], Isabelle Ragot-Court[c]*, Carole Rodon[c]

a IFSTTAR / LMA, 14-20 Boulevard Newton, Cité Descartes, Champs-sur-Marne, Marne la Vallée 77447, France
b ERGO-CENTRE, 1121 rue de la Bergeresse, Olivet 45160, France
c IFSTTAR / LMA, 304 chemin de la Croix Blanche, Salon de Provence 13300, France
** isabelle.ragot-court@ifsttar.fr*

Abstract

The risk associated with motorcycling is a major public health issue in France. Therefore, it is necessary to look at ways of influencing the driving behaviour of motorcyclists after obtaining a driving license. This study initiated by the French Road Safety Department (DSR) focuses on post-licensing training, called "advanced courses". Through a naturalistic study based on a significant number of hours of observation and interviews conducted in four different organizations, the study attempts to analyse the educational content and practices provided by trainers and their interest in preserving motorcyclists' safety. The results show that courses tend to emphasize their content on vehicle control skills, as does initial training. However, pedagogical practices show a real willingness on the part of trainers to seek other skills such as those related to the mastery of traffic situations. This plays a definite role in changing the behaviour of motorcyclists towards greater safety.

Keywords: road safety; training; motorcycling; naturalistic study; ergonomics

1089 Interaction between cyclists, motor vehicles and infrastructure: A simulator study on cyclist strategy and behaviour at intersections

Birgitta Thorslund[a]*, Anders Lindström[a], Andreas Käck[a]

a VTI, Olaus Magnus väg 35, 58195 Linköping, Sweden
** birgitta.thorslund@vti.se*

Abstract

Severe and fatal accidents between cyclists and motor vehicles are common at intersections, and many involve right-turning vehicles, with drivers not observing an adjacent cyclist. Few structured investigations exist regarding the interaction between the two, and factors to be studied are how infrastructure and vehicle properties affect human decision-making and cycling behaviour. Therefore, a bicycle simulator study was performed, where vehicle type, lane markings and width were systematically varied in a scenario with a cyclist approaching a vehicle from behind at an intersection. 33 participants each cycled through 8 intersections. Data on cycling trajectories, stopping points and speed was coupled with survey data and semantically categorized verbal responses to questions regarding strategy for choice of stopping point. Results show that all three factors (vehicle type, lane markings and available vehicle-adjacent space) significantly affects cyclists' behaviour (lateral and longitudinal stopping position), speed choice and verbally expressed conscious strategies.

Keywords: Cycle simulator; Intersection; Vehicle type; Lane width; Lane Markings; Stop position

1115 Technical requirements for real-time traffic detection and dynamic infrastructure measures for safer behaviour

Moritz Berghaus[a]*, Adrian Fazekas[a], Markus Oeser[a]

a Institute of Highway Engineering, RWTH Aachen University, Mies-van-der-Rohe-Strasse 1, 52074 Aachen, Germany
** berghaus@isac.rwth-aachen.de*

Abstract

One of the main reason for road accidents is unsafe driving behaviour due to wrong perception of the road. Infrastructure-based road safety measures are most effective if they only target those drivers that drive unsafely. In order to influence individual drivers towards safer behaviour, their behaviour must be captured and evaluated in real-time. This requires the collection of vehicle trajectory data. We present a system that detects vehicle positions and speeds using thermal cameras and computer vision algorithms. The system uses the concept of nudging to reduce the vehicles' speeds and guide them along a safe trajectory. In order to nudge unsafe drivers individually and in real-time, the detection system needs to fulfil several requirements which we discuss in this work. Furthermore, we present methods of data acquisition able to fulfil these requirements.

Keywords: vehicle tracking; traffic safety; nudging; trajectory analysis; road geometry

1.41 Scientific and technical session 41: Research in pavement and material engineering

367 FIBRA - Fostering the implementation of fibre reinforced asphalt mixtures by ensuring its safe, optimized and cost-efficient use. Preliminary results.

C.J. Slebi-Acevedo[a], P. Lastra-González[a], I. Indacoechea-Vega[a], D. Castro-Fresno[a]*

a GITECO Research Group, University of Cantabria, Spain
** castrod@unican.es*

Abstract

The use of fibers has been presented in the last years as an innovative ideal solution to enhance the mechanical properties of hot mix asphalt (HMA). Several types of fibers found in the literature have shown promising characteristics to be used as fiber reinforced asphalt mixtures (FRAM). However, the majority of the research is focus at the laboratory scale and the economic and environmental aspects have not been taken into account. To fill this gap, the FIBRA project, funded by the European Commission Department of Roads (CEDR) under the contract number N. 867481, aims to overcome the technical barriers for the safe and cost-efficient implementation of fiber-reinforced asphalt mixtures (FRAM). The article presents the main and specific objectives of the project as well as the first results obtained so far.

Keywords: Fibers, hot mix asphalt, Multi-criteria decision making, Life cycle assessment

Full paper: https://www.researchgate.net/publication/339887330_FIBRA_-_Fostering_the_implementation_of_fibre_reinforced_asphalt_mixtures_by_ensuring_its_safe_optimized_and_cost-efficient_use_Preliminary_results

485 Performance of pavement structures with cement bound and cement-bitumen bound base layers

Audrius Vatkus[a], Judita Gražulytė[a]*, Jurgita Židanavičiūtė[a], Donatas Čygas[b], Igoris Kravcovas[a]

a Road Research Institute, Vilnius Gediminas Technical University, Linkmenų g. 28, Vilnius LT-08217, Lithuania
b Dept of Roads, Vilnius Gediminas Technical University, Saulėtekio al. 11, LT-10223, Lithuania
** judita.grazulyte@vgtu.lt*

Abstract

Properly designed and maintained asphalt pavements last for ten to twenty-five years and after that period have to be rehabilitated. Cold in-place recycling has priority over all other rehabilitation methods since there is no need to preheat reclaimed asphalt pavement and transport it. Multiple researches on the performance of cold recycled mixtures have been done; however, it is not clear how the entire pavement structure (cold recycled asphalt pavement overlaid with asphalt mixture) performs depending on binding agents. The main objective of this research was to evaluate the performance of cold in-place recycled asphalt pavements after more than eight to twelve years considering binding agents (foamed bitumen in combination with cement or only cement) and figure out which binder leads to the best pavement performance. Three road sections were analysed. The performance of the entire pavement structure was evaluated in 2013 and 2017, according to the International Roughness Index (IRI), rut depth, and pavement surface distress.

Keywords: cold in-place recycling (CIR); reclaimed asphalt pavement; cold recycled asphalt pavement; International Roughness Index; rut depth; pavement surface distress

552 Design of flexible pavements with cold recycled asphalt bases: Comparison of five national approaches

Marius Winter[a]*, Konrad Mollenhauer[a], Andrea Graziani[b], Mignini Chiara[b], Gaspare Giancontieri[c], Davide Lo Presti [c], Henrik Bjurström[d], Björn Kalman[d], Pierre Hornych[e], Vincent Gaudefroy[e]

a Universität Kassel, Mönchebergstraße 7, 34125 Kassel, Germany
b Università Politecnica delle Marche, Italy
c Nottingham Transportation Engineering Centre (NTEC), UK
d Statens väg- & transportforskningsinstitut (VTI), Sweden
e Institut français des sciences et technologies des transports, de l'aménagement et des réseaux (IFSTTAR), France
** m.winter@uni-kassel.de*

Abstract

The Application of reclaimed asphalt is becoming increasingly important in the European Road Network. Beside the conventional recycling options (i. e. hot asphalt mixtures), cold recycling has been successfully applied in numerous road structures within the secondary and the main road network. However, the standard design procedures for common pavement materials as well as the approaches for cold recycling differ from one country to another. The comparison of five national pavement design procedures shows, that different design approaches may result in similar pavement structures for standard road materials (here: hot asphalt mixtures). The available specifications for pavement design with cold recycled materials indicate generally a surplus of thickness compared to standard structures. This varying surplus in thickness indicates different safety conditions applied in the analysed countries. In order to validate the existing pavement design procedures for cold recycling materials, two options will be followed. On the one hand mechanistic pavement design is applied which allows the calculation of required layer thicknesses. On the other hand, pavement design based on empirical values can be used.

Keywords: Recycling, Pavement design, Cold recycling bays layers

Full paper: http://dx.doi.org/doi:10.17170/kobra-202003131063

701 Opportunistic sensing for road pavement monitoring

Bert De Coensel[a,b]*, Karlo Filipan[b], Wout Van Hauwermeiren[a], Joachim David[a], Luc Dekoninck[a], Toon De Pessemier[a], Wout Joseph[a], Luc Martens[a], Dick Botteldooren[a]

a WAVES Research Group, INTEC, Ghent University / imec, Technologiepark-Zwijnaarde 126, B-9052 Ghent, Belgium
b ASAsense CV, Spanjaardstraat 4, B-8000 Bruges, Belgium
** bert.decoensel@asasense.com*

Abstract

Road surface state monitoring is of main concern for road infrastructure owners. Hence dedicated measurement campaigns using laser scanning and image analysis are performed on a regular basis. Yet, this type of monitoring comes at a high labor cost and thus it is often limited in coverage and update frequency. This paper proposes opportunistic sensing as an alternative approach. Using sound and vibration sensing in cars that are on the road for other purposes and exploiting the advent of cheap communication, big data, and machine learning, timely information on road state is obtained. Results are compared to laser scanning for spatial frequencies between 0.1 and 100 cycles/m showing the applicability of the method. Results are also used for classification and labeling of road surfaces regarding their effect on rolling noise. Mapping illustrates the coverage of highways and local roads obtained in a few months with as few as seven cars.

Keywords: road surface; monitoring; noise; vibration; opportunistic sensing

Full paper: http://hdl.handle.net/1854/LU-8652423

716 The moisture induced and material composition related abnormalities in asphalt concrete pavements in Finland

Michalina Makowska[a]*, Katri Eskola[b], Leena Korkiala-Tanttu[a]

a Aalto University, Rakentajanaukio 4a, Espoo 02150, Finland
b Finnish Transport Infrastructure Agency, P.O. Box 33, Helsinki 00521, Finland
** michalina.makowska@aalto.fi*

Abstract

The good resistance to moisture in asphalt concrete pavement was traditionally not the prioritized design parameter in Finland. Unfortunately, the moisture induced damage in wearing course layers started to manifest more often as the number of freeze-thaw cycles and the amount of precipitation in form of rain increased in the last decades due to the climate change. Additionally, the properties of bitumen, or the lack of compatibility between bitumen and aggregate, lead to the atypical performance. The two special cases are presented, i.e. the loss of adhesion between air-cooled ferrochromium slag aggregate and bitumen after recycling; as well as a peculiar splashing of bitumen rich phase observed from soft asphalt concrete pavements after extraordinarily rainy winter. The strong need to understand the connection between the raw material characteristics and asphalt concrete performance in the context of increasing exposure to moisture lead to the inauguration of a project – BITU2020.

Keywords: moisture, case studies, soft asphalt concrete, slag aggregate

766 Simplified approach of pavement solutions to adopt in roundabout intersections – Standard Catalog

Margarida Gonçalves[a]*, Filipa Marques[a], José Neves[b], Eugénia Correia[a], José Faísca[a]

a Infraestruturas de Portugal, Praça da Portagem, 2809-013 Almada, Portugal
b Instituto Superior Técnico, Av. Rovisco Pais, 1049-001 Lisboa, Portugal
** margarida.goncalves@infraestruturasdeportugal.pt*

Abstract

Due to private investments in the present socio-economic context, there is constant interference on the road network under Infraestruturas de Portugal (IP) jurisdiction, resulting in a high number of requests in Engineering and Environment Directorate (EED) of IP on a permanent basis. In order to combat this trend, an expedited procedure of limited application in pavement solutions was developed, as to simplify the approval of external entities' projects. This procedure allows a reduction on the response time and an increase on the capacity of EED. A simplified approach to road pavements design - standard catalog - was conceived by implementing roundabouts on existing intersections. This approach is based on the methodology presented in the Pavement Design Manual of Portugal and has been updated for flexible pavements frequently used in Portugal. Based on these considerations, flexible pavement structures were proposed and depend on three variables: traffic, climatic conditions and foundation characteristics.

Keywords: road; pavement; roundabout; design; structure; approach

887 Accelerated laboratory ageing of bituminous mixtures using the TEAGE method

João Crucho[a]*, Luís Picado-Santos[a], José Neves[a], Silvino Capitão[a,b]

a CERIS, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa, Portugal
b Instituto Politécnico de Coimbra, Instituto Superior de Engenharia de Coimbra, Rua Pedro Nunes, 3030-199 Coimbra, Portugal
** joao.crucho@tecnico.ulisboa.pt*

Abstract

This study proposes a new method for the laboratory simulation of accelerated ageing in compacted bituminous mixtures – the TEcnico Accelerated aGEing (TEAGE). TEAGE considers the environmental conditions of the pavement service location, namely UV radiation and precipitation, and simulate these actions for the desired exposure period (pavement age). An experimental program was developed to assess the effect of the exposure to UV radiation in the fundamental properties of the bitumen and to complement the existing knowledge regarding the effects of TEAGE ageing simulation in the compacted bituminous mixture. The unaged, TEAGE aged and LTOA aged mixtures were tested for affinity aggregate-bitumen, indirect tensile strength and stiffness modulus. TEAGE provided an ageing simulation more fitted to reality, causing a more effective ageing noted by a more elastic behaviour of the mixture resulting in higher fracture energy to failure in indirect tensile strength tests and lower dissipated energy under bending loading.

Keywords: ageing simulation; UV radiation; moisture damage; TEAGE; bituminous mixture; mechanical performance

Full paper:
https://www.researchgate.net/publication/339796859_Accelerated_laboratory_ageing_of_bituminous_mixtures_using_the_TEAGE_method

914 Multiple objective optimization of sustainable pavement maintenance and rehabilitation strategies: a clustering procedure for selecting preferred Pareto optimal solutions

João Santos[a]*, Cristina Torres-Machi[b], Samuel Morillas[c], Veronique Cerezo[d]

a Department of Construction Management & Engineering, Faculty of Engineering Technology, University of Twente, Enschede, The Netherlands
b Civil, Environmental and Architectural Engineering, University of Colorado Boulder, United States
c Department of Applied Mathematics, Universitat Politècnica de València, Spain
d IFSTTAR, AME-EASE, Route de Bouaye, CS4, F-44341, Bouguenais, France
** j.m.oliveiradossantos@utwente.nl*

Abstract

Multiple objective optimization (MOO) techniques can be used to account for multiple aspects in the design of road pavement maintenance and rehabilitation (M&R) strategies. Contrary to the single-objective optimization problems where a single solution is optimal, the solution of MOO problems is a set of non-dominated solutions. This set of optimal solutions represents the trade-off between the different and often conflicting objectives and, in many cases, is comprised of a vast number of elements. This fact makes it difficult for the decision-makers to select one single solution reflecting the best compromise according to their preferences. To facilitate this process, this paper presents a MOO-based pavement management decision support system (DSS) which utilizes a clustering mechanism to provide decision-makers with an easy and intuitive methodology for selecting the most preferred solution from the Pareto set according to their preferences towards economic, neutral and environmental interests.

