

ABSTRACTS BOOK

NECTAR 2013 International Conference

DYNAMICS OF GLOBAL AND LOCAL NETWORKS

16-18 June 2013, University of Azores, São Miguel Island, Portugal

ABSTRACTS BOOK

NECTAR 2013 International Conference 'Dynamics of Global and Local Networks'

This XII (biennial) International NECTAR Conference is aimed at developing a better understanding of the way in which transport and communications networks are evolving in a rapidly changing world. It considers the complex and diverse challenges facing providers of transport and communications services and those responsible for establishing the associated institutional structures.

The Conference will focus on the role and evolution of transport and communication networks, global and transatlantic, as well as regional and local, with an emphasis on the context of peripheral territories and related local networks.

The island of St. Miguel in the Azores Islands (Portugal), located in mid-Atlantic, is the ideal platform for discussing these topics.

The meeting will provide plenary sessions for keynote speakers, sessions with presentations of submitted papers, and NECTAR Special Sessions/Cluster Meetings.

We would like to take this opportunity to thank all the organizers and participants of these NECTAR Sessions for their enthusiastic and fruitful cooperation in the development of novel research fields in transportation and communication research, and also thank the local organizing committee for their efficiency and hard work.

So, welcome to the Azores!

We wish you a good Conference, on this beautiful island of St. Miguel.

Aura Reggiani (NECTAR Chair) and *Tomaz Dentinho* (Local Organizer)

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Program

Location: Scientific Complex (building) of the University of Azores, Campus Universitário of Ponta Delgada, São Miguel

Sunday, 16 June 2013

- 14:30-15:15** Registration and Welcome with Coffee [Hall of Scientific Complex]
15:15-16:00 Plenary Session [Amphitheatre I of Scientific Complex]
Keynote speech by Prof. Dr. **Roger Stough** - *Dynamics of Global and Local Networks with a Spatial Analysis of US Personal Travel Behavior*
16:00-16:30 Coffee Break [Hall of Scientific Complex]
16:30-18:30 Parallel Sessions I

Session	Location
RS. A - Urban Transport	ROOM V
SS 1. A - A Future for Non-Motorized Transport Modes: Walking and Cycling Networks (I)	ROOM VI
SS 2. A - Sustainable Transport Projects and Policies (I)	ROOM VII
SS 5. A - Accessibility, Population Developments and Needs	ROOM VIII
SS 7. A - Transport Studies and GPS Technologies	Amphitheatre III
SS 8. A - Resilience and Complex Networks: Methodological Perspectives	Amphitheatre IV

18:30-19:00 Cluster Meetings

Cluster	Coordinator	Location
Cluster 1 - Networks	Moshe Givoni	ROOM V
Cluster 2 - Policy & Environment	Maria Attard	ROOM VI
Cluster 3 - Logistics & Freight	Sandra Melo	ROOM VII
Cluster 4 - Commuting, Migration & Labour Market	Jos van Ommeren	ROOM VIII
Cluster 6 - Accessibility	Karst Geurs	Amphitheatre III
Cluster 7 - Transport Security	Luca Zamparini	Amphitheatre IV

Monday, 17 June 2013

08:30-10:30 Parallel Sessions II

Session	Location
RS. B - Accessibility Measures	ROOM V
SS 1. B - A Future for Non-Motorized Transport Modes: Walking and Cycling Networks (II)	ROOM VI
SS 2. B - Attitudes and Mode Choice	ROOM VII
SS 5. B- Accessibility Planning and Evaluation Methodologies	ROOM VIII
SS 7. B - Digital Technologies Within Cities	Amphitheatre III

- 10:30-11:00** Coffee Break [Hall of Scientific Complex]
11:00-13:00 Plenary Session [Amphitheatre I of Scientific Complex]
Word of welcome by the Chair of the Local Organizing Committee: Prof. Dr. **Tomaz Dentinho**
Word of welcome by the Chair of Nectar: Prof. Dr. **Aura Reggiani**
Keynote speech by Prof. Dr. **Erik Verhoef** - *Short-run vs. Long-run Consumer Scheduling: Implications for Travel Time Values*
Keynote speech by Prof. Dr. **Juan Carlos Martín** - *How the Financial Crisis is affecting the European Transport Policy*
13:00-14:30 Lunch Break

14:30-16:30 Parallel Sessions III

Session	Location
RS. C - Transport Policies	ROOM V
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SS 2. C - Car Sharing and Alternative Transport Modes	ROOM VII
SS 4. A - Housing and Labour Markets	ROOM VIII
SS 8. B - Disruptions and Emerging Patterns in Infrastructure Networks (I)	Amphitheatre III

16:30-17:00 Coffee Break [Hall of Scientific Complex]

17:00-19:00 Parallel Sessions IV

Session	Location
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SS 3. A - Sustainable Logistics (I)	ROOM VI
SS 4. B - Commuting (I)	ROOM VII
SS 7. C - Modelling the Relation Between Accessibility and Environment	ROOM VIII
SS 8. C - Critical Networks in Spatial Economic Processes	Amphitheatre III

20:30-23:00 Conference Dinner

Tuesday, 18 June 2013

09:00-11:00 Parallel Sessions V

Session	Location
RS. E - Logistics and Market Accessibility	ROOM V
SS 2. D - Sustainable Transport Projects and Policies (II)	ROOM VI
SS 4. C - Public Policy	ROOM VII
SS 5. C - Accessibility Modelling	ROOM VIII
SS 8. D - Disruptions and Emerging Patterns in Infrastructure Networks (II)	Amphitheatre III

11:00-11:30 Coffee Break [Hall of Scientific Complex]

11:30-13:00 Plenary Round Table: *Dynamics of Global and Local Networks* [Amphitheatre I of Scientific Complex]
 Coordinator: Prof. Dr. **Peter Nijkamp**

13:00-14:30 Lunch Break

14:30-16:30 Parallel Sessions VI

Session	Location
SS 3. B - Sustainable Logistics (II)	ROOM V
SS 4. D - Commuting (II)	ROOM VI
SS 5. E - Accessibility and Spatial Distribution of Services and Resources	ROOM VII
SS 5. D - Accessibility to Train Stations	ROOM VIII
SS 6. A - Transportation Safety and Security Issues	Amphitheatre III

16:30-17:00 General Assembly [Amphitheatre I of Scientific Complex]

17:00-18:00 Closing Reception [Amphitheatre I of Scientific Complex]

Abstracts

Sunday, 16 June 2013

15:15-16.00 | Plenary Session

Dynamics of Global and Local Networks with a Spatial Analysis of US Personal Travel Behavior

Roger R. Stough, Rajendra Kulkarni and Laurie Schintler

George Mason University, USA

In the recent past the world and the U.S. have experienced historic events related to population growth that will have far reaching effects into the future. For the first time in modern human history the majority of world population now lives in cities (www.who.int/gho/urban_health/situation_trends/urban_population_growth_text/en/index.html). And for the first time in the U.S., according to U.S. Census estimates, '...50.4 percent of our nation's population younger than age 1 was minorities as of July 1, 2011.' (www.census.gov/newsroom/releases/archives/population/cb12-90.html). These demographic changes are mainly due to population growth and increasing migration to urban areas that provide better economic opportunities. Among the many changes associated with these two unfolding events are possible changes in travel behavior. In this paper, we investigate personal travel patterns across the U.S. over the recent past. The analysis is based on FHWA's National Household Travel Surveys (www.fhwa.dot.gov/policyinformation/nhts.cfm) for year 2001 and 2009. The microdata from these surveys will be analyzed in an effort to determine if there are significant demographic related changes in travel behavior in the U.S. The travel pattern attributes such as travel time, mode, type of travel, trip length etc. will be studied using multi-partite network analysis in both time and space. The results will be presented as a series of topological maps and statistical tables.

16:30-18:30 | Parallel Sessions I

RS. A - Urban Transport

ROOM V; Chair: Isabelle Thomas

[77] ADOPTING VIA LEASING: COMPANY CAR DRIVERS' PREFERENCES FOR ELECTRIC CARS

Alexandros Dimitropoulos, Piet Rietveld and Jos N. van Ommeren

VU University Amsterdam, The Netherlands

In Europe, around half of new vehicle registrations concern company cars, namely cars offered as fringe benefits to employees, although mainly serving private travel needs [1]. As company car drivers do not have to incur any upfront costs for the use of the car, and the uncertainty concerning vehicle resale price, battery replacement and maintenance costs is shifted from the car user to the car leasing company, the company car market is actually a prominent diffusion channel for alternative fuel vehicles. For instance, it constitutes the cornerstone of the successful diffusion of hybrid electric vehicles (HEVs) in the Netherlands. We examine its potential role in the early adoption process of electric vehicles (EVs), by drawing on the stated preferences of Dutch company car drivers for a number of EV technologies. We employ a choice experiment approach to elicit drivers' preferences for plug-in hybrids and two types of battery electric vehicles, one allowing for fast charging and one for battery swapping at specialised stations. In the framework of an online survey launched in November 2012, drivers make hypothetical choices among cars with alternative propulsion systems, further differing in terms of performance, refuelling time, coverage of refuelling infrastructure and monetary contribution required by the driver. In contrast to previous research, we specify a utility function where the interdependencies between refuelling time, refuelling infrastructure coverage and driving range are investigated by means of interaction terms. Choice data are analysed by the use of Nested, Mixed and Latent Class Logit models. We provide insights into the effects of changes in the examined attribute levels on the probabilities of EV technologies being chosen, and into the implied trade-offs among attributes. We quantify the extent to which battery-swapping options and extended-range EVs can address drivers' concerns over short driving ranges and long charging times and examine how drivers' preferences vary with the fuel type and intensity of use of the current household vehicle holdings and with the access to a standard parking spot at home and workplace. We further investigate the role that drivers' environmental concerns, attitudes towards innovative products, and personal experiences with driving and boarding EVs and HEVs, play in the formulation of their preferences. The current study complements existing transportation literature eliciting the preferences of private car drivers for alternative fuel vehicles (e.g. [2]-[3]). It further informs policy makers about the potential success of various measures aimed at the stimulation of consumer adoption of EVs, in light of their consideration as a means of confronting mounting concerns over environmental degradation, oil dependence and increasing petroleum prices.

References: 1. Gutiérrez-i-Puigarnau, E. and Van Ommeren, J.N. (2011) 'Welfare effects of distortionary fringe benefits taxation: the case of employer-provided cars', *International Economic Review* 52(4): 1105-1122. 2. Calfee, J.E. (1985) 'Estimating the demand for electric automobiles using fully disaggregated probabilistic choice analysis', *Transportation Research B* 19(4): 287-301. 3. Hess, S., Fowler, M., Adler, T. and Bahreinian, A. (2012) 'A joint model for vehicle type and fuel type choice: Evidence from a cross-nested logit study', *Transportation* 39(3): 593-625.'