Keywords: sustainable pavements; pavement management; multi-objective optimization; genetic algorithms; k-means; fuzzy c-means

944 Materials selection for structured horizontal road markings: financial and environmental case studies

Tomasz E. Burghardt[a]*, Anton Pashkevich[b]

a M. Swarovski Gesellschaft m.b.H. Industriestr. 10, 3300 Amstetten, Austria
b Politechnika Krakowska, ul. Warszawska 24, 31-155 Kraków, Poland
** tomasz.burghardt@swarco.com*

Abstract

On majority of roads, horizontal road markings are essential safety feature that must be periodically renewed to maintain appropriate performance. The use of a premium road marking system resulted in prolonged the service life as compared to a standard system, which would be financially-neutral in the long term despite much higher unit and initial costs; advantageously, 54% less glass beads and 63% less paint would be required over 10-year life cycle. When these products usage savings are recalculated into raw materials consumption, the premium system would demand about 21% more of titanium dioxide, but that would be offset by approximately 25% reduction in the consumption of acrylic resin and circa 97% reduction in organic solvents usage and emissions. The results from this analysis can be used by road administrators to select the best systems, by policy makers seeking minimisation of environmental impacts, and by contractors who won performance tenders.

Keywords: horizontal road markings; durability; financial analysis; sustainability; road maintenance policy

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

1074 An Exploratory Study Applied of Rutting Characteristics for Modified Bituminous Mixes by Apply Waste Plastic

Wissam Qassim Al-Salih[a]

a BME University, Faculty of Transportation Engineering and Vehicle Engineering, Budapest, Hungary
** wissamcasio2013@gmail.com*

Abstract

The production of waste plastic has grown exponentially in last a few decades, therefore using the waste plastic in the roads is an alternative solution to their safe disposal. Rutting failure in the bituminous layer can be attributed by heavier axle loads or high pavement temperatures or by both. The object of the paper is to study the rutting behaviour in bituminous mixes modified with waste plastic at high pavement temperatures. In this paper, two types of bituminous mixes, bituminous concrete and stone matrix asphalt, those are used to carry heavier wheel loads. Marshall Test results indicated that addition waste plastic to the mix is have improved the bituminous mixes. Wheel tracking test for rutting showed that the mixes are prepared with waste plastic are forming rutting resistant mixes. Benefits from this study are the waste plastic disposal is an eco-friendly way and better road to withstand rutting.

Keywords: Bituminous Mixes - Waste Plastic - Marshall Test - Wheel tracking test - Rutting resistant

1080 Static in-tire circumferential strain signature using Rayleigh-scattering fiber optic technology: Preliminary results

Martin Fontaine[a]*, Xavier Chapeleau[a], Vincent Baltazart[a], Ivan Guéguen[a], Louis-Marie Cottineau[a], Julien Cesbron[b], David Bétaille[a], Denis Coudouel[c]

a IFSTTAR, F-44344, Bouguenais, France
b IFSTTAR, CEREMA, UMRAE, F-44344 Bouguenais, France
c Captels, Saint-Mathieu-de-Tréviers, F-34270, France
** martin.fontaine@ifsttar.fr*

Abstract

The paper presents both the modeling and the experiment to measure the longitudinal static strain over the inner perimeter of a tire. These measurements are expected to help at updating some unknown geometrical and mechanical parameters of tires for achieving more accurate simulations under conventional CAO software (namely, Solidworks). Compared to the literature, a distributed fiber optic sensing is used to measure the inner liner tire strain profile along the perimeter. Based on the Rayleigh scattering, this technology provides a fine spatial resolution, namely, less than 1 cm. The preliminary results show the typical Mexican-hat-like circumferential strain distribution and the contact patch length. Both quantities are shown to be related to the static load.

Keywords: Strain measurement; Fiber optic; Rayleigh scattering; Contact-patch length; Finite element modeling, static loading

1086 A review of damage modelling approaches for layered composites

Udit Pillai[a]*, Savvas Triantafyllou[a], Ian Ashcroft[a], Yasser Essa[b], Federico Martin de la Escalera[b]

a Faculty of Engineering, University of Nottingham, University Park, NG7 2RD, Nottingham, U.K.
b Aernnova Engineering Division, Avda. del Llano Castellano 13, 28034, Madrid, Spain
** udit.pillai@nottingham.ac.uk*

Abstract

The increasing application of layered composites in the aerospace and automotive industries warrants a need for high-fidelity computational models to ensure robust and reliable designs. The robust predictive modelling of damage thresholds is an important aspect of the overall design and manufacturing lifecycle of composite structures. Composites display a highly nonlinear material behaviour and have a wide range of failure modes extending across length scales. Most of the defects or inherent discontinuities in composites arise at a micro-scale (fibre level) and accumulate into larger cracks at structural level under service loads. The mathematical modelling of this damage envelope involves discontinuities in displacement fields; this poses numerical challenges with regards to automatic initiation, propagation and prediction of growth characteristics of cracks. The current study aims at providing a detailed review and qualitative comparison of different damage modelling methods available in the literature to model damage behaviour in such layered composite laminates.

Keywords: Composite laminates; Damage modelling; eXtended Finite Element Method (XFEM); Phase-Field Method (PFM); Continuum Damage Method (CDM); Cohesive Zone Method (CZM)

1159 Improving porous asphalt mixes by incorporation of additives

Anik Gupta[a]*, Jorge Rodriguez-Hernandez[a], Carlos J. Slebi-Acevedo[a], Daniel Castro-Fresno[a]

a GITECO Research Group, University of Cantabria, Santander 39005, Spain
** anikgupta@unican.es*

Abstract

Porous asphalt (PA) mixtures have shown a huge range of benefits such as noise reduction, better skid resistance and mitigation of hydroplaning effect. However, due to high voids content, this mixture is prone to ravelling and clogging and therefore its service life is limited. Strong interlock between bitumen and aggregates is an important requirement to keep the aggregate structure intact and thus ravelling in check. Some additives have been widely used in order to enhance the mechanical properties of conventional dense-graded asphalt mixtures (DGAM). Incorporation of additives can improve the stability and cohesion of the porous asphalt mix. In this paper, the suitability of different type of aramid fibers in PA mixtures is analysed with the purpose to improve the durability while maintaining the proper functionality requirements. In this study, volumetric analysis was carried out to assess the effect of five different types of fibers on the functional performance of the porous asphalt mixtures. In addition, dry and wet Cantabro tests were carried out to evaluate the performance of porous asphalt concrete with aramid fiber. Binder drain down tests were also performed in order to assess the potential of fibers to be used as stabilizer additives.

Keywords: porous asphalt mixes; additives; aramid fibers; synthetic fibers; Cantabro test

Full paper: https://www.researchgate.net/profile/Anik_Gupta

1.42 Scientific and technical session 42: Maintenance and asset management

134 Low-cost system for monitoring road friction properties

Miha Ambrož[a]*, Simon Grum[a], Rok Kogovšek[a], Patrik Tarfila[a], Rok Štefančič[a], Roman Kamnik[b], Uroš Hudomalj[b], Alexander Marinšek[b], Julijana Jamnik[c], Bajko Kulauzović[c], Gašper Oman[c], Mitja Pajek[c]

a University of Ljubljana, Faculty of Mechanical Engineering, Aškerčeva cesta 6, SI-1000 Ljubljana, Slovenia
b University of Ljubljana, Faculty of Electrical Engineering, Tržaška cesta 25, SI-1000 Ljubljana, Slovenia
c Cestel, d. o. o., Špruha 32, SI-1236 Trzin, Slovenia
** miha.ambroz@fs.uni-lj.si*

Abstract

The knowledge of the friction conditions on driving surfaces on the public road network is a major factor in providing traffic safety. Whenever the specialised measurement equipment is used, it is difficult or even impossible to quickly perform the measurements on all sensitive locations during emergency events. By installing moderately priced and easy to control yet still accurate enough devices for measuring the longitudinal deceleration during braking onto the vehicles that travel over the road network performing their everyday assignments, the friction measurements are available quickly and with minimal additional cost. We present a prototype of a low-price device, which can be installed in the vehicles that traverse the roads on a daily basis. Its application quickly and effortlessly provides the braking-test-based friction data on the critical location on the road surface and their conveyance to the road administration authorities as the basis for taking measures for condition improvement.

Keywords: road friction, skid resistance, braking deceleration, single board computer, database, connected system

Full paper: http://kmtm.fs.uni-lj.si/conskid/CONSKID_TRA2020.pdf

256 A generic framework for decision support systems in maintenance and interventions planning

Jose Solís-Hernández[a]*, Noemi Jiménez-Redondo[a], Iñigo Mingolarra-Garaizar[a], Denise Holfeld[b], Ute Kandler[b], Federico Papa[c], Alice Consilvio[d]

a Centro de Estudios de Materiales y Control de Obra S.A., Calle Benaque 9, Málaga, 29004, Spain
b Fraunhofer Institute for Transportation and Infrastructure Systems IVI, Zeunerstraße 38, Dresden, 01069, Germany
c Hitachi Rail STS, Via P. Mantovani 3-5, Genova, 16151, Italy
d University of Genoa, Via Montallegro 1, Genova, 16145, Italy
** jose.solis@cemosa.es*

Abstract

The objective of this study is to develop a generic framework for decision support systems that manage maintenance and interventions in railway infrastructures. The framework sets the information coming from the measuring and monitoring system and the dynamic management system into a common context to pursue an intelligent asset management strategy. The aim is to complete the processing chain from gathering data and extracting meaningful knowledge to finally turning this information into real-world decisions. The framework presented in this study describes the factors to be considered (i.e. the building blocks); the interactions among these leading factors; the uncertainties associated to the probabilistic predictions formulated and the key performance indicators employed within the asset management process. The work conducted is supported on real world use cases to exemplify and validate the concepts that are presented in the framework.

Keywords: railway infrastructure; asset management; framework; decision support system; planning; interventions

Full paper:
https://www.researchgate.net/publication/339789050_A_generic_framework_for_decision_support_systems_in_maintenance_and_interventions_planning

267 On implementing and testing an Intelligent Asset Management System for rail signalling

Alice Consilvio[b], Carlo Crovetto[a]*, Carlo Dambra[a], Federico Papa[a], Paolo Sanetti[a], Noemi Jiménez Redondo[c], Ute Kandler[d]

a Hitachi Rail STS, Via Paolo Mantovani 3/5, 16151, Genoa, Italy
b DIME University of Genoa, Via Montallegro 1, 16145 Genoa, Italy
c Centro de Estudios de Materiales y Control de Obra S.A., Calle Benaque 9, 29004, Málaga, Spain
d Fraunhofer Institute for Transportation and Infrastructure Systems IVI, Zeunerstraße 38, 01069, Dresden, Germany
** carlo.crovetto@hitachirail.com*

Abstract

This paper describes the implementation phase of the Intelligent Asset Management System (IAMS), developed within the Shift2Rail IN2SMART project, under test and validation within its follow-up project, IN2SMART2. The innovative approach to Asset Management is based on techniques and models for data analysis and decision support, able to take into account the knowledge on asset status, the operational constraints of the rail sector and the main targets for rail operators. The aim is to move towards an automated decision process and a reduction of human effort in decision-making. The validation of the IAMS prototype is described. Then,

its application to a real use case, being under progress in IN2SMART2 and focusing on the signalling system of an Italian metro line, is presented. The in-field implementation and the designed additional functionalities of the system are reported, as well as, the considered KPIs for its test and the benefits of the approach.

Keywords: railway asset management; decision support system; predictive maintenance; data analytics; anomaly detection; signalling maintenance

605 Significance of the contractual relationship for efficient railway maintenance planning

Daria Ivina[a]*, Lena Winslott Hiselius[a], Nils O.E. Olsson[b], Robin A. Stenberg[b]

a Department of Technology and Society, Lund University, P. O. Box 118, Lund 22100, Sweden
b Department of Production and Quality Engineering, Norwegian University of Science and Technology, S. P. Andersens veg 5, Trondheim 7031, Norway
** daria.ivina@tft.lth.se*

Abstract

The continuous use of railway infrastructure causes substantial wear of its components. The planning of railway maintenance, in order to maintain proper system functionality, demands foresight and specification at every step of the organisation process. The Swedish railway organisational model delegates maintenance work to contractor companies, which are chosen in the tender process by the Swedish Transport Administration (Trafikverket). In order to investigate problems occurring at the maintenance planning and execution stages, we conducted internal regulations reviews and interviews with 22 engineers at different stages in the planning process. The main findings show that contractors are struggling to get enough time on the track to perform needed work. The two existing types of contracts in Sweden are perceived differently by parties involved in the contract relationship. Knowledge transfer between contractor companies' engineers and Trafikverket remains a problem to be solved.

Keywords: railway; maintenance; planning; contract; communication; maintenance possessions

656 Forecasting the operational state of highway bridges

Larysa Bodnar[a]*, Sergii Stepanov[a], Petro Koval[a], Nataliia Borodina[a]

a M.P. Shulgin State Road Research Institute - DerzhdorNDI SE (DNDI), 57 Peremohy Avenue, 03113 Kyiv, Ukraine
** LaraGor@ukr.net*

Abstract

In the paper, analysis of bridge life cycle was carried out. The definition of the operational state of the bridge in the Analytical Expert Bridges Management System (AESUM) is considered. It is established that in Ukraine the number of actual survey of bridges is much smaller than the number of inspections provided by standards. This is due to limited funding. The procedure for determining the forecasted operational state of bridge element, the algorithm of which is described using the Nassi-Schneiderman diagram was developed. On the basis of this procedure, implemented in the AESUM, the distribution of the operational state of bridges on roads of state importance of Ukraine for the current year is obtained. The obtained data allow reasonably developing the plans of repairs and reconstruction of bridges.

Keywords: bridge life cycle; bridge operational state; degradation of bridge element; forecasting the operational state of the bridges

709 Gathering observation data from the road physical condition anomalies with Mobile-Louhi tool

Pekka Eloranta[a]*, Laura Riihentupa[a]

a Sitowise Oy, Åkerlundinkatu 11 A, FI-33100 Tampere, Finland
** pekka.eloranta@sitowise.com*

Abstract

The SafeCOP project. established a safety assurance approach, a platform and tools for cost-efficient and practical certification of co-operating cyber-physical systems. The approach was tested in six use cases in Finland, Denmark, Norway, Sweden, Portugal and Italy. As part of the Finnish SafeCOP use case "Vehicle and road-side unit interaction" a specific Mobile-Louhi tool was developed to gather road user observation data from the road physical condition anomalies, incidents, accidents, etc. into the cloud. This kind of data collection is important since the so called C-ITS Platform establisedh by DG for Mobility and Transport of the European Commission has agreed upon a list of "Day 1 services" in co-operative intelligent transport systems. These services have a lot of societal benefits and they will be available for the end users rather soon. Mobile-Louhi provides a tool to collect data related to most of the hazardous notifications of these Day 1 services.

Keywords: Observation data, road condition, anomalies, incidents, accidents, safety, security

809 Use of BIM to put monitoring data into context to simulate infrastructure future performance

S. Lenart[a]*, V. Janjić[b], U. Jovanović[b], R. Vezočnik[a]

a Slovenian National Building and Civil Engineering Institute (ZAG), Dimičeva ulica 12, SI-1000 Ljubljana, Slovenia
b BEXEL Consulting, Slovenčeva ulica 93, SI-1000 Ljubljana, Slovenia
** stanislav.lenart@zag.si*

Abstract

Bridges and tunnels are a crucial part of railway infrastructure, both being exposed to various types of deterioration processes. Thus their state is the subject of monitoring and a source of enormous quantity of data. Data are generated during the whole life cycle of assets and it is important to collect as much information as possible in every phase to reliably predict their performance in future. Monitoring is in charge of information and data collection. Additionally, data management is as important as their generation. EU funded Shift2Rail research project Assets4Rail is focusing on measuring, monitoring and data handling for railway assets. The novel approach to the latter is presented in this paper.

Keywords: monitoring, information management, BIM, infrastructure, bridge, tunnel, Assets4Rail

Full paper:
https://www.researchgate.net/publication/339738344_Use_of_BIM_to_put_monitoring_data_into_context_to_simulate_infrastructure_future_performance

854 Road Access and Weight Control with Geofencing - The Swedish High Capacity Transport case

Thomas Asp[a], Sten Wandel[b]*

a CLOSER, Lindholmen Science Park Gothenburg and Swedish Transport Administration, Vikingsgatan 2, 411 04 Göteborg, Sweden
b Lund University, Box 118, 221 00 Lund, Sweden
** sten.wandel@tlog.lth.se*

Abstract

Most vehicles have GPS and internet connection via mobile network, usable for geofencing services. Australia introduced IAP 2003, Estonia started experimenting with VELUB 2010, and this paper reports on the development of ITK in Sweden. These types of systems are one way to control trucks larger than allowed for general access, so called High Capacity Vehicles. A system analyses estimated benefits of introducing such vehicles in Sweden to be up to 13 times the cost of upgrading the infrastructure. All three systems are based on installed fleet-manage-ment systems, where authorities get access to data regarding route, weight and types of vehicle modules for compliance checking. Three ITK demonstration systems were built, but ITK is not yet mandated by the government, mainly because the EU 96/53 directive is a potential obstacle. This new sharp policy instrument can also be used for environmental zones, speed management, prevent killing pedestrians and road pricing.

Keywords: Transport efficiency; Climate change; Digital infrastructure; Policy and regulation; Pavement and bridge loading; Compliance and enforcement

904 Earthworks degradations, climate change and complex systems: Data mining techniques searching for rail assets resilience

Iñigo Mingolarra-Garaizar[a]*, José Solís-Hernández[a], Noemí Jimenez-Redondo[a], Sunny Modhara[b], Caroline Lowe[b]

a CEMOSA, Benaque 9, Málaga 29004, Spain
b Network Rail, Elder Gate, Milton Keynes MK9 1EN, United Kingdom
** inigo.mingolarra@cemosa.es*

Abstract

The aim of this work is to improve understanding of earthwork degradation to enable better investment decisions. The relationship between earthwork failure, rainfall and saturated soil is well established. Yet many models of earthwork degradation do not explicitly include the impact of environmental exposure on earthwork degradation. A statistical analysis of variance strongly suggests that rainfall has a significant influence on earthwork degradation with embankments most vulnerable. Chalk and cohesive soil earthworks degrade faster with increasing rainfall whilst granular soils appear to be more resilient. Markov chain degradation models are generated to predict the earthwork degradation across different regions and earthwork types which exposes the effect of regional rainfall variations on degradation. Finally, because earthworks form part of the more complex railway system, a methodology, is proposed to identify rapid deterioration of an earthwork by studying the evolution of local track geometry measurements and environment.

Keywords: earthworks; predictive maintenance; climate change; ANOVA; Markov chains; clustering

908 Multi-year maintenance planning framework using multi-attribute theory and genetic algorithms

Zaharah Allah Bukhsh[a]*, Irina Stipanovic[a], Andre G. Doree[a]

a Department of Constructuion Management and Engineering, University of Twente, Enshcede, The Netherlands
** z.allahbukhsh@utwente.nl*

Abstract

This paper introduces a comprehensive framework for the development of optimal multi-year maintenance plans of a large number of bridges. A maintenance plan is said to be optimal when within the given budget, a maximum number of bridges is maintained in the best possible year, achieving maximum performance and minimum impact on the economy and society. The framework incorporates heuristic rules, multi-attribute utility theory, discrete Markov chain process, and genetic algorithms to find an optimal balance between limited budgets and performance requirements. The applicability of the proposed framework is illustrated on a case study of 869 highway bridges. The framework enables asset owners to execute various planning scenarios under varying budget and performance requirements where each resulting plan is optimal. The focus of this study has mainly been on the highway bridges, but the proposed framework is general and can be applied to any other infrastructure assets types.

Keywords: maintenance planning; multi-objectives; optimization; genetic algorithms; Markov decision processes; multi-attribute; utility function; bridges

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

1155 Long-term effects of different bridge maintenance strategies on multimodal transport

Irina Stipanovic[a,b]* Sandra Skaric Palic[a], Marieke S. van der Tuin[c], Jaap Baaker[d], Mirjam Bakx-Leenheer[d]

a Infra plan konzalting j.d.o.o., Luke Kaliterne 7, 10000 Zagreb, Croatia
b University of Twente, Faculty of Engineering Technology, P.O.Box 217, 7500AE Enschede, The Netherlands
c Delft University of Technology, Department of Transport & Planning, the Netherlands
d Rijkswaterstaat, Ministry of Infrastructure and Water Management, the Netherlands
** irina.stipanovic@infraplan.hr*

Abstract

There has been considerable investment in motorway networks in recent times, particularly as a result of EU structural funds. Nevertheless, much of the national road networks and the major elements of the rail infrastructure on the TEN-T network are up to 150 years old and were not designed to modern standards. The replacement cost of this infrastructure is prohibitive, and it is vital to develop a means of accurately quantifying the safety of these assets and tools to enable making of substantiated decisions in asset management processes. The SAFE-10-T project (Safety of Transport Infrastructure on the TEN-T Network) is developing a framework which aims to increase Safety on the TEN-T network through the use of smart infrastructure. The paper presents a whole life cycle model (WLCM)

integrating owners, users and societal costs related to different whole life cycle options, developed in this project and applied on a case study of a bridge in the Port of Rotterdam in the Netherlands.

Keywords: multimodal transport, smart infrastructure, risk, bridge, life cycle cost model

1.43 Scientific and technical session 43: Gender neutrality and special groups needs

250 Structuring the evaluation of the inclusion of women within the transport sector: A use case study based on the inclusion diamond model

Gemma Dolores Molero[a]* , Sara Poveda-Reyes[a], Chris Blache[b], Rawad Choubassi[c], Ludovico Boratto[d], Maria Chiara Leva[e], Francisco Enrique Santarremigia[a]

a AITEC, Parque Tecnológico, C/ Charles Robert Darwin, 20, Paterna 46980, Spain
b GENRE ET VILLE, 69 Rue Haxo, Paris 75020, France
c Systematica Srl, via Lovanio 8, Milan 20121, Italy
d EURECAT, C/ Bilbao 72, Barcelona 08005, Spain
e Technological University Dublin, Grangegorman lower, Dublin D07 H6K8, Ireland
** gmolero@aitec-intl.com*

Abstract

The transport sector is a sector dominated by men. Social norms and conducts have hindered the development of women under equal opportunities. Women have dealt with discrimination in recruitment procedures in job positions that have been historically developed by men or have suffered more sexual harassment in public transport than men. Women participate in different roles within the transport sector. In this paper, a series of goals and fairness variables for women"s inclusion are defined according to the DIAMOND methodology for four different real-world scenarios: as users of public transport infrastructure, as users of autonomous vehicles, as users of bicycle sharing services, and as workers in railway companies and freight transport companies. Further developments will focus on the analysis of gathered data, the definition of inclusion factors, and the assessment of the other vertexes and layers of the inclusion diamond model.

Keywords: women, transport system, inclusive transport, gender, fairness, inclusion diamond

Full paper: http://aitec-intl.com/articulo/61/structuring-the-evaluation-of-the-inclusion-of-women-within-the-transp/

407 Modeling female employees' ability to telecommute in Kuala Lumpur

Mootaz M. Jaff[a], Abdul Azeez Kadar Hamsa[b]*

a Centre for Foundation Studies, International Islamic University Malaysia, Paya Besar, Gambang, 26300, Malaysia
b Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia, P.O. Box 10, Kuala Lumpur, 50728, Malaysia
** azeez@iium.edu.my*

Abstract

Telecommuting is considered to be most apt for female workforce due to their added responsibilities to balance both work and family matters. This paper models the

ability of female employees to telecommute in the selected business organizations in Kuala Lumpur, Malaysia. Four job categories namely "clerical workers", "professionals", "associate professionals", and "managers" were selected to ascertain their perceptions on telecommuting through a questionnaire survey. A binary and an ordinal logistic regression model were used to evaluate the effects of the explanatory variables on the ability to telecommute. The results of the model reveal that 'prior experience working from home and 'increased frequency of telephone usage' almost doubles the ability to telecommute, whereas 'time spent working with others' and the 'usage of the photocopier' reduces it. Managers, Associate Professionals, Professionals were 3.5, 2.3 and 1.5 times more likely to be able to telecommute more frequently than Clerical workers.

Keywords: telecommuting; female workforce; binary logistic model; ordinal logistic model; Kuala Lumpur; Malaysia

635 Gender-related contemporary challenges in the transport ecosystem and women's mobility needs TInnGO (special session on "Women in Transport - EU Projects for Change")

Andree Woodcock[a]*, Lena Levin[b], Miriam Pirra[c] , Cathleen Schöne[d], Esti Sanvicente[e]

a Research Institute, Transport and Future Cities, Coventry University, a.woodcock@coventry.ac.uk, Coventry, CV1 3LD, United Kingdom
b VTI, The Swedish National Road and Transport Research Institute, lena.levin@vti.se, 581 95 Linköping, Sweden
c Politecnico di Torino - DIATI, miriam.pirra@polito.it, Corso Duca degli Abruzzi 24, 10129 Torino, Italy
d Fakultät für Elektrotechnik und Informationstechnik Fachgebiet Medienproduktion, cathleen.schoene@tu-ilmenau.de Technische Universität Ilmenau
e LGI Consulting Sarl, estibaliz.sanvicente@lgi-consulting.com Paris, France
** a.woodcock@coventry.ac.uk*

Abstract

TInnGO addresses contemporary challenges in employment, education and male-domination, through an intersectional analysis applied to examine inequality and privilege in transport and mobility. The European transport sector is marred by strong, persistent biases, which produce gender and other inequalities, permeating the sector whilst having wider repercussions in relation to quality of life, accessibility and inclusivity. The TInnGO project will create a framework and promote mechanisms for sustainable change in gender and diversity sensitive smart mobility through the development of a Pan European TInnGO observatory. This will lead, coordinate, and be fed by hubs across EU (UK, France, Germany, Greece, Spain, Portugal, Romania, Baltic states, Denmark/Sweden, Italy) providing leadership, innovation and critique of smart mobility innovations. The ambition is to become a template for further observatories monitoring and addressing barriers to women's mobility through gendered, culturally sensitive smart mobility innovations. This paper provides an overview of the concepts and initial results.

Keywords: Europe, co and participatory design, gender mainstreaming, gender and diversity sensitive, smart mobility

636 Elderly drivers with brain disorders: Is their driving behavior the same before and after an unexpected incident?

Dimosthenis Pavlou[a]*, Panagiotis Papantoniou[a], George Yannis[a], Sokratis G. Papageorgiou[b]

a National Technical University of Athens, Department of Transportation Planning and Engineering, 5 Heroon Polytechniou str., GR-15773, Athens, Greece

b Behavioral Neurology and Neuropsychology Unit, 2nd Department of Neurology, University of Athens, Greece
"Attikon" University Hospital, 1 Rimini Str, GR-12462 Haidari, Athens, Greece
** dpavlou@central.ntua.gr*

Abstract

The objective of this study is the comparison of driving behaviour of elderly drivers before and after an unexpected incident, by applying a large driving simulator experiment. More specifically, the impact of the presence of a brain disorder (Alzheimer's, Parkinson's disease, and Mild Cognitive Impairment), and the mobile phone use while driving is investigated. The driving behaviour was examined in terms of lateral position and mean driving speed. The driving task included driving in rural road, while various unexpected incidents were scheduled to occur. 125 elderly participants went through the whole experimental procedure. The General Linear Mixed Models indicated that all three diseases and the use of mobile phone were found to significantly affect the model regarding the driving speed before and after the incident. Analysing the lateral control measure it was observed that only PD out of the three examined diseases had a significant impact on the model.

Keywords: driving behaviour; unexpected incident; brain disorders; driving simulator

684 Women's mobility in Europe: An overview based on the Transport Research and Innovation Monitoring and Information System

Alejandro Ortega[a]*, Monica Grosso[a], Gary Haq[a], Anastasios Tsakalidis[a], Ferenc Pekár[a]

a European Commission, Joint Research Centre, Ispra, Italy
** Alejandro.Ortega-Hortelano@ec.europa.eu*

Abstract

Access to transportation and mobility, transportation safety, personal security, and participation in the transportation sector can have different issues and approaches depending on gender. This paper analyses gender differences in the transport sector across Europe using R&I projects listed in the EC Transport and Research and Innovation Monitoring and Information System. It firstly identifies key issues based on a survey of relevant literature and summarises EU policy initiatives and regulations that address gender equality and transport. Afterwards, it will study the evolution of European research in tackling women issues in transport. Thirdly, it will analyse women's participation in transport research and innovation activities, including descriptive statistics, key features and outlining relevant capacities. With this analysis, the paper will assess the progress, challenges and identify gaps and possibilities concerning women and mobility, as well as provide policy and future research recommendations to overcome the main barriers to women's equality in transport.