[63] IMPACTS OF ON-BOARD DEVICES AND ECO DRIVING TRAINING ON URBAN PASSENGERS BUS DRIVERS' BEHAVIOUR

Catarina Rolim¹, Patrícia Baptista¹, Yoram Shiftan² and Tiago Farias¹

¹ *Technical University of Lisbon, Portugal;* ² *Technion – Israel Institute of Technology, Israel*

The main purpose of this project is to study the impact of on-board devices and eco driving training on bus drivers' behavior and their perceptions and attitudes towards their driving and the consequence impact on energy use and polluting levels, taking into account drivers' characteristics, the bus driven, and the routes driven. Rodoviária de Lisboa, a Portuguese bus passenger transport company, uses since 2008 a commercial data logger, GISFROT, developed by the company, to collect data such as excess speeding, extreme brakes and accelerations, excess rpm, use of air conditioning, among other events. The device is used to identify undesirable behaviors and to indicate to the driver, with the use of a sound signal, when this behavior has occurred. Drivers are also subjected to annual in class training sessions, based on eco-driving techniques, and on-board evaluation sessions. The device is currently installed in 100 buses and approximately 800 drivers use these vehicles, among the company's three activity centers, in the Lisbon metropolitan area. Data will be compared between different monitoring periods, with and without sound feedback, taking into consideration the driver and the different buses driven. The impact of device on driving behavior will be assessed for different periods and a comparison between periods will be performed, by percentage of time spent in each of the undesirable events. The main variables analyzed are energy consumption, GHG and local pollutants reduction. Drivers' personal characteristics, such as age, gender, driving experience, number of in-class sessions and number of logins to performance platform, total monitoring times (with and without feedback) and percentage of time in each undesirable event will be taken into consideration when evaluating the potential driving behavior change along the time. Drivers perceptions and attitudes towards their performance and driving behavior evaluation will be assessed with surveys, allowing driver characterization, driving behavior perception, daily routines, advantages and disadvantages of the monitoring process, of the in-class sessions, of the on-board evaluation, of the information gathered at the platform; important aspects of their evaluation and improvement suggestions in the evaluation process. Environmental impacts, in terms of energy consumption and global and local pollutants emissions, will be assessed considering several monitoring periods, comparing periods with sound feedback, without sound feedback, before in-class session and after in-class session. Thanks are due to the Fundação para a Ciência e Tecnologia for the PhD financial support (SFRH/BD/80500/2011) POS_Conhecimento and for the Post-Doctoral financial support (SFRH/BPD/79684/2011). The authors would like to acknowledge Rodoviária de Lisboa for their research support.

[122] TRAVEL MOTIVATIONS OF SENIORS: A REVIEW AND META-ANALYTICAL ASSESSMENT

Roberto Patuelli¹ and Peter Nijkamp²

¹ *University of Bologna, Italy;* ² *VU University Amsterdam, The Netherlands*

Over the last decades, leisure travel has become increasingly popular among older segments of the world population, as a consequence of global factors such as a longer expected life, improved health conditions, larger disposable income, and increased availability of time in retirement age. Consequently, researchers have grown more interested in studying the motivations for travel of the seniors. A number of questions may be raised or have been addressed in the recent past: What are the main factors explaining the travelling choices of seniors? Are their travel motivations different from the ones of the younger population, which have been widely studied in the past? Are geographical differences in terms of motivations comparable between different age groups? Why is senior tourism a topic of particular interest with regard to Asia? In order to answer such questions, in this paper we provide a review of the literature on the travel motivations of seniors. We first provide a qualitative assessment of the past findings, by discussing the dimensions of travel motivations most frequently employed in surveys. Secondly, we offer a first empirical evaluation, by means of a meta-analysis, of the factors (i.e., study characteristics) that may drive the differences observed between the findings of the studies analysed.

[5] ARE LUTI MODELS RESULTS GEOGRAPHICALLY ROBUST?

Isabelle Thomas, Jonathan Jones and Dominique Peeters

Université catholique de Louvain, Belgium

Metropolitan Planning Organizations have a raising interest in Land-Use and Transport Interaction models (LUTI) due to their ability to forecast urban patterns and to evaluate the potential effect of land-use or transport scenarios. Yet, the sensitivity of LUTIs results to spatial issues remains largely underestimated and unexplored. Several standard spatial issues are here considered: (1) the boundaries of the studied urban agglomeration do not always correspond to clear-cut administrative or functional area. Without control by the user of the criteria and methodologies used, this leads to different urban realities, rendering inter-city comparison quite risky. (2) LUTI models often consider the study area as a 'closed environment', with no interaction with the rest of the world. The presence of a Border Effect is thus expectable. (3) Given the delineation of the urban agglomeration, the spatial structure within the study area may also differ, leading to different

'urban models', once again rendering inter-city comparisons quite difficult. (4) If LUTI models are often run with individual data, data availability often constraints to recur to the use of aggregated data, leading to the well-known Modifiable Areal Unit Problem. Finally, (5) geo-statistical biases (spatial autocorrelation, endogeneity) may strongly bias the results of each sub-models and as a consequence of the entire model, since econometrical techniques able to take them into account are not implemented in LUTI. Illustrations are here done with examples provided by the UrbanSim model applied to Paris, Brussels and Zurich in the context of the EU Sustainability project, as well as on a 'synthetic city'. Results are in conformity with other spatial models and can be summarized as follows: (1) the delineation of the study clearly and dramatically influences sub-models results, (2) border effects are observed, (3) the level of data aggregation biases estimates, and (4) spatial autocorrelation, endogeneity and heteroskedasticity pollute econometrical estimations. Last but not least and surprisingly enough (5) as far as the land rent sub-model is concerned, a simple formulation with theoretically grounded variables seems to be as efficient as a more 'data crunching' model. Cautiousness is thus necessary when interpreting and using LUTI's results for policy purposes.

SS 1. A - A Future for Non-Motorized Transport Modes: Walking and Cycling Networks (I)

ROOM VI; Chair: Piet Rietveld

[76] UNDERSTANDING SOCIAL AND SPATIAL DYNAMICS IN BICYCLE USE IN THE NETHERLANDS AND ITS POLICY IMPLICATIONS

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Objective: In recent years, bicycle use in the Netherlands has seen some remarkable changes. For the Netherlands as a whole bicycle use seems to remain constant. However, while in some regions and cities and among certain social groups bicycle use has been increasing, other places and social groups show a decline. The scientific knowledge about the factors explaining these spatial and social dynamics in bicycle use and its implications for policy makers is however limited. This paper focuses on identifying and explaining these (recent) changes in bicycle use in the Netherlands, distinguishing between spatial and population characteristics. **Data/Methodology:** For the Netherlands as a whole data from the National Travel Survey will be used, in which information is available for the period from 1985 till 2010. For detailed social and spatial analysis of bicycle use, survey data from the municipality of Amsterdam will be used, of which data is available from the 1980s onwards. The reason Amsterdam will be used as a case is not only the available (detailed) data, but also the socio-spatial variation in bicycle use. The methods to be used are descriptive and explanatory analyses of databases using regression statistics and a decomposition model which has been developed by the Netherlands Institute for Transport Policy Analysis. **Results/Findings:** Research findings which will be presented are an identification and explanation of (recent) spatial and social changes in bicycle use in the Netherlands and the Amsterdam metropolitan area. The outcomes will provide the conference participants with an overview of threats and opportunities for bicycle use in the Netherlands and other developed countries. It will also help formulating a (more) effective policy strategy to increase bicycle use, taking into account spatial and social characteristics of cities and regions. **Implications for Research/Policy:** The implications of the research findings presented in this paper are a better understanding of socio-spatial specific trends, threats and opportunities, which can serve as a base for formulating more effective and context sensitive policy strategies to increase bicycle use. Implications of the presented knowledge will be given for both supply related policy interventions (e.g. infrastructure) and demand related policy interventions (e.g. marketing campaigns).

[60] A BICYCLE-SHARING SCHEME TO REDUCE BICYCLE CONGESTION

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Bicycle-sharing systems have appeared in countless cities worldwide in recent years. Copenhagen was one of the first; by far the biggest bicycle arsenal – numbering 65,000 – is in the Chinese city of Hangzhou. A good role model can be found in Paris, where the Vélib system, introduced in 2007, now boasts 20,000 bicycles spread across 1450 hubs, with a maximum of 300 metres between. Similar schemes are run in London, Barcelona, Brisbane, New York and many smaller cities. One of the primary aims of bike-sharing is to promote cycling as a step in the efforts to reduce traffic congestion and air pollution that many cities face. Bicycle-sharing will reap added success if it becomes popular among tourists. In a country like the Netherlands, where the bicycle has a long-standing tradition as a mode of transport, there are no real equivalents to the Vélib system, and the market seems to be too small. With 90% of the population who owns at least one bicycle, almost everyone has a bike on hand for trips from home. Furthermore, for decades it has been possible to rent bicycles at railway stations for egress transport. Since a few years, public transport bicycle-renting, called OV-fiets, is in operation at 230 railway stations, where an annual pass offers cheap and easy access to such a bicycle. In addition, second-hand bikes to park permanently at the station are extremely cheap to buy. However, the popularity of cycling also causes problems. Every day, tens of thousands of bicycles are parked around railway stations, especially in university cities, expanding the capacity costs and space. Many of these bicycles are in poor condition and have been abandoned by their owner (orphaned bikes). Similar situations are not uncommon in other parts of the city: bicycles parked everywhere in historical city centres are experienced more and more of a problem for local authorities. Lastly, only limited use is made of many bicycles: commuters

park them at their place of work, students park them on the campus, and part-time workers sometimes leave them at the station for days. A bicycle-sharing scheme like Vélîb might offer a solution: more intensive use would mean fewer bicycles and less parking spaces. Long-term parking would no longer be necessary and there would be fewer 'wrecks' and 'orphans'. Bicycles would be available for everyone, from parking lots as well as stations, while tourists would benefit as well. This paper explores the success prospects of a bicycle-sharing system in Delft, a mid-sized university city in the Netherlands. Surveys were conducted among potential users and, with the aid of conjoint analysis; an assessment was compiled of their willingness to pay for such a system and to walk to the nearest hub. This was related to their current cycling costs and travel patterns. The findings indicated that students and commuters in particular are prepared to pay the costs and walk around 200 metres. An analysis of frequent trips did, however, highlight a need for solutions to the imbalance in demand.

[125] EXPOSED TO THE WEATHER: THE EFFECTS OF SUMMER WEATHER CONDITIONS ON TIME SPENT WALKING AND CYCLING IN ROTTERDAM, THE NETHERLANDS

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In the light of growing societal interest for climate change adaptation and mitigation, insights into the meaning of weather conditions for travel behaviours – particularly weather exposed walking and cycling – have become very important. Intuitively weather seems to play an important role in outdoors (travel) activities. Yet, so far only limited scientific knowledge exists on the role of weather for walking and cycling. First, although some studies provide relevant insights into weather effects on mode choices, distances and destinations, direct analyses of people's temporal exposures to weather are lacking. Second, weather is mostly studied as the separated effects of parameters, such as temperature, precipitation and wind, whereas combined interaction effects are often neglected. Third, although studies often analyse travel behaviours in urban areas, hardly any attention is paid to urban weather, which may differ significantly from weather in surrounding rural areas. To address these shortcomings, this paper aims to provide insights into the effects of individual and combined daily weather parameters on people's temporal exposures to weather conditions for walking and cycling. Travel-diary data from the greater Rotterdam area, collected amongst 966 respondents in August/September 2012, have been coupled to daily meteorological data from one rural and one urban weather station. We first analyse summer weather effects on daily time budgets for walking and cycling, while correcting for personal/household background characteristics as well as for spatial and temporal characteristics. Second, we look whether these effects differ between different residential environments and for different population categories and lifestyles. We generally expect people to decrease their daily walking and cycling time budgets under wet, windy, cloudy and colder weather conditions as well as during excessive heat, particularly when combined with high solar radiation, calms and humidity. Larger effects are expected for cycling compared to walking, as cyclists are more exposed and have fewer opportunities to take shelter. Additionally people in open-set rural areas may be more strongly exposed to wind and rain than those in more sheltered densely populated areas, while in these dense inner-city areas negative heat effects may be more prominent due to so-called urban heat island effects. The paper discusses these outcomes in the context of projected climate change, while highlighting the role of adaptive urban planning.

[86] CYCLIST NETWORK DESIGN MODEL BASED ON THE ANALYSIS OF THE CYCLABILITY OF THE NETWORK AND POTENTIAL CYCLIST FLOW

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In recent years sustainable mobility policies have begun to promote non-motorized transport plans in many cities, and policy makers now face the challenge of designing cycling networks. The number of determinant variables and the global economic crisis, which is limiting investment in many public programs, make this an increasingly complex problem. In order to be more effective, policy making and urban planning require new analytical approaches, methods and applications. The main objective of this research is to create a new cyclist network design model for large urban areas. In order to support policy makers, the research also aims to create a set of tools to better analyse, compare and evaluate different bikeway network proposals. The model is based on the development of a new methodology that combines both the analysis of the cyclability of the network and the analysis of urban mobility. The analysis of the network includes many variables such as slope, traffic density, type of bikeway, crossings, etc. Urban mobility is analysed in order to estimate the potential bicycle flow demand according to both the location of the origin- destination points and the characteristics of every trip and traveller: age, sex, travel distance, original transport mode, reason for travel, etc. Since the model works on large urban areas, potential cyclists from multimodal journeys are considered. By integrating both analyses in a Potential Cyclist Flow Distribution Model, it is possible to identify the optimal bikeway network location. The model evaluates the infrastructure both in terms of potential cyclist flow covered by the selected bikeways, and the profitability related to its cost. That is in terms of service effectiveness. A case study of the Madrid central district was conducted. Mobility data were obtained from the Transport Consortium of Madrid Household Survey and from different official studies and surveys that evaluated potential cyclist demand in Madrid. Network data were obtained from various Madrid Council Transport Public Agencies. Finally, we developed a model for the case study in order to analyse and compare the bikeway network proposed by the Madrid Cycling Mobility General Plan with other alternative cyclist networks, evaluating the relationship between their extension, cost and potential flow covered.

[7] THE IMPACT OF WEATHER AND CLIMATE ON CYCLING

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Of all transport modes, cycling is probably most sensitive to weather conditions. It is our objective to determine the effects of various dimensions of weather on cycling both in terms of adverse and supportive weather conditions. A second objective is to use this result to find out to what extent climate change may affect cycling in the long run. This is a relevant theme in a country like the Netherlands where more than 25% of all trips are made by bicycle. The analysis is based on individual reports on travel behavior in the national travel survey that is carried out each year in The Netherlands. These data are linked with meteorological data. A negative binomial model is used to analyze trip making and the impact of weather conditions. Special attention will be paid to the role of trip purposes. Weather conditions may be expected to have a strong role in leisure trips, whereas in the case of commuting and to work or school the effect may well be smaller. We find that in particular during warm days cycling activity increases strongly with temperature: it is 30% higher than when it is freezing. The strongest interaction with other modes is local public transport. Good weather means a lower occupancy rate of busses. Thus, when it is rainy, bus operators are advised to increase the number of buses running. Also wind has a discouraging impact on cycling in The Netherlands. Where most adverse weather dimensions are difficult to address by cyclists, the e-bike may well be a means to cope with wind problems.

SS 2. A - Sustainable Transport Projects and Policies (I)

ROOM VII; Chair: Maria Attard

[32] INCORPORATING EQUITY CONSIDERATIONS IN TRANSPORT PROJECTS EVALUATION: DEVELOPING A NEW MEASURE

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In this work, it is suggested to develop an innovative and comprehensive transport evaluation criteria accounting for distributional effects and accessibility. A primary challenge of this research is to define what type(s) of equity concepts should be used by planners in the assessment of transport policies and how it should be incorporated in the decision making process in order to promote sustainable transport. In order to assess the full benefits of transportation project implementation on various consumers and calculate the improvement in accessibility, it is best to use Activity-Based Modes (ABM). ABM has two important implications for equity analysis which have not been utilized in the literature so far: First, its ability to analyze results by various groups of the population; second, its ability to use the Activity Based Accessibility (ABA) measure to estimate the overall benefits from transport investments and policies. The ABA measure allows one person to have different accessibilities for different choice situations, depending on his/her characteristics. It is suggested to include social and spatial factors in social welfare assessment by introducing the concept of accessibility gains to key social activities. Specifically, it is suggested to incorporate equity effects into Cost-Benefit Analysis (CBA) by replacing the 'Value of Time' (VOT) with an alternative measure, 'Value of Accessibility gains' (VOA), which is based on the ABM accessibility measure, as the key benefit taken into account in CBA. The proposed new measure will be evaluated through a full model case study for different scenarios, and compared to various alternatives of other equity measures suggested in the literature and in this research.

[47] IMPACT OF NATIONAL FISCAL POLICIES TO FURTHER DECARBONISE PASSENGER CARS

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Objectives: The European Commission aims at a 60 % reduction in CO2 emissions from transport by 2050 compared to 1990 levels. Legislation at European level could be supported by additional national policies, driving decarbonisation of the passenger car sector even further. We focus our research, commissioned by the European Environmental Agency (EEA), on three questions:-What is the relation between car characteristics and emissions-What has been the contribution of national fiscal policies, additional to existing European legislation, in decarbonising passenger cars?-What are the co-benefits or trade-offs of such policies on the emissions of air polluting substances? The result of this research should give insights in how to design national car taxation systems to further decarbonise passenger cars. Data and methods: For the 2001-2010 period we collected annual figures on the number of new car sales per fuel type, prices, weight, engine power, engine capacity, emission of CO2, NOx and PM10 and national car taxation regimes in 14 European countries. We used linear regression techniques to analyse the relation between emissions, engine power, weight and engine capacity. Econometric modelling techniques known as random effect panel estimates were used to isolate the influence of taxes on the observed decarbonisation of the fleet. The advantage of using random effect estimates is that they show the magnitude of certain factors (for instance taxes) and their statistical significance corrected for other relevant factors and taking into account variation in time and space. Results: Based on new car sales data for 14 EU countries in the 2001-2010 period, our research shows that:-A 10 % increase in weight accounts for about 8.4 % increase in CO2 emissions, whereas a 10 % increase in engine capacity accounts for an increase in CO2 emissions of a 0.8 %. -Over the 2001-2010 period, due to weight increase

alone, diesel and petrol cars have become less fuel efficient by 6 % and 2 % respectively.-Corrected for fuel type, weight, engine capacity and engine power, over the same period cars have become some 23 % more fuel efficient.-Using registration taxes to affect the shares of diesel and petrol cars appears to work, while annual road taxes and fuel taxes only have smaller and less reliable effects.-Using fuel taxes is clearly effective in reducing the number of car kilometres per person. For each 10 eurocents increase in fuel price the number of passenger car kilometres per capita decreases by about 260 kilometres annually-A policy to decarbonise the passenger car fleet may have positive or negative impacts on air emissions, depending on the instruments used and the mechanisms involved. Positive impacts can be expected from policies aimed at consumers buying lighter cars: a 10 % weight decrease will reduce NOx emissions by 3 % to 4 %. Negative impacts may be expected from policies aimed at consumers switching from petrol to diesel. Positive or negative impacts may be expected, depending on the technology involved, from policies aimed at improving fuel efficiency by improving technology.

[40] POLICY DEVELOPMENT AND SUSTAINABLE TRANSPORT SYSTEMS - THE CASE OF MALTA

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Malta is an island state with a high population density and limited land and space resources located at the southernmost tip of the European Union. Since the turn of the century the islands experienced a steady economic growth and in parallel its population became increasingly car dependent leading to problems of congestion and pollution in the dense built up area, and therefore raising concerns over the sustainability of its transport system. This trend is common to other urban areas across the world. Enoch and Warren (2008) and earlier, King (1993) suggested that islands could function as small scale spatial laboratories for complex politics of larger countries, making them interesting case studies. Malta's population totals just over 400,000 and attracts over a million tourists every year. It has an area of 316 km² and through strict planning regulations aimed at protecting the rural areas only 28 per cent of it is built up. This increases population density and reduces the area within which activities are carried out, including the daily movement of people and goods. This research reviews the development of the transport system in Malta and in particular it describes the measures implemented over the past 10 years by Government to reverse the increasing car dependence and analysis the success or otherwise of these measures in support of a sustainable future. The research is based on own observations, local secondary sources and data collected over the years on the island. Results will show that despite bold attempts by Government to restrain car use, stop the supply of more (road) infrastructure and a focus on developing a new public transport service, the trends of increasing mobility are high. People on the island, like anywhere else in the world, are increasingly becoming more mobile. The islands also face demographic challenges in the future with an ageing population which will require specific transport needs, whilst the economy will be shaped by new sectors. The historic village centres, tightly-knit urban areas and in some cases very high population densities are also a challenge but might provide opportunities for better land use and transport planning. This, however, in the context of a planning institution that still requires significant reform. Within the context of a rapidly changing economy and socio-cultural trends, the sustainability of transport systems in cities will be dependent on the flexibility of measures designed taking into consideration the 'new' risks of economic failure, climate change, changing population dynamics, and facing challenges which are increasingly becoming unpredictable.

SS 5. A - Accessibility, Population Developments and Needs

ROOM VIII; Chair: Benjamin Büttner

[114] IS THE POPULATION DECLINE IN THE PORTUGUESE COUNTRYSIDE STILL RELATED TO ACCESSIBILITY?

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This paper studies the relationships between accessibility and population dynamics in the Portuguese countryside and island regions, comparing the period 2001-2011 with the preceding decades. The research adds to existing literature by considering multiple accessibility dimensions, taking into account various types of destinations (national, regional and local centres) and modes of transport (private transport, coach and train services, and internal flights). The analysis uses GIS methods to estimate indicators of accessibility at the level of the *freguesia* (civil parish), which are then related to data from the population census. The results show that the investment in the motorway and air networks and the disinvestment in the railway network are significantly associated with demographic variables. However, these relationships vary among different parts of the country, as private and public transport accessibility can act either as a push or pull factor in migration from the most isolated regions.