Keywords: gender issues, social issues, equity, societal impacts, transport research

694 Transforming city neighbourhoods in a child-friendly way to increase the quality of life for all citizens

A. Wong[a]*, N. van Apeldoorn[b], L. Dazzo[c], J.P. Glock[c], S. Wrighton[d], K. Reiter[d], H. Chivers[e], C. Ireland[e], J.M. Preston[a]

a University of Southampton, University Road, Southampton, SO17 1BJ, United Kingdom
b Breda University of Applied Sciences, Claudius Prinsenlaan 12, 4811 DK Breda, Netherlands

c Chair of Transport Ecology, Technische Universität Dresden, Hettnerstr. 1, Dresden 01069, Germany
d Forschungsgesellschaft Mobilität (FGM-AMOR), Schönaugasse 8a, 8010 Graz, Austria
e Southampton City Council, SO14 7LY, United Kingdom
** a.wong@soton.ac.uk*

Abstract

City planning has historically been largely top down, with a focus on economic development and motor car use, which has led to many problems. Although there is now a move towards liveable neighbourhoods that also encourage active mobility, the mechanisms for delivering this are still investigated, and city planners/policy makers need further ideas and inspirations to achieve these objectives. This paper therefore suggests how a bottom-up approach that engages children, and wider communities as a whole, can provide the motivations for change. The process involves engaging these groups in vision-building/co-design workshops to develop specific schemes, and widening the participation in implementation trials. Early results suggest this approach is important for gaining acceptance, as it empowers communities and especially children to work with local city and municipal councils. This in turn gives rise to growing appetite to develop neighbourhoods that are more child-friendly, which can also encourage greater walking and cycling.

Keywords: Child-friendly neighbourhoods; Future cities; Active mobility; Interventions in public space; Temporary street openings/closures; Tactical urbanism

727 Gender and Generation effects on Perception of Value of Travel Time and Mode Choice

Ghadir Pourhashem[a]*, Giuseppe Lugano[a]

a ERAdiate Team, University of Žilina, Univerzitná 8215/1, Žilina 01 026, Slovakia
** Ghadir.Pourhashem@erachair.uniza.sk*

Abstract

Women and men often do not experience equal mobility opportunities in their societies. Increasingly gender is being recognised to play a significant role in transport planning, particularly for addressing individual mobility needs in urban and rural areas. Recent advances in studying mobility behaviours (e.g., data collection through smartphone apps) also allow capturing data on activities done while travelling, as well as factors enhancing or degrading the people's travel experience. By understanding the link between female travellers' preferences, perceived values and behaviour, as well as experienced barriers, transport systems could be better tailored to women activity and mobility needs by putting the women perspective in centre stage. The objective of this paper is to present how the "Mobility and Time Value" (MoTiV) H2020 project addresses mobility value preposition differences across genders and generations in connection with cultural and social contexts in 8 EU countries.

Keywords: Value Proposition of Mobility, Daily Travel Patterns, Gender Sensitive Design, Mobility Planning, Transport Policy, Mode Choice

Full paper:
https://motivproject.eu/fileadmin/user_upload/dissemination/TRA2020_Gender_and_Generation_effects_on_Perception_of_Value_of_Travel_Time_and_Mode_Choice_.pdf

1097 Traffic Design for Ageing Population – Belgrade Case Study

Ana Trpković[a]*, Sreten Jevremović[a]

a University of Belgrade, Faculty of Transport and Ttraffic Engineering, Vojvode Stepe 305, 11000 Belgrade, Serbia
** a.trpkovic@sf.bg.ac.rs*

Abstract

Increasing number of older population represents a global demographic trend, as well as the growing density in urban areas. It is estimated that the share of the elderly in total population will increase from one in eight, as it is today, to one in five in 2030, where the term "old" refers to population older than 65 years. Ageing and urbanization introduce significant changes in structure and character of traffic demands in modern cities. Urban transportation systems should offer the equality and equity regarding service for all participants of the transportation process. Therefore, in previous period, Serbia has also started the process of inspecting, redefining and adapting its transportation systems to the requirements of older population, based on recent research and best practices regarding the mobility of older people. This paper gives a brief overview of research work and its results in this field on the case study of Belgrade.

Keywords: ageing population; urban transportation systems; traffic design; traffic safety

Full paper:
https://www.researchgate.net/publication/339827013_Traffic_Design_for_Ageing_Population_-Belgrade_Case_Study

1104 Co-creating mobility services with disabled and elderly people

Matti Luhtala[a]*, Maija Federley[a], Olli Kuusisto[a], Olli Pihlajamaa[a], Juho Kostiainen[a]

a VTT Technical Research Center of Finland Ltd, P.O. Box 1000, VTT, FIN-02044, Finland
** matti.luhtala@vtt.fi*

Abstract

This paper outlines a co-creation process including used participatory design methods for knowledge co-creation and lo-fidelity service prototyping, focusing on persons with reduced mobility and their use of public transport. The overall aim of the research was to co-create a design framework specifically aimed for developing IoT based accessible mobility solutions. Further, in this paper, we present a structure designed for participatory activities through an application of the framework. In practice, user research interviews and storytelling co-design workshop activities as a use case allowed us to refine the framework further by testing it in practice. Our initial results show that through an action oriented participatory design research approach designers and developers of accessible public transportation and mobility services are able to create comprehensive understanding of the humans, their activities and contextual service solutions.

Keywords: Accessibility; co-creation; co-design; IoT; public transport; people with disabilities; service design

1.44 Scientific and technical session 44: Corridors – connecting markets in a sustainable way

227 Mobility related trends and their implications on providing future-proof road networks

Karin Markvica[a]*, Gernot Lenz[a], Martin Reinthaler[a], Johannes Asamer[a], Stefan Seer[a], Martin Binder[b]

a AIT Austrian Institute of Technology, Center for Mobility Systems, Giefinggasse 4, 1210 Vienna, Austria b AUTOBAHNEN- UND SCHNELLSTRASSEN-FINANZIERUNGS-AKTIENGESELLSCHAFT, Rotenturmstrasse 5-9, 1011 Vienna, Austria
** karin.markvica@ait.ac.at*

Abstract

The last few years have brought about a rapid change in transport infrastructure and transportation technology. It is assumed that the mobility sector will continue to develop dynamically in the future which poses a challenge for the European Transportation Network. So far, strategic plans (CEDR Action Plan and EU Policy) have been elaborated to enable future-proof road networks. One key element in the process of developing visions and roadmaps for the coming years is the identification of space and infrastructure trends that trigger the development. This paper examines trends in mobility and spatial development that affect road networks. Based on the trends described, the implications for the road networks are pointed out and compared with innovative concepts and measures that already exist. This extended trend analysis enables a targeted development of visions and roadmaps to guarantee sustainable and fit-for-the-future road networks.

Keywords: mobility trends; trend analysis; concepts; road networks; European Transport Network

322 Rethinking planning for urban nodes and corridors: lessons from European practice

Kevin van der Linden[a]*, Sjaak van der Werf[a], Jos Arts[a,b]

a Rijkswaterstaat, P.O. Box 2232, 3500 GE Utrecht, The Netherlands
b University of Groningen, Faculty of Spatial Sciences, P.O. Box 800, 9700 AV Groningen, The Netherlands
** kevin.vander.linden@rws.nl*

Abstract

Achieving a smart, green and integrated transport system is essential to developing the (social-)economic and environmental vitality of European urban regions. A focus on innovative technical solutions will not be enough to cope with current developments. There is need for a coordinated approach that connects the world of infrastructure, mobility and freight/logistics with the world of urban and spatial development. This paper highlights experiences gained in so-called urban nodes – focusing on Vienna – and discusses the recommendations of Vital Nodes. This Horizon 2020-funded project focuses on integration of infrastructure planning, urban planning and freight transport for sustainably incorporating urban nodes into TEN-T corridors. Recommendations focus on network/spatial and governance/time dimensions, illustrated by input from stakeholder workshops in 18 urban nodes. The paper ends with conclusions on, e.g., the need to develop a mixture of different interventions to strengthen the relation between urban nodes and corridors for vital regional development.

Keywords: integrated planning; infrastructure planning; regional planning; urban nodes; TEN-T corridors; freight and logistics transport

348 Future scenarios for urban main road corridor co-design: Enhancing the European TEN-T network

Meng Lu[a]*, Peter Jones[b], Berisha Gelebo[a], Robbin Blokpoel[a]

a Dynniq, Basicweg 16, 3821 BR Amersfoort, The Netherlands
b University College London, Gower St, Bloomsbury, London WC1E 6BT, UK

* meng.lu@dynniq.com

Abstract

The paper presents a concept for developing and implementing procedures for the comprehensive co-design of urban main road corridor infrastructure feeding the European TEN-T network, to accommodate their current and future multi-modal and multifunctional requirements, and to address severe problems related to congestion, emissions, safety and security, in situations where building new roads is not an option. It investigates an approach to enable city authorities to make the best use of available road space, by optimally allocating the available capacity dynamically, in space and time. In addition, it analyses advances of emerging technologies and provide an example of future traffic management for the co-design of urban main road corridors.

Keywords: urban; space; ICT; traffic; corridor; prediction

Full paper: www.linkedin.com/pub/meng-lu/4b/12b/758

433 Transportation at the corridor-last mile interface: An international inventory of good practices in collaborative transportation planning

Niels Heeres[a]*, Maarten van der Leck[a], Robert Broesi[b], Tertius Hanekamp[c], Jos Arts[d]

a Sweco Netherlands, De Holle Bilt 22, 3732 HM De Bilt , The Netherlands
b MUST Städtebau, Eigelstein 103 - 113, Köln 50558, Germany
c TEMAH, Zandweg 90 3454 JX De Meern, The Netherlands
d University of Groningen, Faculty of Spatial Sciences, P.O. Box 800, 9700AV Groningen, The Netherlands & Rijkswaterstaat, P.O. Box 2232, 3500 GE Utrecht, The Netherlands
** niels.heeres@sweco.nl*

Abstract

National Road Authorities (NRAs) face fundamental challenges in improving the performance of their networks (i.e. robustness or connectivity), especially in urban regions at the interface of corridor-, regional- and last-mile traffic. In order to deal with these challenges, CEDR (European platform of NRAs) wants to explore options to engage in more collaborative planning approaches. As part of CEDR's Collaborative Planning call, the SPINdesign study aims to draw lessons for collaborative planning and design for transportation at the corridor-last mile interface. To this end, first an overview is made of good practices in collaborative strategies for transportation planning. Subsequently, a toolbox for collaborative planning and design is developed and tested in six pilot applications. Finally, the study concludes with a vision on the NRAs' position in collaborative transportation planning and design. This paper presents the outcomes of the first steps of the SPINdesign study, first conclusions, and an outlook to coming research activities.

Keywords: National Road Administrations; transportation planning; urban regions; transport systems; collaborative planning; corridor-last mile interface

460 Connecting the dots: Rethinking large-scale corridor infrastructure planning

Charlotta Faith Ell[a]*, Heikki Kalle[b], Jos Arts[c]

a Mid-Sweden University, Department of Ecotechnology and Sustainable Building Engineering, 831 25 Östersund, Sweden and Estonian Environment Institute (EKKI), Raekoja plats 8, 51004 Tartu, Estonia

b Estonian Environment Instiute (EKKI) Raekoja plats 8, 51004 Tartu, Estonia
c University of Groningen, Faculty of Spatial Sciences, Landleven 1, Groningen, 9747 AD, The Netherlands
** charlotta.faith-ell@wsp.com*

Abstract

Throughout Europe, huge investments in transport infrastructure are made, both by national and European authorities. Usually focus seems to be on improving individual links for individual modes in the form of largescale projects, despite the use of corridor-concepts in TEN-T policies. However, in practice this large-scale project planning proves to be cumbersome and results in cost overruns, time delays and limited public support. Often local (land-use) planning issues become the focus instead of the overall system of transport corridors connecting individual places and services. This paper explores the concept of corridor planning for large infrastructure development that connects with land-use development and (cross)national transport needs. To this end we explore cases throughout Europe. We argue the need for a programmatic approach that connects the individual dots of infrastructure and land-use project planning, while acknowledging the differences between the two and at the same time upholding the integrity as a corridor.

Keywords: cross-national corridors; TEN-T network; transport infrastructure planning; land-use planning; programmatic approach; corridor planning

503 RAGTIME holistic governance management tool for multimodal transport infrastructures

Maria Antonia Perez Hernando[a]*, José Alberto Armijo Prieto[b], Ignacio Robles Urquijo[c], Luis Acebes Escudero[a], Miguel Cuartas Hernandez[a], Tania Ivanova Ivanova[a], David Garcia Sanchez[b], María Zalbide Saenz De Buruaga[b]

a University of Cantabria, Avda. Los Castros sn, Santander 39005, Spain
b Fundación Tecnalia Research & Innovation, Parque Cientifico y Tecnologico de Bizkaia c\Geldo, Edif. 700, Derio-Bizkaia 48160, Spain
c WSP Spain Apia, Albert Einstein n6, Santander 39011, Spain
** antonia.perez@unican.es*

Abstract

RAGTIME governance management tool is a risk-based approach for multimodal Transport Infrastructure Asset Management. The governance tool implements a whole system planning software platform able to facilitate a holistic management throughout the entire lifecycle of infrastructures. The development is based on multi-scale data model that uses a risk-based approach, incorporating resilient concepts and mitigation actions to support infrastructure stakeholders during its whole life-cycle by fostering an electronic Tender Process procurement mechanism that promotes the transparency and efficiency, while reducing the risks of the process.

Keywords: Infrastructure governance; risk management; asset management optimization; multicriteria evaluation; structural health monitoring

Full paper: https://doi.org/10.5281/zenodo.3707781

560 Digitizing international and multimodal traffic management plans

Martin Nemec[a]*, Brane Nastran[b], Tamás Tomaschek[c]

a ASFINAG Maut Service GmbH, Am Europlatz 1, 1120 Vienna, Austria
b DARS d.d., Ulica XIV. divizije 4, 3000 Celje, Slovenia

c Magyar Közút Nonprofit Zrt., Fényes Elek utca 7-13, 1024 Budapest, Hungary
** Martin.Nemec@asfinag.at*

Abstract

A traffic management plan comprises strategies and operative measures to ensure a continuous traffic flow in abnormal situations (e.g. in case of long-term roadworks or motorway closures due to incidents). It is imperative that traffic management plans are established and coordinated beyond organizational borders of relevant stakeholders, e.g. rail and road infrastructure operators, railway companies and public service providers. In the region of Austria, Slovenia and Hungary, the road operators ASFINAG (Austrian motorways), DARS (Slovenian motorways) as well as KÖZÚT (Hungary public roads) have been using such basic traffic management plans on regional as well as on international levels for years. In order to improve the information transmission along the complete chain, the above-mentioned partners are fully committed to further widen the cooperation. The paper will give an overview of existing and future cooperations across national and organizational borders in this region.

Keywords: traffic management, international routing, operator routing, MaaS, coordination, traffic management plan

695 CaaS from pilots to business

Lasse Nykänen[a]*, Matti Lankinen[a], Pekka Eloranta[b],Laura Riihentupa[b], Noora Lähde[c]

a Vediafi, Valimotie 13A, Helsinki 00380, Finland
b Sitowise, Åkerlundinkatu 11 A, Tampere 33100, Finland
c Traficom, Kumpulantie 9, 00520 Helsinki, Finland
** lasse.nykanen@vedia.fi*

Abstract

The aim of this paper, is to describe how a new concept for logistics, CaaS (Corridor as a Service) has been developed from research initiative to commercial service portfolio under PPP collaboration. An open ecosystem approach and learning by doing in pilot projects in open environment have been enablers and fundaments for the CaaS development. The concept aims to intensify logistics by utilizing data, digital services and by enabling data sharing among stakeholder network. The goal for CaaS is to enable smooth freight and data flow in international multimodal logistics network and hence offer benefits and new solutions for both freight consignors and logistics service providers. The Caas concept integrates traffic and transport information to logistics processes, which traditionally produce a lot of information and paper documents. A shift from paper-based documentation towards digital data-based approach enables a new way to manage and organize logistics services and to cut-off inefficiency.

Keywords: CaaS; logistic; data; digital services; multimodality; freight

Full paper:
https://drive.google.com/open?id=11SmVbzoSNiIj2MpSP4Lz_1Pls_NLfgms

964 Integrating environmental impacts in an intercity corridor level pricing scheme

Carlos Sampaio[a]*, Margarida C. Coelho[a], Eloísa Macedo[a], Jorge M. Bandeira[a]

a University of Aveiro, Centre for Mechanical Technology and Automation (TEMA) Department of Mechanical Engineering, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

* c.sampaio@ua.pt

Abstract

A significant part of the transport sector externalities occurs in intercity corridors, which account for 65% of the total of the kilometers travelled in for example, Portugal (for 2017). A thorough analysis of intercity corridors characteristics has been receiving less attention compared to urban roads. The objective of this work is to propose a methodology to tackle intercity corridors issues with respect to environmental impacts. It will focus on suggesting smart and dynamic toll systems, integration of impacts in pricing schemes, and optimization of public transport fares, coupled with a scheme based on the "polluter pays" principle. This vision paper presents the main objectives and methodology of an ongoing research in which the final objective is to lead to a more efficient usage of the infrastructures. The optimization is mainly focused on an environmental perspective, which can be important for decision-makers to improve specific intercity corridor measures/policies.

Keywords: Intercity corridors; external costs; toll design; fare optimization

Full paper:
https://www.researchgate.net/publication/339747332_Integrating_environmental_impacts_in_an_intercity_corridor_level_pricing_scheme

1.45 Scientific and technical session 45: Innovation for a multimodal society

316 Three key drivers of European transport research as barriers to sustainable mobility

Ángel Aparicio[a]*

a Technical University of Madrid (UPM), Escuela de ingenieros de caminos, Madrid 28040, Spain
** angel.aparicio@upm.es*

Abstract

This paper explores the main drivers of the implementation of transport research results in Europe. It reviews the EU policy documents on transport and research since the 1990s and the results of the review of a sample of transport research projects completed in 2014. Three key drivers are identified: the dominance of a market-based approach to the implementation of innovation; the limited autonomy of transport research, due to its increasingly subsidiary position vis-à-vis the Information and Communication Technologies (ICT) sector; and the highly contextual character of transport innovation, due to the strong embedment of mobility within lifestyles and production patterns. The relevance of the three drivers identified suggest the need for the EU transport research policy to set up research agendas with more ambitious long-term perspectives, and to strengthen efforts in demonstration activities that can provide a deeper insight on the necessary reconfigurations of the governance framework.

Keywords: Transport research policy; innovation implementation; Europe; living labs

Full paper:
https://www.researchgate.net/publication/339916406_Three_key_drivers_of_European_transport_research_as_barriers_to_sustainable_mobility

633 Getting ready for the future: How can we reach user-centric mobility in Europe by 2030?

Imre Keseru[a]*, Beate Müller[b], Marcia Urban[c], Erzsebet Foldesi[d], Linda Napoletano[e], Thierry Coosemans[a], Cathy Macharis[a], Alain L'Hostis[f]

a Vrije Universiteit Brussel, Department BUTO, MOBI Research Centre, Pleinlaan 2, Brussels 1050, Belgium
b VDI-VDI-IT, Berlin, Germany
c Bauhaus Luftfahrt, Munich, Germany
d Budapest Association of Disabled Persons, Budapest, Hungary
e Deep Blue, Rome, Italy
f LVMT, Univ Gustave Eiffel, IFSTTAR, UPEM, ENPC, 77447 Marne-la-Vallée, France
** imre.keseru@vub.be*

Abstract

The Mobility4EU project created a vision for a user-centric and cross-modal European transport system in 2030 and an Action Plan to implement it. We used a combination of creative and analytical methods to come from problem identification to the Action Plan applying a user-centric methodology that included stakeholders within a participative process. First, dominant societal trends influencing mobility and logistics were identified. Then four scenarios were co-created using the intuitive logic method. The scenarios were evaluated with the multi-actor multi-criteria analysis to select the ones that are preferred by the majority of stakeholders. Then a common vision was developed and an action plan was created that fulfils the vision. Three priority areas for further research, innovation and collaboration have been identified in order to address the gaps in user-centric transport: Improving participation in urban mobility planning; Mainstreaming universal design and user-centric approaches; Viable business for seamless transport.

Keywords: scenarios, vision, roadmap, multimodal transport, co-creation, mobility as a service, universal design

Full paper: https://doi.org/10.5281/zenodo.3707706

836 The role of the duraBASt research facility in an innovation ecosystem: An innovation management portfolio analysis

B. Gyergyay[a]*, S. Höller[a], L. Pinkofsky[a]

a Bundesanstalt für Straßenwesen, Brüderstraße 53, Bergisch Gladbach, 51427, Germany
** gyergyay@bast.de*

Abstract

In order to facilitate innovation in the road construction sector the German Federal Highway Research Institute (BASt) has set up in 2017 an external demonstration, investigation and reference area, the duraBASt. Investigation fields and demonstrators enable realistic tests on a scale of 1:1. The aim of this unique research facility is to significantly shorten the time required from the idea of an innovation to its standard application. The duraBASt also fills the gap between small scale research in a laboratory and the very complex process of setting up a test track on the road network. In order to improve the future selection of research projects on the duraBASt an innovation management portfolio analysis was conducted to analyse the research projects that were completed on the duraBASt. This paper shows the results of this analysis and provides recommendation how research projects can be evaluated on their innovation characteristics.

Keywords: research facilities, road construction, innovation management

Full paper:
https://www.researchgate.net/publication/340101109_The_role_of_the_duraBASt_research_facility_in_an_innovation_ecosystem_An_innovation_management_portfolio_analysis

858 Smart mobility co-innovation: Aligning research activities for stakeholder needs

Juho Kostiainen[a]*, Tuomo Kinnunen[b], Katri Valkokari[a]

a VTT Technical Research Centre of Finland, Vuorimiehentie 3, Espoo 02150, Finland
b VTT Technical Research Centre of Finland, Kaitoväylä 1, Oulu 90570, Finland
** juho.kostiainen@gmail.com*

Abstract

Mobility and transport services ranging from traveller information and traffic management to vehicle solutions are increasingly based on data from multiple sources. They are often delivered by a network of versatile organisations. The development of new data-driven solutions to address major challenges and business opportunities requires various skills and technologies but also new business models. In order to find win-win situations for different business and societal goals requires collaboration and joint development. This paper studies and reflects on experiences of building co-funded innovation ecosystems, and especially aligning research activities for innovation ecosystem stakeholder needs. Key issues to consider include timelines of when research results can be applied and how broad the potential fields of application are as well as addressing societal trends and future opportunities. The results contribute to knowledge creation within shared co-innovation arena – building up and conducting smart mobility co-innovation projects – aiming to serve both practitioners and researchers.

Keywords: innovation; ecosystem; co-development; triple helix; quadruple helix

1000 WATERBORNE: Improving European transport with Maritime Intelligent Transport Systems – Identification of important technology gaps

Ørnulf Jan Rødseth[a]*, Kwangil Lee[b], Jukka Merenluoto[c]

a SINTEF Ocean, Otto Nielsens vei 10, 7045 Trondheim, Norway
b Korea Maritime and Offshore University, Address, City and Postcode, Country
c DIMECC, Lemminkäisenkatu 32, 20520 Turku, Finland
** ornulfjan.rodseth@sintef.no*

Abstract

The transport sector is a significant contributor to greenhouse gas emissions and these emissions must be reduced. Maritime transport is essential in international trade and is a greener alternative to road transport. New energy systems and cleaner vehicle and cargo technology can reduce maritime emissions, but improved transport system efficiency is also important. Efficiency is improved by better logistics and/or increased automation. This requires automation of administrative work processes and better access to transport information. In the road sector, Intelligent Transport Systems (ITS) play an important role and this paper will explore how ITS type technology is being deployed in the maritime sector and how this links to Shipping 4.0. This includes digitalization of business to administration (B2A) as well as business to business (B2B) information exchanges. Due to shipping's international nature, the paper will also look at the role of international organizations and standards.

Keywords: Waterborne transport, innovation, sustainability, ITS, digital infrastructure, digital economy

Full paper:
https://www.researchgate.net/publication/339746640_WATERBORNE_Improving_European_transport_with_Maritime_Intelligent_Transport_Systems_-_Identification_of_important_technology_gaps

1129 Towards growth, employment and exports - A case study of MaaS as platform business

Heidi Korhonen[a]*, Kirsi Hyytinen[a]

a VTT Technical Research Centre of Finland, P.O.Box 1000, Espoo 02044 VTT, Finland
** heidi.korhonen@vtt.fi*

Abstract

The transport sector is going through major changes, one of them being the formation of platform business models. Mobility as a Service is one example of new business areas where platform business can be formed. We did a small case study based on interviews to find out how such platform business could form growth, employment and exports for Finland. The purpose of this paper is to describe the results of the interviews analyzed in the theoretical framework of sociotechnical transition.

Keywords: MaaS, Mobility as a Service, platform business, policy, ecosystems

1139 Solving urban problems through co-creation: The LOOPER project

Jesse Pappers[a]*, Imre Keserü[a], James Evans[b], Janice Astbury[b], Massimiliano Condotta[c], Joe Ravetz[b], Chiara Scanagatta[c], Cathy Macharis[a]

a Vrije Universiteit Brussel, Pleinlaan 2, Brussels 1050, Belgium
b University of Manchester,Oxford Rd, Manchester M13 9PL,United Kingdom
C University IUAV Venice, Santa Croce 191, Venice, Italy
** jesse.pappers@vub.be*

Abstract

The aim of this paper is to present the LOOPER participatory co-creation methodology and platform developed in the Learning Loops in the Public Realm (LOOPER) project to demonstrate 'learning loops' i.e. new ways of decision-making which bring together citizens, stakeholders and policy-makers to iteratively learn how to address urban challenges. The methodology and platform are demonstrated in three Living Labs with different spatial, cultural and thematic contexts. The main issues are traffic and mobility in Brussels; traffic and green space in Manchester; and air and noise pollution in Verona. The paper discusses the LOOPER approach to support finding solutions to urban problems in a participatory co-creation process. The experiences from the LOOPER Living Labs show that combining offline and online participation tools is often necessary in co-creation and that online tools should have a low entry threshold. Furthermore, formal evaluation methods can be effective tools in ensuring stakeholder participation.

Keywords: co-creation; traffic safety; air pollution; urban living labs; public participation

Full paper:
https://www.researchgate.net/publication/339848880_Solving_urban_problems_through_co-creation_The_LOOPER_project

1.46 Scientific and technical session 46: Advances in Public-Private Partnerships

54 Operationalising ITS: how much is the transport industry really investing in digitalisation and how has that changed its productivity?

Pekka Leviäkangas[a]*, Osmo Kauppila[b]

a Principal Scientist, Docent in Industrial Engineering and Management
b Senior Lecturer in Industrial Engineering and Management
** pekka.leviakangas@oulu.fi*

Abstract

This paper demonstrates the level of digitalisation of different industries in two case countries: Finland and Australia. The empirical longitudinal data sets are retrieved from the national accounts of the two countries' official statistical offices and the Eurostat. The proxies for levels of digitalisation are the investments made in information and communications technology. According to the results, the transport industry one of the least digitalised industries, in both countries. Therefore the transport industry has a significant investment gap when compared to other industries, which means that the concept of 'Intelligent Transport System' somewhat lacks credibility in operational and empirical sense. The productivity of the transport industry has been modest, and it seems that the correlation between industries' productivity and investments in digitalisation is weak.

Keywords: Digitalisation, investment, transport industry, productivity

161 Identification and Analysis of Critical Success Factors in High-Speed Railway Lines Contracted by Public–Private Partnerships: Three Case Studies in France

Mario González-Medrano[a]*, Tomás García Martín[a]

a Camilo José Cela University, Almagro 5, Madrid 28010, Spain
** mario.gonzalez@alumno.ucjc.edu*

Abstract

Contracting infrastructure by public–private partnerships (PPP) is a rare model for high-speed railway lines but is an established model for other transports or public services. This article takes as its starting point the possibility that the railway sector is not as efficient as it could be due to its unique framework of public railway managers, operators and exclusive public investment. In France, three high-speed railway lines have been contracted by PPPs: Sud-Europe Atlantique, Bretagne-Pays de la Loire and Contournement Nîmes-Montpellier. This article presents a detailed identification and analysis of the critical success factors for each line and the development of a new efficient PPP model for implementation in future high-speed railway lines.

Keywords: critical success factor (CSF); public-private partnership (PPP); high-speed line (HSL); high-speed train (HST); infrastructure; finance

199 Comprehensive assessment of the implementation of public-private partnership in transport infrastructure

Yuliia Bibyk[a], Olena Belska[b]*

a M.P. Shulgin State Road Research Institute State Enterprise – DerzhdorNDI SE, 03113 Kyiv, Ukraine
** Belskaya30@ukr.net*

Abstract

The implementation of public-private partnerships (PPPs) is an important step for the industry modernization, improving of work quality and creating a competitive environment. Research in this direction and the development of methodological recommendations will allow determining the economic efficiency when concluding PPP contracts for customer and investor and social efficiency for direct users of a concession road. The determination of the socio-economic effect for entities of concession and other public-private partnership projects will contribute to the effective investment of funds in the project and the possibility of obtaining profit from management of a concession or other public-private partnership project.

Keywords: public-private partnership; socio-economic effect; integrated index; users, state

Full paper: https://doi.org/10.26226/morressier.5e4fe9bd6bc493207536f5cf

265 Accelerating autonomous public transportation by Public-Private Partnerships

Ulla Tikkanen[a]*, Renske Martijnse-Hartikka[b] , Oscar Nissin[c]

a Forum Virium Helsinki, Unioninkatu 24, 00250 Helsinki, Finland
b Forum Virium Helsinki, Unioninkatu 24, 00250 Helsinki, Finland
c Metropolia University of Applied Sciences, Myllypurontie 1,00920 Helsinki, Finland
** ulla.tikkanen@forumvirium.fi*

Abstract

This paper describes how PPPs contribute to developing novel solutions needed in cities preparing for autonomous mobility future. Currently, there is gap between the ambitions and knowledge between the supply and demand side. In Helsinki, there is a long history of successful PPP collaboration with automated shuttle trials. The city's innovation company, Forum Virium Helsinki (FVH) is currently leading a cross-European FABULOS project, focusing on R&D performed by private companies. The project aims to developing solutions for smart systems operating automated shuttles as part of public transportation. Here, we share the phase by phase results of the project, together with our learnings related to PPP: how to target private companies' development efforts to meet cities' mobility needs. Cooperation between public and private sector is key in achieving successful trials, regulation and implementation of AVs as part of cities' mobility systems.