[97] EFFECTS ON UNCERTAINTY AND DELAYS ON DAILY COMMUTING ACCESSIBILITY BY PUBLIC RAIL TRANSIT

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Commuting travel time is an important element for determining the choice of daily transport mode, at short term, and location of residential area for households, at long term. Accessibility to job centres' is often considered using expected travel time and not actual travel time. This paper refers to reliability in regional rail public transport lines. It analyses impacts of commuting rail travel time variability and therefore uncertainty on travel time and accessibility to job, considering train delays or cancellation. Reliability is defined as the level of variability between the expected travel time (based on scheduled time) and the actual travel time experienced. Variability is shown for a train as the frequency of being delayed by 5 min or more and of being cancelled. Actual travel time can be defined in terms of expected travel time weighted by the probability for the train to be delayed or cancelled; these elements are dependent on the type of line. For the Lyon metropolitan area, the modelling and simulating MOSART platform identifies actual travel time between each rail station located on one of the 12 regional rail lines and the city of Lyon (France). We identify probability of delay and cancellation using data from the regional rail organizing authority for each of the 12 lines, on the morning peak period. Then accessibility to jobs with actual travel time is compared to accessibility with expected travel time. If more than 85% of daily trains are delayed by 5 minutes or less arriving at the Lyon stations', the delay probability distribution indicates a high level of heterogeneity across lines. It differs across lines location, number of users and the type of rolling stock. Actual accessibility to job centers varies therefore if compared to the expected one. Accessibility maps highlight a high accessibility decrease for lines joining the East part of the territory to the city of Lyon while the West part tends to be less impacted by delays or cancellations. While land use planner often considers theoretical accessibility, this paper highlights impacts of daily trains' delays and cancellations on accessibility. Likewise road congestion is today integrated on road travel time and accessibility computation, public transport reliability knowledge has to be improved. Our results offer to the public decision maker quantitative accessibility-based elements to control the development of urban form implementing strategies of firms and population locations.

[106] ENSURING ACCESSIBILITY TO DAILY ACTIVITIES FOR DIFFERENT POPULATION SEGMENTS IN RESPECT OF SHARP INCREASES IN MOBILITY COSTS

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The amount of the household budget spent on mobility is rising dramatically. While residential costs – a monthly mortgage, for example – can be estimated quite easily and accurately, mobility costs and travel times are often underestimated or even ignored in household location decisions. When taken in aggregate, these disconnect between residential locations and transport costs can have serious impacts on a household budget in the face of rising gas prices. After performing a vulnerability assessment based on the dimensions of exposure, sensitivity, and resilience, three municipalities with different settlement structures were selected from within the Munich region to better understand and characterize localized differences in vulnerability. Fürstfeldbruck is characterized by an urban structure with 35.000 inhabitants and sufficient social infrastructure. As a suburban community, Haar has an excellent connection to the city of Munich and a high population density of 1.520 inhabitants per square kilometre. Kirchdorf an der Amper, representing the rural settlement structure, has a population density of only 85 inhabitants per square kilometre and lacks accessibility to public transportation. Within these municipalities, synthetic households and their respective storylines were generated to evaluate representative household travel behavior and to approximate potential mobility cost tipping points. To calculate georeference and visualize these representative households, researchers used a GIS-based accessibility instrument implementing real address data. Next, researchers applied various stress tests (price shock scenarios like \$200/bbl, triple of gas price) to each household and mapped their spatial patterns of movement and corresponding modes. All trips were attributed a cost, CO₂ emissions, and travel times. These household mobility maps illustrate how commuting patterns might change, such as from private car to public transport or carpooling, in the face of increasing fuel prices. The ultimate aim is to ensure the social participation, hence the accessibility to daily activities for different population segments.

SS 7. A - Transport Studies and GPS Technologies

Amphitheatre III; Chair: Emmanouil Tranos

[35] ANALYSIS OF ERROR IN PROMPTED RECALL SURVEYS

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In recent years, GPS technology has been widely applied in transportation research as an alternative to traditional surveys to collect activity-travel data. Particular imputation algorithms have been developed to extract activity agendas from GPS traces. In most studies, the imputed activity-travel diaries are then validated using prompted recall surveys, which ask respondents to check the imputed diaries and change any wrongly imputed elements. Generally, it is assumed that the outcomes of these prompted recall surveys are perfect and error-free. The assumption of error-free prompted recall surveys is however questionable. Respondents may have an incomplete or wrong memory of their activities or may make simple mistakes in completing the survey. The degree of error will depend on such factors as the size of the validation task, the complexity of the experiment, and respondent characteristics. A long period of time gap might be difficult for respondents to remember clearly their activity-travel details. On the other hand, a burdensome validation task may also increase errors. Therefore, it is important to examine error in prompted recall surveys. To this end, the purpose of this

paper is to measure error in prompted recall surveys and investigate the reasons for such error. Error will be detected on visual inspection of GPS traces. It will be measured for each agenda according to the correctness of activity location, transport mode, start and end time, and whether there are missing activities/trips. Regression models are estimated to analyze the effect of day of the week, time spent on validation tasks, number of activities, number of trips, and personal profiles like age, gender, income, education, etc. on error rates. Moreover, panel effects will be examined using multiple days of activity data.

[79] MULTI-AGENT-SIMULATION BASED ON CARSHARING BACK-END DATA

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Only a few years ago, it was unthinkable that original equipment manufacturers (OEMs) like Daimler, BMW or Citroën would deliver the benchmarks in innovative carsharing systems. With offers like Car2Go, DriveNow and MultiCity, they now do exactly that in cities like Berlin, Amsterdam, Vancouver, Washington, and 13 other cities. Furthermore, public transport operators are increasingly including carsharing into their portfolio. These advanced carsharing developments can be characterised through four attributes: instant access to vehicles, open end of booking time, a one-way option and an intermodal integration. Common tools of transportation planning like activity based four-step-modelling can quickly become outdated when taking such trends into account. For the quantification of mobility patterns traditional traffic planning uses four-step-models, which help traffic forecasting on an urban and regional scale. Dynamic attributes over a certain period of time as well as decentralized infrastructure are hardly implementable in such an approach. To assess time-dependent mobility patterns, models are currently often based on activity data. The traditional modelling concept is further changed in agent-based models, where activity chains are linked to specific individuals based on social-demographic attributes and availability of specific mode types. This way multi-agent-models can deal with complex research questions. The impact of a wider diffusion of carsharing usage is such a topic. A multi-agent-simulation can therefore be an important future tool to assess specific topics related to carsharing: How does carsharing influence traditional public transport products? What will happen when instant access, open end and one way booking become common attributes of carsharing? How will individual mobility patterns change with regards to the wider availability of such products? Which effects will shared electric vehicles have? To answer these questions, an intermodal multi-agent-simulation for Carsharing in Berlin has been conducted. The open source software MATSim was used as tool for the simulation. Our model is based on an existing model conducted by the local transport operator (BVG). Activity and mobility patterns are simulated for four million agents. Private car, public transport, bike and walking as modes of transport are enriched with three scenarios of carsharing usage: 1. Station-based carsharing; 2. Station-based and flexible carsharing; 3. Station-based and flexible carsharing with a significant share of electric vehicles. Carsharing data was gathered primarily through back-end data and secondarily through questionnaires on carsharing usage. With the back-end data from the biggest station-based carsharing operator and from all of the current flexible carsharing operators, an almost full census for carsharing usage of Berlin 2011 has been available. This data of approximately 180 000 bookings cover attributes like origin and destination, travelled distance, trip duration and trip costs. Additional attributes on activities and social demographic attributes of the user have been collected in the research project Berlin elektroMobil 2.0. The usage of state of the art transportation modelling, broad back-end data and in-depth research data make this study unique and may show a path to future transportation assessment. Results of the calibrated simulation are currently assessed and will be presented at the NECTAR 2013 conference.

[91] ERRORS IN VOLUNTEERED GPS TRAJECTORIES - RECOGNITION AND VISUALISATION

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Crowdsourcing has recently become a widespread resource for attaining various tasks in large quantity. GPS traces voluntarily collected and shared on the Web can be treated as valuable sources of information about the nature of human mobility, personal activities, city and regions' dynamics etc. To ensure the credibility of crowdsourced traces, issues of uncertainty and inaccuracy of GPS trajectories have to be taken into account to present the level of reliance on such a type of data to protect networks users against blind faith in the falsified information available on the Web. Until May 2000, the main source of GPS inaccuracy was the deliberate falsification of the time of signal transmission from the satellite produced by switching on selective availability (SA). When Bill Clinton authorized switching off SA the reduction of the error level of the position determination decreased from 150m to 20m or less. Further developments in technology have brought down the error levels to 3-5m in standard receivers and below centimetre level in professional ones. However, a series of factors affect the precise level of accuracy achievement at any given time period and any given location. These include: the geometry of the satellites 'seen' by the receiver; atmospheric effects; multipath effect; receiver clock errors. All together, those factors tend to induce errors of around 15m but they can be ameliorated by supplementing the GPS signals with augmentation systems such as WAAS and EGNOS. Apart from the factors described above, there are some technical ones which also influence the accuracy of determining position. The quality of the GPS receiver, its antenna and software may have a huge impact on the accuracy. The quality of antenna in the receiver may cause an increase of error to many meters so the selection of the device is important. Raw trajectories from the devices can be map-matched in commonly used software with low accuracy, introducing further error. Initially the inaccuracy was assigned only to the points measured with GPS methods, but now, in the era of GPS loggers/trackers it is useful to take into consideration GPS-based trajectories understood as sets of points with links between them, where uncertainty in the point location causes uncertainty in the

trajectory, the same causing uncertainty in the publicly available information. Because of all the errors from GPS and their random appearance in different environmental situations, few experiments on errors in trajectories have been undertaken. With the use of various personal GPS loggers (QSTARZ BT1000XT, GlobalSat GB-100, I-GotU 600, etc.) their behaviour in terms of accuracy in different scenarios (urban areas, urban canyon areas, non-urban areas) with different settings is examined here. As well as reporting on the effects of environmental factors such as time of the day, weather, side of the street etc. on GPS accuracy, we further examine the visualisation of such errors back in terms of point locations and trajectories. We attempt to provide novel visualisation of errors in voluntarily collected and Web shared GPS trajectories through the use of space-time cubes.

SS 8. A - Resilience and Complex Networks: Methodological Perspectives

Amphitheatre IV; Chair: Aura Reggiani

[64] A NEW MEASURE OF RESILIENCE

Minette D'Lima and Francesca Medda

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The many varied views on resilience indicate that it is an important concept which has significance in many disciplines, from ecology to psychology to risk/disaster management. However, it is important to be able to quantifiably measure the resilience of systems, and consequently be able to make decisions on how the resilience of the system can be improved. Against this background, in this work we define resilience as the ability of a system to absorb, adapt to, and/or rapidly recover from potentially disruptive events. We therefore think of a system as being more or less resilient based on its ability to recover rapidly or slowly from disruptive events or shocks. We develop a mean-reverting stochastic model to study the diffusive effects of shocks and we apply this model to the case of the London Underground. As a shock diffuses through the network, the human-flow in the network adapts to the shock. The speed with which the passenger counts return to normal is an indicator of how quickly the line is able to adapt to the shock and thereafter resume normal operations. The case of the London Underground allows us to test our new measure of resilience. We conclude by using this new measure of resilience to assess the economic implications of disruptions in the London Underground.

[93] NETWORK-BASED INFRASTRUCTURE VULNERABILITY ANALYSIS - A CRITICAL REVIEW OF RECENT SWEDISH STUDIES

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Recent disasters such as the 2004 Thailand tsunami, the 2010 Haiti earthquake, the 2011 Fukushima Daiichi nuclear power accident and the 2012 Sandy hurricane sadly illustrate the vulnerability of modern societies. The far-reaching consequences of these disasters have often been possible to attribute partly to the increasing complexity of the socio-technical systems that modern life relies on. Everyday life, business, production and many critical societal functions are highly dependent on systems for information and telecommunication, power supply, transport, water provision, sewage handling, as well as financial transactions, just to mention a few critical societal infrastructure systems. Moreover, these different infrastructure systems tend to be increasingly dependent on each other. This means that the consequences of a collapse in one infrastructure system can spread widely and be difficult to predict. The ongoing climate change is likely to make extreme weather even more common, which will intensify the consequences and uncertainties of such events for the society. Sweden is a country with a very low risk of earthquakes and where adverse weather conditions tend to be less dramatic than in most other countries. Still, hurricanes, heavy snow storms and flooding due to continuous raining are not uncommon. Preventing emergencies and disasters, reducing their consequences and improving the resilience of the infrastructure systems are important national, regional and local political goals. In this presentation we will review some recent research in Sweden on the vulnerability of network-based infrastructure systems, concentrating on power distribution and transport systems. We will present and compare various methodological approaches that have been applied. To what extent is it possible to use an approach developed for one system for analyzing another system? We will critically discuss how useful these approaches are, or could be, for planning, maintenance and operation of the infrastructure systems in order to increase their robustness and resilience. We will also identify important knowledge gaps and alternative approaches where further research could be particularly fruitful.

[137] SPATIAL AUTOCORRELATION IN SPATIAL INTERACTIONS MODELS: GEOGRAPHIC SCALE AND RESOLUTION DIMENSIONS OF PARAMETER ESTIMATES

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Recent attention has turned to network autocorrelation, one of the previously neglected components of spatial interaction models. This component coupled with spatial autocorrelation latent in the geographic distribution of origin and destination characteristics affiliated with flows over space impacts upon global distance decay parameter estimates, and results in substantially better goodness-of-fit measures between predicted and observed flows. To date, this improved model specification outcome, which reflects a dimension of spatial network complexity, is documented for journey-to-work flows

at the county/landkreis level for Texas (Complexity and Spatial Networks, 2009), Germany (J. of Geographical Systems, 2009), and Pennsylvania (Computers, Environment & Urban Systems, 2011), as well as at coarser geographic resolutions (United States: Annals, AAG, 2011; European Union NUTS-2 regions: J. of Regional Sciences, 2008). Both geographic scale and resolution can stretch/compress the geographic landscape of spatial interaction data. A change in geographic scale relates to increasing domain spatial sampling; a change in geographic resolution relates to infill spatial sampling. One question needing to be addressed at this time asks about the resiliency of spatial interaction model parameter estimates: do parameter estimates return to given values after being disturbed by a change in geographic scale or resolution? This paper summarizes experiments with 2000 Chicago journey-to-work flows data for both the census tract and the county resolutions. Census tract based parameter estimation comparisons are made for changes in scale: City of Chicago (871 census tracts; 758,641 flows), Cook County (1,343 census tracts; 1,803,649 flows), and the Chicago Metropolitan Statistical Area (2,067 census tracts; 4,272,489 flows). The respective number of zero flows presents one data analytic complication: 710,617, 1,674,792, and 4,032,015. Parameter estimation comparisons also are made for changes in resolution across the Chicago Metropolitan Statistical Area: 2,067 census tracts, and 13 counties (169 flows). Excessive zero flows do not complicate analyses based upon this latter coarser resolution. Estimation is of the parameters of a double-constrained gravity spatial interaction model specification, where network autocorrelation is captured with eigenvector spatial filters. These spatial filters represent one feature of complexity in spatial networks. Spatial autocorrelation in the geographic distribution of the balancing factors represents another feature of spatial network complexity. Estimation is with Poisson regression. This specific specification reveals that network autocorrelation either inflates (a positive eigenvector spatial filter value) or deflates (a negative eigenvector spatial filter value) a predicted flows value. This adjustment arises from the geographic clustering tendency of origins for flows to a particular destination, and the geographic clustering tendency of destinations for flows from a given origin. This paper makes novel contributions to the literature. One concerns visualization of the eigenvector spatial filtering predicted flows inflation/deflation. Another concerns parameter estimate comparisons across geographic scale and resolution, and particularly for a resolution as fine as a census tract. Because of the nature of spatial autocorrelation, the eigenvector spatial filters are expected to vary across resolution, but not necessarily across scale. Yet another contribution concerns the establishing of relationships between parameter estimates across geographic resolutions. Appropriate parameter estimate implications are drawn.

[53] NETWORK RESILIENCE AND VULNERABILITY: SOME METHODOLOGICAL CONSIDERATIONS

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This paper proposes a general conceptual framework which aims to integrate the concepts of network resilience and vulnerability, in the light of critical network infrastructure issues. The literature on critical network infrastructures, which explores the robustness/vulnerability to disruption, has grown considerably in recent years, demonstrating the relevance of this issue. In parallel, a number of different approaches (such as mathematical programming, general equilibrium models, simulation tools, etc), which are able to identify network criticalities/fragilities have been investigated: approaches which also show the complexity of the related models and analyses. In this context, the concepts of resilience and vulnerability seem to be the most interesting, given their powerful theoretical background from the modelling viewpoint. The importance of network infrastructure resilience/vulnerability is largely dependent on the location of its links and nodes, as well as on their connectivity. And therefore, the type of topological relationships between the network nodes – combined with the analysis of the related economic weight/use – is a crucial issue further study, also taking on board the interesting recent contributions in network analysis. Given this background, the paper highlights methodological considerations on the role and interpretation of resilience vs vulnerability in complex network structures, with reference to the conventional (static and dynamic) models in spatial science. In particular, attention will be paid to a complementary analysis of these two (dynamic) concepts. While resilience analysis refers to the speed at which a network returns at its equilibrium after a shock, as well as to the perturbations/shocks that can be absorbed, vulnerability analysis refers to the propagation of shocks in a network. Propagation as flow in a network, according to different dimensions, turns out to be an appealing concept, worth examining. This indicates the need to study and to model shocks in complex networks. In this context, cascading disaster models seem to be an interesting methodological tool. The question is, therefore, how conventional (complex) system dynamic modelling, as well as the conventional (complex) network modelling, takes into account these resilience/vulnerability dynamics from the methodological viewpoint. In this paper, further attention is given to the connection between accessibility, resilience and vulnerability, in particular to whether the accessibility indicator is related to the identification of resilience/vulnerability in complex network structures. From the empirical viewpoint, operational measures of resilience are then discussed, as a means to enhance resilience in transport and communication networks. Current policy strategies which focus on resilience show the importance of continuing research on the links between complex transport networks, resilience and vulnerability, mostly by exploring these relationships at different scale levels and their impact on the whole network.

RS. B - Accessibility Measures

ROOM V; Chair: Concepción Román

[3] DIMINISHING RETURNS TO ACCESSIBILITY? SOME EVIDENCE FROM SWISS MUNICIPALITIES, 1950-2000

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This study analyzes how accessibility of individual locations has affected, in the second half of the twentieth century, the population growth of 2889 municipalities in Switzerland, by investigating the relative strength of factors affecting population growth rates of individual municipalities each decade, between 1950 and 2000. In addition to accessibility variables, used as population growth predictors, the analysis covers a range of additional locational and spatial attributes (such as weather, population size, proximity to main cities and international borders, etc.) and is performed using both traditional multivariate regressions and spatial dependency models. In the analysis, population growth rates are analyzed separately, using, first, absolute, and, then, canton-standardized attributes, assuming that the relative importance of each locational factor is likely to depend on whether other places possess it as well, and may thus change across different time periods. As the study indicates, the substitution of absolute location variables by canton-standardized ones improves the models' fit and generality, thus lending empirical support to our initial research hypothesis about temporal relativity of locational and accessibility attributes, even for small territorial divisions such as the Swiss cantons. However, the analysis also shows that, both absolute and relative accessibility measures appeared to have weakened over time as population growth predictors, apparently due to improving road infrastructures, and growing motorization. The main contribution of this study to the location relativity hypothesis is demonstrating the temporal relativity of location attributes, even for small regional divisions (not only at the national scale), apparently due to Switzerland's mountainous terrain, which still hinders intra-country mobility. The study has been made possible by a detailed historical population and accessibility database available for Swiss municipalities. To the best of our knowledge, no database of such scope and quality is available for any other European country.

[82] THE ROLE OF THE BORDER EFFECT IN EUROPEAN ACCESSIBILITY: IMPROVED ESTIMATIONS BASED ON NETWORK DISTANCE AND GEOGRAPHICALLY WEIGHTED REGRESSION

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International borders act as trade barriers, thus hampering accessibility to goods, and to a lesser extent, services. Lowering trade barriers has become an issue of worldwide interest with the European Union as well as other international organizations like World Trade Organization (WTO) or Mercosur being highly concerned about it. However, accessibility studies often ignore the role of international borders when measuring the accessibility of cities, regions or countries. The main objective of this paper is to obtain a realistic measure of the border effect of manufactured products for European countries, thus contributing to clarify the dimension of the home bias and its spatial variation. Border effect estimations might eventually be integrated in accessibility measures. Our contribution to improve the current state of the art is two-fold: on the one hand, Euclidean distance is replaced with network-based distance measures, as supplied in the TRANSTOOLS geodatabase. National production and export data was obtained from EUROSTAT. Current limitations of these datasets required an oversimplification of internal trade, which introduces the so-called Rotterdam Effect (i.e. the proportion of exports over national production in small countries with large ports is extremely large). This proved to have a strong influence on the estimation of home bias. On the other hand, traditional analysis based on the gravity model is improved with the use of Geographically Weighted Regression (GWR), which will be compared with Ordinary Least Square (OLS) regressions. Once countries presumably affected by the Rotterdam effect were removed from the analysis, we obtained a better adjustment with the use of OLS than previous studies. Moreover, we found out that estimating distance as a function of time or Generalized Transport Cost (GTC) maintains R^2 over 0.9 and that both distance conceptualizations show similar results, multiplying previous Euclidean home bias estimations by 2.4 on average for the selected European countries. Moran's I test for spatial autocorrelation was used to test OLS residuals, with GTC showing lower spatial autocorrelation in most countries, but still high for 44 per cent of the countries. We aim to improve these results through the use of GWR to further analyze the fourth dimension of origin-destination data. Therefore, a more detailed and spatially accurate analysis of the border effect between European countries will be reached. Results include cartography of the border effect for 18 EU countries and four distance conceptualizations (Euclidean, network, time and GTC). Conclusions extracted from the impedance of each variable for each country will benefit a better adjustment of accessibility measures. This will eventually lead to a better understanding of freight transport dynamics, as well as the effect of European policies on the diverse integration of each country in the EU market.