Keywords: Automated Shuttles, Public-Private Partnership, Innovative Procurement

307 New modes of financing public transport in Germany - Estimating the impacts of three tariff and financing instruments on demand and revenue

Dominik Bieland[a]*, Carsten Sommer[a]

a Universität Kassel Mönchebergstraße 7, 34125 Kassel, Germany
** d.bieland@uni-kassel.de*

Abstract

This article presents three tariff and financing instruments and offers estimates of the effects of their implementation on passenger demand and the revenues of transport association of the Rhine-Main-Area (RMV) in Hesse over the course of the investigation period based on model calculations. The following instruments were analyzed: The introduction of a cost-saving annual season ticket covering all of Hesse, a resident ticket allowing all residents of Hesse to use public transport without further payment in exchange for paying a mandatory solidarity contribution, and a so-called basic price offer, with all residents of Hesse paying a mandatory solidarity contribution, based on which ticket prices for fares for occasional customers (single fare, day ticket) are cut in half.

Keywords: public transport, public transport tariffs, passenger demand, new business models, ticketing, mobility as a service

Full paper: www.researchgate.net/publication/339376921

390 Does land value capture succeed or fail in urban rail transit PPPs: Lessons from Hong Kong and Delhi

Xinjian Li[a]*, Peter E.D. Love[a]

a School of Civil and Mechanical Engineering, Curtin University, GPO Box U1987, Perth 6845, Australia
** xinjian.li@postgrad.curtin.edu.au*

Abstract

Land Value Capture (LVC) has been recognized as a feasible mechanism that can improve the viability of Urban Rail Transit (URT) systems delivered through the Public-Private Partnerships (PPPs). Yet, the employment of LVC in URT PPPs projects has been limited. The diverse experiences of Hong Kong and Delhi contain valuable lessons for other cities worldwide. In this paper, analyze the distinctive features of the Hong Kong Mass Transit Rail and Delhi's Airport Metro Express that utilized a PPP and LVC, which utilized a consortium structure contracted to deliver and operate the rail line and designed LVC funding mechanism. Our analysis of the Hong Kong and Delhi experience provide governments with invaluable insights that can be used to improve future decision-making and policy development around URT.

Keywords: Public-Private Partnership, consortium structure, finance, land value capture, rail

Full paper:
https://www.researchgate.net/publication/339787843_Does_land_value_capture_succeed_or_fail_in_urban_rail_transit_PPPs_Lessons_from_Hong_Kong_and_Delhi

539 Has the latest global financial crisis changed the way road publicprivate partnerships are financed? A comparison of Europe and Latin America

Ana Nikolić[a]*, Athena Roumboutsos[b], Jelena Ćirilović Stanković[c], Goran Mladenović[a]

a University of Belgrade, Faculty of Civil Engineering, Bulevar kralja Aleksandra 73, 11000 Belgrade, Serbia
b University of Aegean, Department of Shipping, Trade and Transport, 2A Korai Street, Chios Island, 82100 Greece
c IMS Instutute, Bulevar vojvode Mišića 43, 11000 Belgrade, Serbia

* anikolic@grf.bg.ac.rs

Abstract

Public-private partnerships (PPPs) have been widely promoted to assist governments with limited or restricted budgets, especially in the transport sector. A financial/economic crisis may have an adverse effect on transport PPPs as both traffic demand is negatively influenced, and governments are further under pressure. However, research on awarded road PPP contracts over a 20-year period in the European Union (EU) and Latin America and the Caribbean (LAC) showed that the market slowdown is brief and followed by a re-bounce leading to an overall upward trend. The LAC region has experienced multiple financial setbacks with no significant change in the PPP market structure as opposed to the EU, where significant changes were observed concerning a shift in the remuneration schemes employed (demand-based to availability-based) while countries active demonstrate a positive sovereign macroeconomic outlook seeking value-for-money through private sector efficiency.

Keywords: global financial crisis; public-private partnership; remuneration scheme; roads

This paper is a part of the Utilities Policy Special Issue:
https://www.sciencedirect.com/journal/utilities-policy/special-issue/10D8V459F11

788 Is ex-post fiscal support to PPPs sustainable? The case of government loans to shadow toll roads in Spain

Laura Garrido[a]*, José Manuel Vassallo[a]

a Centro de Investigación del Transporte (TRANSyT), Universidad Politécnica de Madrid, Calle Profesor Aranguren s/n, 28040 Madrid, Spain
** l.garrido@upm.es*

Abstract

Budgetary constraints are prompting many governments to encourage private financing of transportation infrastructure through Public Private Partnerships (PPPs). Fiscal support measures have been often used to improve the financial feasibility of these projects, but also to compensate PPP contractors for changes imposed by the government. This paper analyses the awarding of subordinated public participation loans (SPPLs) to ten brownfield shadow-toll motorway PPPs in Spain after additional works were imposed. This paper evaluates the financial and social impacts of the awarding of these government loans to three of these projects. To that end, the SPPL repayment capacity of the PPP contractors and the social benefits derived from improved road safety are estimated to evaluate whether the government's decision to support these projects was socially justified. The results show that, although the government's decision was reasonable, the SPPL design and its awarding conditions should be improved to guarantee the public interest.

Keywords: government support; financial sustainability; infrastructure financing; public-private partnerships; shadow-toll road

883 From business models to value networks and business ecosystems – what does it mean for the economics and governance of the transport system?

Pekka Leviäkangas[a], Risto Öörni[b]*

a Principal Scientist, VTT Technical Research Centre of Finland Ltd., PO Box 1100, Oulu 90571, Finland

b Senior Scientist, VTT Technical Research Centre of Finland Ltd, P.O. Box 1000, 02044 VTT, Finland
** risto.oorni@vtt.fi*

Abstract

The entire transport sector is experiencing disruption on a global scale due to a number of drivers. These include the drivers of technology, changes in governance structures, a range of environmental challenges, and the need to provide mobility regardless of social status or income level. To realise socio-economically worthwhile investments in the transport system, particularly where new technologies are involved, a fresh views of the economy and investment are needed. This paper explores the relationship between business models, value chains and business ecosystems and demonstrates a meta-model for a transport-related services that involve profound incorporation of new technologies. The meta-model consists of four elements: end customer value (value proposition to the end user), business value (shareholder value), collaborative value (business value to the supply chain) and societal value (value creation in the supply chain and control of negative externalities). The meta-model is tested with a case study.

Keywords: Intelligent transport systems, business ecosystem, meta-model

This paper is a part of the Utilities Policy Special Issue:
https://www.sciencedirect.com/journal/utilities-policy/special-issue/10D8V459F11

Full paper: https://doi.org/10.1016/j.jup.2020.101046

1002 Public-private partnerships for infrastructure - an integrated PPP model to manage stakeholders' interests and distributional effects

Pekka Leviäkangas[a]*, Athena Roumboutsos[b], Thierry Vanelslander[c]

a Principal scientist, PO Box 1100, Oulu 90571, Finland
b Professor, University of the Aegean, Greece
c Professor, University of Antwerpen, Belgium
** pekka.leviakangas@oulu.fi*

Abstract

Public-private partnerships (PPP) are considered an alternative to the delivery of transport infrastructure, where the issue of funding (repayment of invested capital) is postponed to 'a better future' or shared among indirect and direct users and beneficiaries. This paper introduces an integrated model how to analyze PPP investments. The model has been developed on the basis of empirical cases and analysis on the financial ratios of Finnish infrastructures and utilities. Three resolution levels are identified by the model: project level, business ecosystem level, and the market and societal level. The model shows the relevance of stakeholder management when designing PPPs. The integrated model suggests that investing in merely financially viable projects is not sufficient to realize economically and socially sustainable and acceptable projects.

Keywords: public-private partnership, investments, infrastructure, business ecosystem, project

1090 Public-Private Partnerships: The 50,000 foot view from seven countries

Karim Nour[a]

a Independent study, Egypt

* karim.nour@caa.columbia.edu

Abstract

Public-Private Partnership (PPPs) projects elude consistent definition, but typically involve some combination of private financing, long-term risk sharing between firm and client, and outcomes measured by long-term results. After two and a half decades and well over 1,000 PPP projects, what is the general consensus on how PPP has performed? Strangely, there isn't one; PPP has been nearly abandoned in its country of origin; at the same time, other countries are rushing to develop PPP frameworks and attract foreign PPP expertise. Why the inconsistency? Are PPPs suited to some types of projects, and not others? Are some PPP models more effective? Are some countries better suited to PPP implementation? With these questions in mind, the author sought to glean a high-level review of PPPs from seven industrialized countries: the UK, Ireland, Finland, Sweden, Canada, Australia and New Zealand. Research was conducted primarily through interviews with government, academics, contracting firms, financial institutions, and rating agencies.

Keywords: PPP; public-private partnership; alliance; infrastructure; project finance

1.47 Scientific and technical session 47: Building human capital for the future mobility system

93 The Role of Education for Sustainable Urban Mobility

Lucia Ilieva[a]*, Lachezar Rossenov[a], Nikolay Simeonov[b]

a CSDCS, Dospat Str. 28-A, Sofia – 1463, BULGARIA
b Ruse Municipality, Svoboda Sq. 1, Ruse - 7000, BULGARIA
** mail@csdcs.org*

Abstract

The paper covers the current status of the implemented education on mobility management in the frames of the CIVITAS ECCENTRIC Project in Bulgaria, with a special focus on communication and experimentation of sustainable mobility offers. It is intended to overcome the dual structure of overvalued motorized private transport on the one hand and local public transport and pedestrian and bicycle mobility on the other. Successful mobility management also includes professional marketing that addresses different target groups. The training activities in Ruse encourage various actors, stakeholders and users of public transport and mobility services to adopt sustainable mobility habits in order to make walking and cycling safer and a more desirable way of travelling in the neighbourhood and periphery. Particular emphasis focuses on road safety to raise public awareness and reduce the risk of road accidents.

Keywords: education; training; mobility management; road safety

Full paper:
http://www.csdcs.org/images/stories/02.projects/25.eccentric/tra2020/tra2020_lucia_ilieva.pdf

211 Learnings from the Mobility and Logistics B.Sc. degree program at Rhine-Waal University of Applied Sciences

Amir Duri[a]*, Dirk Bruckmann[a]

a Rhine-Waal University of Applied Sciences, Friedrich-Heinrich-Allee 25, Kamp-Lintfort 47475, Germany

* amir.duri@hochschule-rhein-waal.de

Abstract

The need for logistics and transport professionals is increasing as economic relations become more globalised. The Mobility and Logistics bachelor's degree program taught at Rhine-Waal University of Applied Science in Kamp-Lintfort, Germany, was established in 2009 and offers a formal framework for students to acquire the required knowledge to integrate as professionals into logistics and transport related industries. This paper aims to shed light on the learnings that have emerged as a result of 10 years of teaching this program. These learnings include the knowledge gaps which were detected in graduates and the resulting partial restructuring of the degree program. The above-mentioned learnings may serve as a reference for other similar degree programs as there is a clear lack of research done in the field of logistics and transport education.

Keywords: logistics education; mobility and logistics

239 A social network perspective on learning and adaptivity in project-oriented organizations in transport infrastructure planning

Bert de Groot[a,b]*, Wim Leendertse[a,b], Jos Arts[a]

a University of Groningen, Faculty of Spatial Sciences, Landleven 1, Groningen, 9747 AD, the Netherlands
b Ministry of Infrastructure and Water Management, Rijkswaterstaat, Griffioenlaan 2, Utrecht, 3526 LA, the Netherlands
** e.a.j.de.groot@rug.nl*

Abstract

The management of transport infrastructure networks in European countries, such as the Netherlands, is currently being challenged by uncertain developments like climate change, the emergence of new mobility technologies, the ageing of infrastructure and the energy transition. This necessitates an adaptive management approach towards existing and new infrastructure. Literature describes learning as a key element of adaptivity, but how do infrastructure network agencies learn from their practice? Most agencies manage their networks in a project-oriented way, which commonly implicates that intra-project relationships are strong compared to interand meta-project relationships. Assuming that a certain mix of weak and strong relationships is necessary for an organization to be adaptive, patterns in and strengths of relationships in social networks were analysed from the perspective of collective learning. The findings are based on an in-depth case study of Rijkswaterstaat – the agency responsible for the main road and waterway networks in the Netherlands.

Keywords: adaptivity; collective learning; project-oriented organization; social networks; transport infrastructure planning

327 Partnerships in "Horizon Europe" and Innovation strategy of the Czech Republic

Miroslav Haltuf[a]*

a Vice-chairman of the Shift2Rail States Representatives Group, Washingtonova 1567/25, Prague 1, CZ-110 00, Czech Republic
** miroslav.haltuf@hcomp.eu*

Abstract

The presented paper describes the legal process of Horizon Europe and Partnerships within it from Member States' point of view and from the point of view of the already

existing initiative Shift2Rail, whilst showing the importance of Partnerships for the railway sector. It emphasizes new aspects of automation, digitalization, and mobility as a service. Finally, it covers synergies of the innovation strategy of the Czech Republic and the mentioned activities, keeping in mind the new official slogan - Czech Republic, the country of the future.

Keywords: Public-Private Partnerships, Trans-European Networks, regulation, research and innovation strategy, policy, financing, funding

Full paper: https://puu.sh/FhpPs/1b8bb5a1df.pdf

490 Research and Innovation Capacity Mapping of the European Transport Sector

Monica Grosso[a]*, Mitchell van Balen[a], Alejandro Ortega Hortelano[a], Ferenc Pekar[a]

a European Commission, Joint Research Centre (JRC), Via Enrico Fermi 2749, 21027, Ispra (VA), Italy
** monica.grosso@ec.europa.eu*

Abstract

Research and innovation (R&I) in the transport sector plays an essential role towards cleaner, fairer and more competitive transport. Many governments support transport R&I through funding and support programmes, and therefore need to understand a country's or region's capacity to innovate. A systemic need, therefore, exists to conduct robust assessments of the barriers and opportunities for innovation. This paper illustrates two approaches, macro and micro-level analyses, and addresses their strengths and weaknesses. Examples are provided based on statistical output and on the Transport Research and Innovation Monitoring and Innovation System (TRIMIS). The paper concludes with recommendations on how to combine both approaches to develop more insightful assessments on transport R&I capacity.

Keywords: Research and innovation; innovation capacity mapping; funding; investment needs; Europe

Full paper:
https://www.researchgate.net/publication/339882863_Research_and_Innovation_Capacity_Mapping_of_the_European_Transport_Sector

625 A new type of delivery jobs in large cities: On-demand instant delivery couriers in Paris

Anne Aguilera[a], Laetitia Dablanc[b]*, Alain Rallet[c]

a IFSTTAR Univ of Paris-East, France
b IFSTTAR Univ of Paris-East, France
c Univ of Paris-South, France
** laetitia.dablanc@ifsttar.fr*

Abstract

The article focuses on a rapidly growing phenomenon: the development of instant delivery platforms in major cities around the world. Two surveys were conducted in 2016 and 2018 among couriers operating in the eastern part of the city of Paris. The data characterize the socio-economic profile of delivery workers and their working conditions, such as their legal status, the number of working hours per week, the delivery conditions, as well as more subjective information on the difficulties encountered and ideas for improvement from the couriers. As it develops, instant delivery in eastern Paris seems to become increasingly a full-time

activity for young people leaving school early, rather than an income supplement. The article also highlights the vulnerability of couriers in the face of the conditions set up by the platforms as well as by regulations.

Keywords: on-demand delivery, instant delivery, city logistics, gig economy, crowd delivery

776 Evaluation of current European open science initiatives in transport research

Afroditi Anagnostopoulou[a], Attila Akac[a]*, Maria Boile[b]

a Hellenic Institute of Transport, Centre for Research and Technology Hellas, G. Kassimati 1, Piraeus 18531, Greece
b Hellenic Institute of Transport, Centre for Research and Technology Hellas, Aigialeias 52, Marousi 15125, Greece
** akac.attila@certh.gr*

Abstract

Latest technological developments have endorsed the creation of new collaborative tools and enabling transport research community information sharing. Following these technological directives, European Commission is continuously developing appropriate initiatives that aim at making science more efficient and reproducible to societal and economical expectations. This paper conducts an analysis and evaluation of exploited Open Science initiatives and open access platforms in Europe. The proposed analysis presents clusters of possible use areas with respect to different challenges that key actors in transport research may face. The focus is given on the evaluation of different combined factors which could be used as a qualitative measurement for existing Open Science tools. Subsequently, relevant stakeholders could acknowledge the existence of Open Science initiatives and the way to use them efficiently in order to enhance a collaborative, innovative and transparent research environment.

Keywords: open science; transport research; evaluation

839 How effective capacity building allows monitoring and evaluation to improve the delivery of sustainable urban mobility projects: Experience and lessons from the EU Metamorphosis project

J.P. Glock[a]*, N. van Apeldoorn[b], L. Dazzo[a], A. Wong[c]

a Chair of Transport Ecology, Technische Universität Dresden, Hettnerstr. 1, Dresden 01069, Germany
b Breda University of Applied Sciences, Claudius Prinsenlaan 12, 4811 DK Breda, Netherlands
c University of Southampton, University Road, Southampton, SO17 1BJ, United Kingdom
** jan_peter.glock@tu-dresden.de*

Abstract

Sustainable urban mobility is an established target of policy making and planning in Europe. It is associated with, among others, better air quality, less noise disturbance, increased safety and quality of public space. In this regard, one of the EU Commission's main tools to achieve sustainable urban mobility, through Sustainable Urban Mobility Plans (SUMP), require the explicit integration of Monitoring and Evaluation (M&E). Yet, European cities face common barriers when it comes to materialising M&E in practice. To avoid or overcome these barriers, this paper argues for integrating Capacity Building (CB). We draw this conclusion based

on experiences made during the M&E and CB of the Horizon 2020 Project 'Metamorphosis'. We report our experiences, rating different monitoring indicators used for the evaluation of measures transforming car-oriented neighbourhoods into children-friendly neighbourhoods in seven European cities. We then give advice on how to design and integrate CB for a feasible M&E scheme.

Keywords: Monitoring and evaluation; Process and impact; Capacity building; Education and training; Active mobility; Child-friendly neighbourhood

844 The practical part of train driver education: Experiences, expectations and possibilities

Niklas Olsson[a]*, Birgitta Thorslund[a], Björn Lidestam[a]

a VTI, Olaus Magnus väg 35, Linköping 58195, Sweden
** niklas.olsson@vti.se*

Abstract

Despite all the technical aids introduced to the railway the train drivers' knowledge and skills are still important for traffic efficiency and safety. The literature shows a clear connection between practical experience and safer and more efficient action. Thus, the aims were (1) to examine what is likely to be included in the internship of the train driver education, and (2) to assess the difference in expectations on novice versus experienced drivers. Quantitative data, obtained through Swedish train drivers, indicate a great possibility that a student will not have the possibility to practice many situations sufficiently or even at all during internship. Results from the instructors and employers show that the expectations on the novice drivers can be regarded as realistic and correspond with the literature about development of profession expertise. Finally, we argue that pedagogical use of simulators may provide effective practice of critical situations in a safe environment.

Keywords: train driver; train simulation; practical training; education methods; practical skills; profession development

909 2020-2050: The Challenges of Integrated Transport Sector and Its Workforce Inclusion

Jeannette Edler[a]*, Matina Loukea[b], Evangelos Bekiaris[b], Jean-Christophe Meunier[c], Wouter Van den Berghe[c], Dana Sitányiová[d], Virginia Infante[e], Aoife Ahern[f], Anu Tuominen[g]

a Institute for safety technology and ships safety (ISV e.V.), Friedrich-Barnewitz-Str. 4 c, 18119 Rostock-Warnemünde, Germany
b Center for Research and Technology Hellas – Hellenic Institute of Transport (CERTH/HIT), 6th Km Charilaou - Thermi Rd., 57001 Thessaloniki, Greece
c Vias institute, Chaussée de Haecht, 1405, Brussels-1130, Belgium
d University of Zilina, Univerzitna 1, 01026, Zilina, Slovakia
e Instituto Superior Tecnico, Rovisco Pais 1, 1049-001 Lisboa, Portugal
f University College Dublin, Belfield, Dublin 4, Ireland
g VTT Technical Research Centre of Finland, P.O. Box 1000, FI-02044 VTT, Finland
** j.edler@schiffssicherheit.de*

Abstract

The transportation industry in Europe accounts for 4.5% of total employment and represents 4.6% of Europe's Gross Domestic Product (GDP). Transport´s economic importance in Europe with its continuous growth and the rapidly changing technologies places greater demands on the sector's employment requirements and on training and education. The European Commission (EC) places great importance on the role of academic and vocational qualifications. This paper is based on the

outcomes of the European Research Project SKILLFUL, which has assessed the future training and education needs of the European transport sector. An extensive desk study of current training in Europe and interviews/workshops with experts in both education and transport sectors were conducted. SKILLFULs conclusions are changing training needs and employment growth in sectors such as cyber security and data analysis. In terms of training, the importance of continuous upskilling and a blended approach to education and training is a significant research finding.

Keywords: employability, transportation professionals, future jobs, future skills, education and training, lifelong learning

1060 Assessing gender gaps in educational provision, research and employment opportunities in the transport sector at the European level

Miriam Pirra[a], Angela Carboni[a]*, Marco Diana[a]

a Politecnico di Torino - DIATI, Corso Duca degli Abruzzi 24, 10129 Torino, Italy
** angela.carboni@polito.it*

Abstract

Serious gaps are found when evaluating recognition and inclusion of gender aspects in transport strategies, research and innovation. Similar issues can be spotted in the transport labour market, where only 22% of workers are women at the European level. The roots of these limitations are in the low participation of women in Science, Technology, Engineering and Maths (STEM) studies and, therefore, in the traditionally male-dominated transport field occupations. Stemming from the European project TInnGO, the current paper proposes a descriptive analysis to evaluate the gender gaps in educational provision and research in ten European countries. The presented approach includes the definition and collection of specific indicators to describe the framework and a desktop review of practices for encouraging and supporting women in STEM studies underling their main characteristics (such as the kind of initiative, the methods and tools used, the target group or the type of promoter) and results.

Keywords: gender issues, STEM culture, H2020, smart mobility, women in transport

1132 High impact partnership towards the establishment of a sustainable marine engineering programme in Namibia

Samuel John[a]*, Meri-Maija Marva[b], Riitta Tempakka[b], Andrew Zulu[a], Rajaram, Swaminathan[a], Tobias Nambala[c], Heikki Koivisto[b]

a Namibia University of Science and Technology, 13 Jackson Kaujeua St, Windhoek, 10005, Namibia
b Satakunta University of Applied Sciences, Satakunnankatu 23, FI-28101 Pori, Finland
c Namibian Maritime and Fisheries Institute, 1st Street East No 29, Walvis Bay, Namibia
** sjohn@nust.na*

Abstract

The relatively peaceful and stable democracy that Namibia has enjoyed since its independence in 1990 has attracted investors and has seen growing maritime activities within its shores. The purchase of a research vessel from Finland by the Namibian Government in 2012 was the starting point of a strategic partnership between two Namibian institutions and a Finnish university. During the training by Satakunta University of Applied Sciences (SAMK) of the Namibian operating officers of the vessel, it became eminent that there was a need for improving the maritime education in Namibia. In order to achieve this objective, an empirical study was conducted to ascertain the critical needs of the sector. Marine engineering training

was identified as one of the critical skills to be developed. This paper presents the methodology followed in developing a double degree programme between Namibia and Finland to tackle this skill need.

Keywords: Education; partnership; marine engineering; double-degree; capacity building; workforce future skills

1170 Exploring the Establishment of a European Transport Research Cloud

J. Rod Franklin[a], Martin Böhm[b], Sarah Jones[c], Tatiana Kovacikova[d], Katarzyna Nowicka[e], Rafal Rowinski[f], Katerina Folla[g]*, George Yannis[g]

a Kühne Logistics University, Großer Grasbrook 17, 20457 Hamburg, Germany
b AustriaTech, Raimundgasse 1/6, 1020 Vienna, Austria
c Digital Curation Centre, Argyle House 3 Lady Lawson Street, Edinburgh EH3 9DR, UK
d University of Žilina, Univerzitná 8215/1, 010 26 Žilina, Slovakia
e SGH Warsaw School of Economics, al. Niepodległości 162, 02-554 Warsaw, Poland
f European Commission, Directorate-General for Research & Innovation H.1., 1049 Bruxelles/Brussel, Belgium
g National Technical University of Athens, 5 Iroon Polytechniou str., Athens GR-15773, Greece
** katfolla@central.ntua.gr*

Abstract

The aim of this research is to explore the potential of a European Transport Research Cloud (TRC) as a subset of the European Open Science Cloud (EOSC). On that purpose, a group of six experts was created to perform a preliminary analysis concerning the current practices, the main barriers, needs, and possible benefits of establishing a TRC. The experts collected data based on their personal experiences and contacts, prior research, as well as a survey was carried out with the participation of researchers from the transport sector. The results of this research led to ten recommendations, grouped into five thematic areas, which are considered essential for the development of a viable European Transport Research Cloud.

Keywords: open science; open data; research cloud; transport

1.48 Scientific and technical session 48: Perspectives on policy, regulation and pricing

169 Setting up a system for effective monitoring of the performance of concession contracts in the public passenger transport

Janez Blaž[a]*, Samo Zupan[b], Miha Ambrož[b]

a Republic of Slovenia, Ministry of Infrastructure, Langusova ulica 4, SI-1000 Ljubljana, Slovenia
b University of Ljubljana, Faculty of Mechanical Engineering, Aškerčeva cesta 6, SI-1000 Ljubljana, Slovenia
** janez.blaz@gov.si*

Abstract

The implementation of public passenger transport as a public service obligation is based on concession contracts between the operator, i.e. the Public Transport Authority, and the contractors. The key task of competent Public Transport Authorities is monitoring the implementation and assessing the effectiveness of the service. Public passenger transport has an increasing role also in the transport aspect of energy savings and the reduction of pollutant emissions. The research in this article shows the infrastructure transport model consisting of two parts: the bus line optimization and the use of vehicles with alternative propulsion systems. It has been proven that for a successful development of public passenger transport

as public service obligation, the results from both types of research need to be compared and the best joint effects identified and implemented.

Keywords: public passenger transport, hybrid drive, regeneration energy, air pollutant emissions

Full paper: http://kmtm.fs.uni-lj.si/datoteke/PPTMonitoring_TRA2020.pdf

238 Ways for increasing the level of fair competition in the conditions of road works market increasing

Kateryna Dendebera[a]*, Serhii Illiash[a], Artem Bezuglyi[a]

a M.P. Shulgin State Road Research Institute State Enterprise – DerzhdorNDI SE, 03113 Kyiv, Ukraine
** tender_dorndi@ukr.net*

Abstract

Over the past few years, the road sector in Ukraine has undergone many decisive changes which have led to an increase in the number of procurement, as well as the occurrence of new companies in the market. Since not all of these companies are guided by the fair competition principles, customers often have problems such as incompetent participating companies, blocking the tenders and troll bidding. These issues lead to a prolonged delay in the procurement procedure or until it is cancelled. In order to introduce transparent and clear "rules of the game" on the market and to optimize the procurement procedure of road works, the following measures were proposed, such as the establishment of clear qualification requirements for participants, the introduction of nonprice criteria and the required financial security for the fulfilment of procurement and contract conditions.

Keywords: blocking of tenders; incompetence of companies; troll bidding; qualification; non-price criteria; financial security

292 How much pricing measures can help achieve sustainable goals: A market segmentation based on road pricing acceptability

Valentina Rappazzo[a]*, Cristina Pronello[b]

a Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio, Politecnico di Torino, Viale Mattioli 39, Torino 10125, Italy
b Département Génie des systèmes urbains (GSU) & EA 7284 AVENUES, Sorbonne Universités - Université de Technologie de Compiègne, 2, Rue du docteur Schweitzer, 60203 Compiègne Cedex, France
** valentina.rappazzo@polito.it*

Abstract

This research proposes a market segmentation based on road pricing acceptability. A questionnaire was ad hoc designed and administered to a sample of 61 people living in Lyon metropolitan area, selected in order to include various profiles as regards modes' use and socio-economic characteristics. An Exploratory Factor Analysis and then a Cluster Analysis were carried out and four groups were found: 1) the Careful and committed; 2) the Green and pragmatic; 3) the Smart and flexible; and 4) the Car addicted. The results of the Cluster Analysis were compared to the outcomes of a grouping exercise previously carried out on data collected through Focus Group discussions involving the same sample. Willingness To Pay

and travel behaviour have been deeply analysed. A good coherence between the two clustering exercises was found, despite few inconsistencies, notably for Cluster 3, showing the importance of using a mixed approach in investigating so complex issues.

Keywords: road pricing; market segmentation; pricing acceptability; Willingness To Pay; travel behaviour; 11th UN Sustainable Development Goal "Sustainable Cities and Communities"

Full paper: https://iris.polito.it/handle/11583/2803159#.XmvGfahKg2w

337 Platooning regulatory state of the art based on the H2020 Project: ENSEMBLE

Ignacio Lafuente[a], Carlos Luján[a], Marta Tobar[a]*, Estrella Martínez[a]

a IDIADA Automotive Technology S.A, Pol. L'Albornar – PO Box 20, Santa Oliva 43710, Spain
** marta.tobar@idiada.com*

Abstract

The aim of this paper is to review and analyse the current European regulatory framework related to truck platooning. The work presented is based on the results and outcomes of the European project ENSEMBLE. One of the final objectives of the project is to draft a list of recommendations addressed to policy makers to enable the deployment of multi-brand platooning on European highways. To achieve it, it is necessary to first understand the background of ENSEMBLE so the lessons learned from other initiatives like COMPANION project or the European Truck Platooning Challenge (ETCP) are presented. Nevertheless, a deep review of current regulatory framework at the UNECE and the European Commission is included. In addition, technical regulations that might become a barrier for the deployment of platoons, are analysed and discussed at a vehicle, infrastructure and use level. Finally, relevant discussions related to safety distances or CO2 emissions are also included.