[127] TRANSPORT ACCESSIBILITY MEASURE FOR EUROPE: EX-POST ANALYSIS OF COHESION FUND INFRASTRUCTURE PROJECTS

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Socio-economic disparities within Europe are expected to be reduced partly with proper transport investments. Several EU level policy frameworks and the recently published White Paper on Transport emphasize the relationship between territorial cohesion and transportation investments. The deficiencies in transport accessibility are seen as an obstacle for economic development in these frameworks. Many transport infrastructure projects are being publicly funded particularly in peripheral countries to improve their infrastructure in order to narrow the gap with respect to more developed parts of Europe. One of the most important efforts to achieve this goal has been given by the Cohesion Fund infrastructure projects. However, there exist some difficulties to assess impact of these efforts, since a common framework for ex-ante and ex-post analysis of transport projects/policies in terms of monitoring change in accessibility and regional disparities is still lacking. Hence, a methodology and a framework should be developed in order to quantify at which extent the projects serve to increase transport accessibility. Within this context, the aim of this study is to develop a framework to assess the impacts of various policy options on transport accessibility at European level. For the purpose, impacts of Cohesion Fund infrastructure projects, mainly established to improve road and rail transport networks in the peripheral countries between 2000 and 2006, has been analyzed as a real case policy option. Measure of accessibility simply shows how advantageous is an area in terms of reaching some certain type of opportunities. Motivation behind measuring regional accessibility is that the regions with better access to economic activities will be more productive and competitive. The quantitative methodology of measuring regional transport accessibility is performed by broad range of indicators. Generally, a combination of two functions, one representing the activities to be reached and one representing the effort or cost needed to reach them. Any measure proposed to be used at European level should be sensitive to i) network improvements, ii) modal and technological shifts, iii) demand and supply side change, and iv) change in socio-economic and demographic characteristics. Among various accessibility indicators with the above criteria, an adequate combination has been selected for ex-post evaluation of Cohesion Fund infrastructure projects. The transport costs for the existing situation and the policy option with the improved road and rail infrastructure have been estimated with the TRANS-TOOLS model (the EU-wide transport network model used as one of the reference tool for impact assessments by the European Commission). Then, the outputs of the TRANS-TOOLS model have been used for measuring transport accessibility at European NUTS 3 level. Finally, several statistical techniques were introduced to differentiate amongst changes in the accessibility pattern of Europe and in the similarity-dissimilarity of regions. The overall results show that the transport infrastructure investments in the European peripheral countries have significantly improved the regional accessibility in these countries.

[27] SOURCES OF HETEROGENEITY AFFECTING THE VALUATION OF TRAVEL TIME COMPONENTS

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We obtain estimates of the VOT for the Madrid-Barcelona corridor and explore the main sources of heterogeneity affecting the various components of total travel time. The analysis is based on the estimation of discrete choice models among the main public transport services in the corridor: air transport, high speed rail (HSR) and bus. The new HSR alternative (which started to operate in February 2008) competes directly with one of the densest airline domestic markets in the world, and its introduction produced substantial improvements in level of service, achieving reductions in travel time of more than 50% over the conventional train. A specifically designed revealed preference (RP) survey coupled with highly precise measurements of the level-of-service variables for all alternatives, allowed us to estimate progressively more flexible models, the specification of which also considered different interactions of socioeconomic variables (and other important factors affecting mode choice) with the typical level-of-service attributes. We also examined income effect through the introduction of the expenditure rate multiplying all time components. We found, as expected, that HSR and air transport users exhibit substantially higher values of travel time savings than bus travellers. Also as expected, savings of waiting time are more valued than savings of access time, and the latter more valued than savings of in-vehicle travel time. Finally, we were able to demonstrate the relevance of considering a differentiated analysis for travellers that do not pay for their travel expenses, providing a theoretically sound explanation for the large differences encountered in WTP with respect to other travellers.

SS 1. B - A Future for Non-Motorized Transport Modes: Walking and Cycling Networks (II)

ROOM VI; Chair: Andy Goetz

[102] THE INFLUENCE OF PARENT'S PERCEPTIONS AND RESIDENTIAL SELF-SELECTIVITY TO THE CHILDREN'S ACTIVE TRAVEL MODES AT SINGLE PARENT HOUSEHOLDS

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This paper investigates the impacts of households' residential self-selectivity, parents' perceptions and their travel patterns to their children's daily travel mode shares among single parent households. To capture the complexity of the relationships between parent and children travel mode choices, an integrated model structured is introduced and the model estimated

with simultaneous equation modelling. The results shows that, beside parent's daily activity-travel engagements, both parent's perceptions and his/her residential self-selectivity reasons play significant roles in influencing their children daily travel mode shares. The parent's perceptions play more significant roles in influencing children's travel modes shares, whilst the residential self-selectivity reasons have more significant influence to the parent's travel mode choice. The finding of this study reveals a fact that wherever the children lives, their travel behaviour are tend to be 'neutral' and open to be influenced by their parents throughout their live time.

[49] A RECIPE FOR ESTIMATING PEDESTRIAN EXPOSURE IN URBAN AREAS

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Pedestrians have an important role in urban accessibility, representing, in the case of Lisbon city, ca. 20% of daily urban trips. The choice for walking mode instead of using motorized modes has positive impacts considering the inexistence of environmental impacts (energy consumption and pollutant emissions), as well as the reduction of congestion and space occupancy. Thus, it is important to understand and characterize this mode in order to better promote its usage. Considering this, the aim of the present research work is to define and demonstrate a new methodology for estimating pedestrian exposure in urban areas considering trip dynamic (distance, time), street topography (slopes), environment characteristics (level of service, type of pavement, barriers) and particulate matter inhalation (PM10, PM2.5 and PM1). The methodology consists on a recipe with consecutive steps that characterize the pedestrian trip (terrain, walking distance, type of road, existence of traffic signals, barriers, level of service, etc.) as well as the type of pedestrian (namely elderly people, disabled people, children, stroller carriers, among others) and, for each pedestrian type, the pedestrian specific effort (maximum inhalation rate, heart rate, stress, ...). Information on air quality data from stationary stations is also required in order to better estimate particulate matter exposure. A case study in Lisbon center was made, using a specific laboratory to acquire the data needed for characterizing pedestrian trips (instant speed, PM exposure, GPS coordinates, etc.) and specific effort, and defined origin/destination trips to apply the methodology. As an output of this research work, indicators of pedestrian particulate matter exposure and trip costs (time, distance) were achieved, enabling a characterization and comparison of different urban areas taking into consideration pedestrian comfort.

[37] CYCLING IN MIXED TRAFFIC IN BRISBANE AND COPENHAGEN: A MODEL OF RISK PERCEPTIONS, ATTITUDES AND BEHAVIOUR

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In emerging cycling regions, namely highly motorized regions where the shares of cyclists are historically marginal but rapidly growing, cyclists and motorists face the challenge of sharing the road because the development of dedicated cycling infrastructure is lagging behind in terms of length and continuity. Studies have shown that the road sharing experience is often characterized by cyclist-motorist conflicts and a general sense of threat among cyclists. The associated negative perception of safety impedes the seamless integration of cycling with the general traffic and leads to fear-based exclusion of cyclists from the transport network. Only a few studies focused on exploring the road sharing experience of cyclists and motorists. Joshi et al. (2001) documented cyclist-motorist conflicts in Oxford, England. O'Connor and Brown (2010) provided evidence regarding the aggressive behavior of drivers towards leisure cyclists in Victoria, Australia. Heesch et al. (2011) unravelled harassment behavior such as blocking, shouting, and making obscene gestures by drivers toward cyclists in Queensland, Australia. Kaplan and Prato (2012) investigated the chain of cognition, emotion, and behavior associated with the road sharing experience in inter-urban roads Israel. The current study contributes to this research stream by exploring cyclists' risk perceptions, attitudes and behavior towards cycling in mixed traffic conditions in urban areas. Doing so, this study investigates the difference between Brisbane (Australia) as an emerging cycling city and Copenhagen (Denmark) as an established cycling capital. A custom-designed web-based questionnaire was developed in order to collect the data for the analysis. The questionnaire consisted of items concerning (i) the perceived risk of infrastructure layouts considering the number of lanes, parking cycling lane availability, (ii) the perceived risk due to the proximity of cars, (iii) own risky/safe cycling habits, (iv) cycling avoidance due to feeling unsafe, (v) the willingness to cycle on the road in general traffic, and (vi) cyclists' demographics and cycling experience. The survey was administered among cyclists in the two cities through university networks and cyclist forums and included two versions to account for the different driving direction in the two countries. The survey yielded 865 complete and valid responses. The current study uses generalized linear latent and mixed models. These models allow to accommodate the latent nature of perceptions and attitudes and the observed nature of socio-demographic characteristics of cyclists and their behavior, as well as to account for both known population groups and latent classes. These models comprise two components, namely a measurement model and a structural model. Measurement equations correlate the items collected with the web-based questionnaire to latent constructs, while structural equations relate the latent constructs with the socio-demographic characteristics as covariates and reveal their correlation structure. Expected results will uncover the correlations among latent constructs (i.e., risk perceptions, risky cycling habits, cycling experience, cycling avoidance, and willingness to cycle on the road in general traffic) and the differences across cyclists in Brisbane and Copenhagen ('safety in numbers' effect), while controlling for cyclist demographics and cycling experience.

[9] KEEP THE CHILDREN WALKING: ACTIVE SCHOOL TRAVEL IN TIRANA, ALBANIA

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This paper examines how characteristics of the physical and socio-economic environment influence children's school travel mode in Tirana, the capital of Albania. A survey of approximately 500 students aged 11 to 13, revealed that an overwhelming majority walk to school, while bicycling and bus use are minimal. Students who walk to school often do so as part of a larger group of schoolmates, attend schools that are located relatively near their house, are faced with relatively few major road crossings during their journey, and belong to families that are less likely to own a car. Children who are driven to school (only 13.5% of our sample) usually have higher-income families and live farther from the school. Although Tirana's high residential density has some environmental drawbacks, we deem it positive in that its result is that most students live very close to their schools and in close proximity to classmates walking to school. The fine-grained pattern of the urban public school network contributes to the short distances between schools and homes. We provide a number of recommendations for the promotion of walking in home-school trips, as well as for the future physical development of the city and the school network. In view of the fact that the proportion of schoolchildren who walk to school in Tirana is substantially higher than in Western countries, our recommendations aim at maintaining current shares of walking in the face of growing incomes and car ownership rates. The same goals and policies that we recommend may be applicable to school travel planning in other developing cities of similar size.