Keywords: Truck Platooning, ENSEMBLE Project, H2020, Regulatory Framework

401 Socio-Economic Impacts of Mobility Disruptive Trends

Jette Krause[a]*, Monica Grosso[a], Amandine Duboz[a], Maria Alonso Raposo[a], Marie Tamba[b], Bert Saveyn[b], Marta Fana[b], Enrique Fernandez Macias[b], Biagio Ciuffo[a]

a European Commission, Joint Research Centre (JRC), Via Enrico Fermi 2749, 21027, Ispra (VA), Italy
b European Commission, Joint Research Centre (JRC), Edificio Expo, Calle Inca Garcilaso, 3, 41092 Sevilla, Spain
** jette.krause@ec.europa.eu*

Abstract

In the context of digitalisation and decarbonisation, the transport sector may undergo radical transformations in the decades to come. Four key trends hold a significant disruptive potential: Automation, Connectivity, Electrification and Sharing (ACES). In the next decades, these trends could trigger substantial shifts in vehicle stock, ownership and activity, vehicle manufacturing, fuel use and emissions, traffic flows and volumes, accidents and commuting times. Such disruptions can have important socio-economic impacts, including changes in availability, costs of and demand for transport options, or employment and growth impacts due to changes in the manufacturing and operation of vehicles. The Societal Implications of MObility Disruptions (SIMOD) project aims at exploring such impacts, employing a combined approach of data analysis, scenario development, macro-economic modelling and analysis of occupations, skills and tasks. This

approach and first results are presented in this paper, focussing on impacts from transport electrification.

Keywords: Autonomous driving, connectivity, electrification, sharing, socio-economic impacts, environment

Full paper: https://www.researchgate.net/publication/339797217_Socio-Economic_Impacts_of_Mobility_Disruptive_Trends

419 Subsidising Urban and Sub-Urban Transport – Distributional Impacts

Nils Fearnley[a], Jørgen Aarhaug[a]*

a Institute of Transport Economics, Oslo 0349, Norway
** jaa@toi.no*

Abstract

This paper studies distributional effects of public transport (PT) subsidies focusing on the Greater Oslo region. We identify how different PT markets enjoy different levels of subsidies. We describe how subsidies are distributed along PT modes and their respective patronage. This is done by document studies and travel surveys, supplemented by expert inquiries. We find that high-income groups, served by regional trains and high-speed crafts, receive large per passenger and per passenger-kilometre subsidy, while lower-income areas, typically served by local and regional buses, metros and local trains, receive lower subsidies per passenger. Peak traffic receives higher subsidies than off-peak traffic. The overall distributional profile is, however, found to be moderately progressive, in particular because of the socio-economic profile of the average PT passenger relative to the population as a whole.

Keywords: public transport; subsidy; distribution; fares

This paper is a part of the European Transport Research Review Special Issue: https://www.springeropen.com/collections/TRA2020

477 New tariffs for electronic fare management systems in public transport

Daniel Leonhäuser[a]*, Carsten Sommer[a]

a Chair of transportation planing and traffic systems, University of Kassel, Mönchebergstraße 7, 34125 Kassel, Germany
** leonhaeuser@uni-kassel.de*

Abstract

This paper presents the results of a project focused on the development and field testing of new tariff products tailored to occasional customers based on electronic fare management (EFM) systems in public transport. Existing flexible tariff concepts in public transport and other sectors are examined and their transferability to two existing regional EFM systems were analyzed. Based on this research and data analysis with historical booking data of two transport associations, participating in the project, new tariff product options were developed and tested in the two regional EFM systems. All three tested new tariffs resulted in more public transport trips, demonstrating that the incentive components of the tariffs resulted in increased usage.

Keywords: public transport; electronic fare management systems; electronic ticketing; incentive; demand response

650 Parking versus Congestion Pricing: Comparative Analysis

Draženko Glavić[a]*, Jelena Simićević[a], Marina Milenković[a]

a University of Belgrade, Faculty of Traffic & Transport Engineering, V. Stepe 305, Belgrade Serbia
** drazen@sf.bg.ac.rs*

Abstract

This paper through comparative analysis of parking charge and congestion pricing features, aims to highlight their possibilities and identify limitations, and thus to encourage transport policy makers to implement them. Both policies can tackle with negative consequences of traffic, such as pollution, noise, accidents, etc. But they still differ in a way they act on car users. Analysis of this similarities and differences will be main task of this paper. The results of analysis can be useful for better understanding of effects of both policies when selecting measures that can be used by decision makers in solving congestion in cities.

Keywords: Congestion Pricing, Parking Charging, SWOT analysis, Transport Demand Management

Full paper:
https://www.researchgate.net/publication/339383639_Parking_versus_Congestion_Pricing_Comparative_Analysis

677 Digital transformation in transport: Policy perspectives and technology developments in Europe

Anastasios Tsakalidis[a], Konstantinos Gkoumas[a]*, Ferenc Pekár[a]

a European Commission, Joint Research Centre (JRC), Via Enrico Fermi 2749, 21027, Ispra (VA), Italy
** konstantinos.gkoumas@ec.europa.eu*

Abstract

Digital technologies, together with connectivity and automation are transforming traditional concepts of mobility. New business models are emerging and giving rise to innovative mobility services including new on-line platforms for car-pooling, car or bicycle sharing services, freight operations, or smartphone applications offering real-time travel information and other analytics. This study leverages the technologies that are influencing the uptake of digital transformation in transport and identifies issues and challenges from a European perspective. To that end, it follows a two-tier approach, that examines policy and legislative initiatives from the European Commission, highlighting possible challenges and enablers, and analyses transport technology developments in Europe focusing on the technology maturity from European research and innovation framework programmes, using the methodology developed for the European Commission's Transport Research and Innovation Monitoring and Information System (TRIMIS). The technology analysis provides insights that aid policy decisions related to funding allocation in future research and innovation framework programmes.

Keywords: digital transformation; transport policies; knowledge management; transport research; transport innovation

715 Backshift effects of Sulphur Emission Regulation in Baltic Sea Ro-Ro Traffic

Tomi Solakivi[a]*, George Panagakos[b], Harilaos Psaraftis[b]

a University of Turku, 20014 University of Turku, Finland
b Department of Technology, Management and Economics, Technical University of Denmark, Bygningstorvet 1, 2800 Kgs Lyngby, Denmark
** tomi.solakivi@utu.fi*

Abstract

Since the beginning of 2015, the International Maritime Organisation has introduced Sulphur Emission Control Areas (SECAs) to limit the sulphur content of bunker oil. As the price of the low sulphur marine fuel has constantly been higher than that of the heavy fuel oil, this change was expected to increase the cost of sea transport. As such, this would make sea transport less competitive against other transport modes in cases where other modes of transport would realistically be applicable. This research analyses the backshift effect of the SECA regulation in the Baltic Sea Ro-Ro traffic, where land based transport alternatives are available. The findings indicate, that the transport flows are sensitive to changes in cost balance between sea and road transport. However, due to the decline of crude oil and marine fuel prices, no major changes between road and sea transport have occurred.

Keywords: Shipping, Environmental regulations, Sulphur Emission Control Area, Sulphur emission abatement method, Baltic Sea, Finland

825 FRAME NEXT project: FRAME architecture as reference for building a single point of access

Alexander Froetscher[a]*, Willi Becker[b], Holger Drees[c], Richard Bossom[d], Adam Grochowski[e]

a Austriatech GmbH, Austria
b AlbrechtConsult GmbH, Germany
c Federal Highway Research Institute (BASt), Germany
d Richard Bossom ITS Consulting, UK
e Adam Grochowski, ITS Laboratories LTD, UK
** alexander.froetscher@austriatech.at*

Abstract

Increasing connectivity in transport, new organization of the actors in the transport domain, and huge demand for user information caused a paradigm shift from ITS systems to ITS service delivery. Consequently, complex Intelligent Transport Systems (ITS) necessitate a structured implementation approach based on the use of ITS Architectures and related methodologies. The FRAME NEXT project is developing the European ITS Framework Architecture, in short FRAME, further. The extension of FRAME is based on the oncoming needs from authorities and private ITS providers to full fill the latest regulations of the EU ITS Directive 2010/40/EU on their way to interoperable services including reference architectures for single points of access to transport data. The FRAME NEXT architecture will incorporate knowledge and experience from other related work, e.g. the ARKTRANS and Common Framework. The resulting Frame Architecture will offer a common ITS architecture for interoperable intelligent transport services with additional views, like the physical and the organizational view, but also with delivering a common starting point for projects and an additional impetus for the fast implementation of ITS services in Europe.

Keywords: ITS Architecture, EU wide ITS Services, Systems Engineering

827 Gaps in current regulations for ship emissions

Hulda Winnes[a]*, Erik Fridell[a], Leonidas Ntziachristos[b], Sokratis Mamarikas[b], Jukka-Pekka Jalkanen[c], Jan Duyzer[d], Ruud Verbeek[d], Andreas Weigelt[e], Jasper van Vliet[f], Johan Mellqvist[g]

a IVL Swedish Environmental Research Institute, Aschebergsgatan 44, 411 33 Gothenburg, Sweden
b Aristotle University of Thessaloniki, Aristotle University Campus, Thessaloniki 54636, Greece
c Finnish Meteorological Institute, Erik Palmenin aukio 1, Helsinki 00560, Finland
d TNO, Anna van Buerenplein 1, Den Haag 2595, Netherlands
e BSH, Bernhard-Nocht-Strasse 78, Hamburg 20359, Germany
f Ministerie van Infrastructuur en Waterstaat, Rijnstraat 8, Den Haag 2500, Netherlands
g Chalmers University of Technology, Gothenburg, 41296, Sweden
** hulda.winnes@ivl.se*

Abstract

In this paper we identify gaps in monitoring and enforcement of emission regulations for international shipping. We compile the knowledge on monitoring practices and their suitability from the perspectives of both emissions regulations and abatement technologies. This is the first step in a newly started EU-financed project, SCIPPER, that will further develop these issues and address the identified gaps. Policy makers are presented a scientific and technical platform to efficiently monitor the regulated emissions from ships. Monitoring practices for ship operations are needed in order to assure compliance with SOX and NOX emission regulations. Monitoring of SOX emissions is potential through remote sensing. For NOX emissions the situation will become more stressing from a European perspective in 2021.

Keywords: Shipping, emissions, monitoring, compliance, remote sensing, MARPOL

840 Dynamic pricing of track capacity in the short-term allocation process

Emanuel Broman[a,b]*, Jonas Eliasson[b]

a Swedish Naional Road and Transport Research Institute (VTI), Malvinas väg 6, SE-114 28 Stockholm, Sweden
b Linköping University, Luntgatan 2, SE-602 47 Norrköping, Sweden
** emanuel.broman@vti.se*

Abstract

On deregulated railway markets, a welfare efficient means to allocate track capacity may be trough market pricing of departure slots. This paper uses simulation to test a dynamic pricing algorithm intended for the short-term process. A number of outputs are tested, including the welfare of the traffic allowed by the produced timetable; price volatility; reliability; and possibilities to manipulate the process. Two benchmarks are used for comparison: first-come-first served and the optimal static price strategy.

Keywords: railways; deregulation; dynamic pricing; capacity allocation; short-term process

920 Sub-23nm exhaust particle number emissions from latest Euro 6 passenger road vehicles

Z. Toumasatos[a], J. Andersson[b], L. Ntziachristos[a], A. Mamakos[c], A. Klug[c], B. Giechaskiel[d], T. Lahde[d], A. Kontses[a], Z. Samaras[a]*

a Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, Thessaloniki, 541 24, Greece
b Ricardo UK, Limited, Shoreham-by-Sea, BN43 5FG, United Kingdom
c AVL List GmbH, Graz, 8020, Austria
d Sustainable Transport Unit, Institute for Energy, Transport and Climate, Joint Research Centre, European Commission, Ispra, 21027 Italy
** zisis@auth.gr*

Abstract

The Horizon 2020 Green Vehicle "DownToTen" project aims at the scientific underpinning the efforts of the European Union (EU) for more robust vehicular exhaust particulate emissions control. The project first aims at developing a robust sampling system to measure particle number (PN) emissions below 23 nm and, second, at delivering a detailed physicochemical characterization of such particles. The first technical step in this process was to locate those vehicle technologies which appear to emit a significant number of non-volatile particles below 23 nm (SPN23nm). The current study examines emission levels of latest passenger car powertrain technologies, involving a number of combustion, aftertreatment, and fuel-use combinations that are popular in the EU. Latest vehicle technologies, even those not covered by the regulations, are found to largely comply with the SPN23nm limit and not to emit substantial numbers below 23 nm. However, specific cases, such as certain natural gas and gasoline direct injection (GDI) vehicle models emit a significant number of particles below 23 nm. For GDI vehicles, use of a gasoline particle filter (GPF) is very efficient in reducing the emission of these very small particles.

Keywords: exhaust particles; particle number, catalytic stripper, gasoline particle filter

960 The potential of route based ERS network optimization

Gyözö Gidofalvi[a,b]*, Can Yang[b]

a Integrated Transport Research Lab (ITRL), KTH Royal Institute of Technology, Drottning Kistinas Väg 40, 114 28 Stockholm, Sweden
b Div. of Geoinformatics / Dept. Urban Planning and Env., KTH Royal Institute of Technology, Teknikringen 10A, 114 28 Stockholm, Sweden
** gyozo@kth.se*

Abstract

The large scale deployment of Electric Road Systems (ERS) is a necessary and viable choice for reaching the emission reduction targets in the road-bound heavy freight sector. The per-kilometer infrastructure development cost of ERS is large, thus selecting segments that yield a high utility is important. According to a newly introduced concept, the electrification utility of a segment in a network is highly dependent on the freight routes-, the powertrain technology-, the energy supply and demand- and the transport loads of the vehicles as well as the topographic aspects- and traffic state of the road network. This paper explains these concepts and aspects and provides first empirical evidence about the potential of route based ERS network optimization that takes these aspects into consideration. Results show that the potential cost savings are up to 75%, which for national expressway networks is estimated to be in the range of 120M€ to 8,520M€.

Keywords: electrification utility; infrastructure planning and development; big mobility data analytics; routes; combinatorial network optimization; business case

Full paper: https://kth.diva-portal.org/smash/record.jsf?pid=diva2:1414166

Finnish Transport and Communications Agency Traficom

P.O.Box 320 FI-00059 TRAFICOM, Finland
Tel. +358 295 345 000

traficom.fi

ISBN 978-952-311-484-5
ISSN 2669-8781 (online)

TRAFICOM
Finnish Transport and Communications Agency