SS 2. B - Attitudes and Mode Choice

ROOM VII; Chair: Richard Quodmine

[108] UNDERSTANDING OF THE SENSITIVITY OF WEATHER ON PEOPLE'S MODE CHOICE DECISION: A CASE STUDY IN SWEDEN

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This paper investigates the influence of weather condition on Swedish people's mode choice, using Swedish National Transport Survey Data and daily weather data from Swedish Meteorological and Hydrological Institute. Since time duration covered in these data is 13 years and distinct regions all over Sweden are included, seasonal effect and regional effect of weather indicators on individual's mode choice decision are studied. The sensitivity of these weather indicators on mode choice is investigated using multinomial logit model. Results show that, in mode choice decision, Swedish people are more sensitive to temperature increase when it is below 10°C than when it is up to 10°C. Also the sensitivity to temperature and precipitation varies in different temperature and precipitation intervals, which is similar to the notion of perception constraint. Also further analysis indicates that sensitivity of weather indicator differs in different seasons and different regions. Temperature increase has a positive effect on walk choice in summer, while the opposite holds true in other three seasons. However the influence of precipitation in different seasons seems to be vague, probably because increased precipitation leads to a slight shortening of the distance and thus would increase the share of non-motorized mode, which interacts with the direct effect that precipitation would reduce the share of non-motorized mode. Regional effect shows that, generally speaking, people in north Sweden are less affected by changing of weather than that in south and middle Sweden. However north bicycle users' sensitivity to temperature in autumn is much larger than that for middle and south bicycle users, showing a lagged effect of willing to use bicycle in north after summer when weather is still moderate (autumn temperature > 0°C).

[39] THE MALTA BUS REFORM: IMPLICATIONS FOR POLICY FROM A 'NATURAL EXPERIMENT' OF PERCEIVED BUS SERVICE QUALITY AND ATTITUDES TOWARDS MODAL SHIFT.

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Private car use is considered to be one of the leading contributors to air pollution within the urban environment. This is also the case in Malta where a low quality bus service that has been operating for the past three decades resulted in patronage decline and increase in car use. As a result, in 2008 Government issued a policy document with the agenda of sustainable mobility in mind. The objective was to reform the bus system and induce modal shift. The reform eventually took place on the third of July 2011. The research aims to explore the attitudes of non-bus users towards modal shift and how they perceive bus service quality. It also tries to identify whether current policy measures suffice to obtain an increase in bus patronage. The research objectives are to: (i) Explain the need of the reform in the local policy context, (ii) Discuss the methodology used for collecting the data, (iii) present the results regarding attitudes on modal shift and perceived quality of bus service provision, and (iv) Discuss whether existing policy measures are sufficient to obtain modal shift. A natural experiment approach was attributed to the research in the form of a cross-sectional study. This involved disseminating questionnaires to locals two months before the reform and one year after. This paper focuses on structured and semi-structured questions of the questionnaire and the data is analysed quantitatively. Discrete Choice Modelling using Multinomial Logistic Regression is applied in order to identify population stereotypes regarding mode choice. Factor Analysis is used as a data reduction technique to identify population segments and their attitudes towards the perceived

bus service quality before and after the reform. Results cast doubt on whether current policy measures regarding the bus service quality are adequate to contribute to a modal shift from car to bus use. It is suggested that existing policy measures should focus more on regulatory aspects that improve the quality of the bus service, while at the same time promote smarter choices by targeting specific population segments.

[96] THE ROLE OF ATTITUDES IN SUSTAINABLE TRANSPORTATION BEHAVIOUR – THE E-CAR SHARING EXAMPLE

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The project BeMobility aims to integrate electric cars, as a car sharing service, in the public transportation system of Berlin (Germany). The integration is threefold. Firstly, both projects provide Smartphone users with multi-modal routing and real-time information on PT and EVs in one single app. Secondly, a mobility card has been offered to test electric and conventional car sharing, bike sharing and PT in Berlin for a three month period. Thirdly, car sharing stations including charging stations are placed at central knots of the public transportation system. Stations have been installed in residential areas close to the city center so that there have been 16 e-car sharing stations by the end of 2011. During the two-year BeMobility field trial 1,209 individuals drove 194,037 km with 47 EVs. This paper aims to provide the final results of the project BeMobility and draws comparisons to a national wide study on mobility related attitudes during the BeMobility 2.0 project. In summer 2012 a representative survey in agglomerations (Berlin, Hamburg, Frankfurt, München, n=2400) was conducted and compared to existing mobility types. The research of project BeMobility was conducted in three stages – T0, T1, and T2 – by a triangulation of qualitative and quantitative methods. Before starting the field trial, qualitative group discussions were conducted to explore the opinions, requirements and prejudices of prospective users concerning car sharing, electric cars, their integration into public transport, and potential product concepts. All quantitative surveys were realized as Computer Assisted Web Interviewing (CAWI). Quantitative surveys included qualitative, open questions in order to reveal explanations and interpretations for the quantitative data. The first of three quantitative surveys was carried out with 311 participants before they used the service (T0, November 2011). After approximately 8 weeks of user experience 160 users were surveyed on experiences and impressions (T1, November 2010 - April 2011). After been given the opportunity of further experience a third quantitative survey was completed with 178 users (T2, August 2011). The results of the study show that participants of the surveys are satisfied with the integrated service. Even the worst rated items are still above or close to a mean value of 3.5 which is the scale center of the applied 6-point likert scale. A great majority of expectations is matched by the experiences. Items concerning range and charging infrastructure are below expectations but still high. The comparison to the representative study in BeMobility 2.0 shows relevant differences in mobility preferences, attitudes towards information- and communication technologies, innovations in general and current mobility services. The comprehensive characterization of the attitude based typology, which includes social norms of vehicle use also, provides precise picture of possible target groups of sustainable behavior including transport mode and ICT-availability, mobility patterns, usage of various mobility services, social demographic data.

[46] THE ROLE OF ATTITUDES, NORMS, AND EXPERIENCE IN ADOLESCENTS' INTENTIONS TO DRIVE AND CYCLE AS FUTURE ADULTS

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While the EU countries have set a target to reduce emissions of greenhouse gases (GHG) by 20% below the 1990 level before 2020, in the last two decades GHG emissions from road transport increased by 28% and the annual kilometrage increased by 1.5%. By 2009, personal travel by car comprised 74% of the total passenger transport in EU countries. A key element towards facilitating the transition to more sustainable transport modes lies in a better understanding of adolescents because they are in the initial stages of adopting new travel patterns and developing habits, and therefore they are still open to change these patterns. Therefore knowledge about the travel intentions of adolescents and the factors related to them is valuable for encouraging their transition to more sustainable transport modes. However, little is known about the determinants of young people's intentions (Mackay, 1998; Davison et al., 2003; Line et al., 2010). The current study focuses on the intentions of adolescents to drive a car and cycle to work and leisure activities as adults in the future. A custom-designed web-based questionnaire was developed on the basis of the theory of planned behavior (TPB) in order to collect the data for the analysis. The questionnaire included questions regarding the adolescent intentions to obtain a driving license, own a car in the future, and use car, bicycle and public transport, as well as questions about attitudes towards the various transport modes, the subjective norm of obtaining a driving license and owning a car, and perceived behavioral control. Additional questions referred to environmental constructs, expectations regarding the future of transport, and willingness to accept limitations on car travel. The items were measured on a 5-point Likert scale. The adolescent current travel mode to school and leisure, the parents commuting pattern and the family socio-economic information were also elicited. With the aid of the Denmark Statistics Bureau the survey was administered among a random sample of 3025 adolescents born in 1995, and 891 completed questionnaires were obtained. Structural equations models (SEM) are employed for modelling the adolescents' intentions as a function of their attitudes, norms, future expectations and experience of using transport modes to school and leisure activities and parental travel patterns. These models are particularly useful in accommodating the latent nature of attitudes, norms, expectation and experience with the observed nature of travel patterns and socio-economic characteristics. Models are estimated for future car and bicycle travel to work

and leisure. Results show that while 82% of the adolescents intend to own a car, only 47% and 34% would like to drive to work and leisure activities, respectively, while 28% and 43% would like to bike to work and leisure activities respectively. The intentions to drive are related among other factors to the current travel experience, environmental concerns, the willingness to accept future restrictions on car use, and the possibility of technological solutions to pollution problems. The intentions to cycle are related among other factors to favorable cycling experience, environmental concerns and parental commuting patterns.

SS 5. B- Accessibility Planning and Evaluation Methodologies

ROOM VIII; Chair: Jonathan Levine

[24] DEVELOPING A METHOD TO EVALUATE TRANSPORT AND SOCIAL EXCLUSION POLICIES: COMBINING ETHICAL THEORIES AND ACCESSIBILITY-BASED APPROACHES

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In this discussion paper we argue that traditional transport appraisal methods do not sufficiently capture the social effects of transport decision-making, in particular with reference to wider social policy goals to promote social inclusion. We discuss how changes in social exclusion arising from new transport projects might be better evaluated within the two prevailing appraisal methodologies of cost-benefit analysis (CBA) and multi-criteria analysis (MCA) by combining the principles of ethics and accessibility-based analytical approaches. We suggest that if the method of preference is CBA, the valuation of changes in social exclusion should be based on willingness to pay for fairness (WTPF), derived from the preferences of politicians and/or the wider public. In case of MCA, we present the case that evaluations should be more strongly grounded in core ethical principles; the theories of egalitarianism and sufficientarianism are potentially the most promising in our view. To operationalize this, we propose an ethically-based accessibility framework based on the Gini index and Lorenz curve for improved evaluation of the social exclusion impacts of transport policies.

[69] APPRAISAL METHODOLOGIES OF TRANSPORT INVESTMENTS IN FRANCE: HOW TO INTRODUCE ACCESSIBILITY INDEX?

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Context and Objective: In order to assess transport investments Cost benefit analysis (CBA) is a key reference in France since the end of the 60'. The official guidelines edited by the Ministry of Transport are based on a proven methodology. Nevertheless the appraisal of transport investments in new infrastructures is facing a double challenge. - There is an official list of more than 80 new projects (rail, road, airports and waterways). But due to financial constraints a ministerial commission of ten members has been installed in October 2012 to select the best 10 or 15 projects. - Applied to the majority of these projects, CBA leads to very low internal rates of return (IRR) mainly because the time gains are weak. It is clear that CBA is still useful to point out the bad projects, there is a lot! But maybe some projects should be profitable even if, mainly because of the quasi absence of time gains, the IRR is low. Conversely, there are some bad projects even with some significant time gains. Is it therefore possible to introduce accessibility index and accessibility maps to improve the official appraisal methodology? Methodology: Within the present official guidelines, accessibility index is already included complementary to CBA. But the methodology proposed in the guidelines is confusing consumer surplus and gains of GDP. The aim of our paper is to reset accessibility index in the right direction. The first part of the paper, focused on interurban road accessibility, presents a detailed review of the methodologies to define the best impedance function of the accessibility index. Three options are compared: Exponential function $F(C_{ij})=e^{(-\alpha t_{ij})}$, Power function $F(C_{ij})= [t_{ij}]^{(-\gamma)}$, and a mix function $F(C_{ij})= [K*t_{ij}]^{(-\gamma)} [e]^{(-\alpha t_{ij})}$. The second part of the paper applies the reshaped methodology of accessibility index to a case study: a new motorway between Pau and Langon (Southwest of France) opened in 2011. The traffic on this motorway is much lower than expected, and this can be explained by the sensitivity of the accessibility index to the chosen functions and parameters. Implications for Research and Policy: Trying to bridge the gap between academic and practical applications of accessibility, the third part of the paper underlines why, especially for road investments, time gains are less and less relevant. The appraisal of transport investment has to target a better accessibility subject to land use objectives. Accessibility maps are therefore a relevant tool.

[51] ACCESSIBILITY, URBAN POVERTY AND TOOLS FOR EQUITABLE TRANSPORT PLANNING IN DEVELOPING CITIES

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One of the key objectives of equitable transport planning is the delivery of accessibility, that is affordable, available and acceptable (Carruthers et al, 2005). Yet the accessibility needs of the urban poor are rarely incorporated in transport planning, a gap that has wider implications in the renewed planning focus that is occurring in cities of Africa, Asia and Latin America. Furthermore where approaches are made, the planning practices often rely on expensive data gathering

methodologies that are rarely repeated if undertaken at all. This paper will build on work undertaken for UN-HABITAT on developing an Urban Poor Accessibility Assessment Tool to map out directions for work to capture the specific accessibility needs of the urban poor that would improve equity of planning outcomes and enhance the ability the urban transport sector to contribute to poverty reduction. It will explore a package of methodological approach to rapid appraisal of accessibility within urban low-income communities; it will examine the scope of new technologies and participatory approaches to deliver user group planning practices and protocols within such communities. It will highlight examples of innovative practice in user group planning and in delivering accessibility for low-income communities and it will recommend future steps for work in this area.

[17] WHY IS ACCESSIBILITY STUCK IN THE LABORATORY?

Jonathan Levine

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Accessibility as a measured attribute of land-use and transportation systems has existed as a concept in positive research use for over half a century. And since the 1970s, many researchers have also identified accessibility—rather than mobility—as the proper normative goal for transportation planning. Despite this understanding, mobility-based evaluation continues to dominate transportation and land-use policy worldwide, while accessibility remains largely mired in the laboratory. In part this can be explained by measurement challenges, political factors, and the inertia of professional practices. But the lack of progress toward accessibility implementation in practice is also a product of factors more directly under the control of researchers and accessibility's proponents more generally. These factors include: 1) An implicit definition on the part of many advocates of the accessibility concept—often those associated with urban design—equating accessibility with dense, mixed-use, pedestrian-oriented development. While urbanist neighborhoods may indeed offer high accessibility, they are not accessible by definition. More importantly, this definition ignores the vital regional dimension of accessibility; 2) A belief that validity of the accessibility paradigm rests upon observed travel-cost minimization. Under this view, the observation (for example) that people do not choose travel-minimizing residential locations is erroneously thought to undermine accessibility as a normative goal of planning; 3) The propensity of research to treat accessibility predominantly as a positive variable in descriptive or predictive models rather as a normative goal for planning; 4) A social-scientific approach that evaluates accessibility instrumentally in terms of its impact on travel behavior rather than as the inherent goal of transportation; 5) Misperceptions about the relationship between mobility and accessibility. Mobility is one of three means to accessibility; the other two are proximity and remote electronic connectivity. Some versions reverse the relationship, making accessibility a means to mobility; others seek to broaden mobility so as to incorporate accessibility. Reflecting this confusion, transportation planning has begun to express its goals as the promotion of 'mobility and accessibility' without any clear distinctions between the two. By reinjecting mobility as an independent objective, this formulation undermines the potential for accessibility-based evaluation to transform transportation and land-use practice. In combination, these factors have weakened the position of proponents of accessibility-based evaluation in transportation and land-use planning. This paper will explore these issues in a critical review, and will propose alternative formulations to facilitate accessibility's leap from laboratory to practice.

SS 7. B - Digital Technologies Within Cities

Amphitheatre III; Chair: Laurie Schintler

[25] GATHERING TRAVEL BEHAVIOUR VIA A SMARTPHONE: A PILOT STUDY OF THE DUTCH MOBILE MOBILITY PANEL

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Objective: With the rise of Smartphone use, a new method of travel behaviour data acquisition arises as well. The Smartphone, carrying numerous sensors including GPS, may allow for registered data acquisition instead of reported data from the traditional travel diary surveys. In this research, we use an automated trip registration procedure via a Smartphone application in contrast to self-registration. This survey design may cater for a reduction in under registration of trips in comparison to self-registration and therefore provides a benchmark for the quality of the traditional travel diary surveys. However, the use of Smartphone's in the acquisition of travel behaviour data is still in an emerging phase and the potential is still largely unclear. The objective of this study is to assess the potential of using a Smartphone in the process of data acquisition of travel behaviour by evaluating the accuracy of measurement, battery life and participant burden in a pilot study. Methodology: To assess the potential of using the Smartphone in travel behaviour data acquisition, we will evaluate the functionality and the user experience of the MoveSmarter-application during the pilot study of the Dutch Mobile Mobility Panel (DMMP). This panel, containing over 500 individuals, will be monitored for 4 weeks and are paid for their cooperation. We provide some non-smartphone-users in the sample group with a Smartphone with the MoveSmarter-application installed. The application uses the data from the GPS-sensor in the Smartphone to recognize trips of an individual. After processing the data, information per trip can be extracted such as distance travelled, time spent, (average) speed, modality used and travel purpose. Furthermore, the respondents are asked roughly twice per week to verify and, if needed, to correct the processed trip information using a web interface to ensure the accuracy of the trip overview. Moreover, the respondents are asked to answer some additional questions about their travel choices as well. On a daily

basis the respondents are asked if there were any circumstances that influenced their travel choices (e.g. weather conditions and delays in the transport system). Results: The results of the pilot study will show the potential of using Smartphone for the acquisition of travel behaviour data. The results will be analyzed from an accuracy, technical and usability viewpoint. Firstly, the data gathered should accurately reflect the travel behaviour of the participants. All trips made should be detected and an accurate estimation of the trip purpose and modality should be made. Secondly, the Smartphone's and measurement application should not use too much of the Smartphone's resources to ensure sufficient battery life (i.e. recharging only once per day). Finally, participating in a travel behaviour study as such should not come with a large burden on the respondent. The evaluation of the pilot study will reflect on the balance between these three elements in using Smartphone's for travel behaviour research and will provide suggestions for future application in longitudinal travel behaviour research in combination or eventually as a substitute for the widely-used cross-sectional one-day travel surveys.

[89] DIGITAL CONNECTIVITY FOR WALKING NETWORKS

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This paper addresses the aspects of the spatiality of the digital economy through developing an understanding of the relationship between physical connectivity and internet connectivity among older people. The focus of the work is on walking. This is an important mode which is increasing in significance in most city transport plans and this work indicates how mobile internet technologies and walking infrastructures can interact to promote walking among one of the growing sections of our population, older people. This is of considerable significance to digital and transport infrastructure planning and management as our society's age and as walking is turned to as a major tool in measures to reduce CO2 emissions and health problems. Yet little is understood of how older people can take advantage of increasing internet connectivity and in turn how this can be used to support walking. This work explores the skills and competencies involved in accessing the internet and using the internet both prior to and whilst making journeys and highlights such skills, as map reading, journey rehearsal and land-marking. The work then turns to an analysis of how those skills are attained: who teaches them and how are they learnt. It is this analysis of the communities of practice and the social environment of older people that demonstrates how social networks are both a resource that enables the development of skills and how the improved connectivity enables social networks to grow. This then demonstrates the relationship between competencies and skills of individuals, social practices of connectivity both internet and physical (walking) and the social processes of building social networks. The paper will conclude by detailing the implications for transport demand management. It will outline how transport implementations and practice can exploit an improved understanding of the social skills and resources required to use these internet technologies when walking in the design new implementations.

[126] ANALYSIS OF URBAN MOBILITY PATTERNS COMBINING MOBILE PHONE AND CREDIT CARD DATA

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Sustainable urban mobility is one of the major challenges facing European cities. To tackle the challenge of sustainable urban mobility, urban planners need models and decision support tools allowing the assessment of policies and their resulting effects. One of main problems for the implementation of such models is that the input data are usually scarce and/or expensive to obtain. Modern ICT, such as smart phones, e-transactions, Internet social networks, or smart card technologies, allow the automatic collection of spatial and temporal movement data that can complement and enhance the data collected by using traditional methods (census data, travel surveys). Yet, the collected data have to be analysed, making it necessary to develop new data mining techniques. The main objective of the paper is to investigate how new data available from ICT can be exploited to understand mobility and location patterns in cities. This study makes use of statistical analysis and data mining methods, as well as of spatial analysis methods recently developed in the context of network theory, to combine and mine data from anonymised mobile phone calls and credit card payment data. Mobile phone data mainly include the telephone of origin (encrypted), telephone of destination (encrypted), the duration of the call, date and time of the day, cell where the telephone of origin is located when the call starts and cell where the telephone of destination is located when the call starts. Credit card data mainly include socio economical characterization of the credit card owner, the import of the transaction, the place where it takes place, date and time of the day and type of store. The result is a statistical characterisation of different features of urban mobility patterns, such as travel distances and trip purposes, as a function of the socio-economical characteristics of the travellers, which can be used to inform the development of transport simulation models. The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 318367.

Short-run vs. Long-run Consumer Scheduling: Implications for Travel Time Values

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Theoretical and empirical studies of consumer scheduling behaviour, the work-horse framework to assess values of time and schedule delay, usually ignore that consumers have more flexibility to adjust their schedule in the long run than in the short run. This presentation will argue that, from a conceptual viewpoint, this may cause serious biases in the estimation of such time values. There may be several mechanisms at work. One is that consumers may have adopted their daily schedules such that they avoid the heaviest peaks in traffic. Whereas traditional models of consumer scheduling usually postulate that there is a single most desired arrival time, such long-run rescheduling may lead to a situation that in the short run, when appointments at work and home have been made, the most desired arrival time may diverge from what it would be without congestion. Someone who plans to be at work at 7:00 instead of 9:00 in order to avoid the heaviest congestion, and has a meeting scheduled at 8:00, will experience schedule delay late rather than early. That there are implications for the measurement of values of time and schedule delays will be clear. Furthermore, one may expect that the values of travel time saving may be quite different depending on whether they are incidental - a short-run concept - versus structural - a long-run concept. One would expect them to be higher in the second case, as structural time gains can be used more effectively. And finally, an opposite pattern may be expected for the value of schedule delays: these may be much higher in the short run - when appointments have been made - than in the longer run - when there is much more flexibility. After discussing these conceptual ideas, the presentation will proceed by providing some empirical evidence of the relevance of the distinction, and by exploring the impacts for a typical transport policy in the face of congestion: road pricing. Both extensions rest on joint work with Stefanie Peer. In the empirical study, we are able to distinguish between long-run choices of travel routines and short-run choices of departure times due to an extensive panel dataset of commuters who participate in a real-life peak avoidance experiment. We find that the participants, who obtain a monetary reward for not travelling along a camera-observed highway link during the morning peak, indeed value travel time higher in the long-run context compared to the short run, as changes in travel time are more permanent and can be exploited better through the adjustment of routines. Schedule delays are, in contrast, valued higher in the short-run model, reflecting that scheduling restrictions are typically more binding in the short run. Since the short-run and the long-run shadow prices differ by factors ranging from 2 to 5 in our basic model, our results may have substantial impacts on optimal choices for transport policies such as pricing and investment. We next consider equilibrium and optimum use of a Vickrey road bottleneck, distinguishing between such long-run and short-run scheduling preferences, in an otherwise stylized scheduling model. We characterize the unpriced equilibrium, the social optimum which is shown to require separate instruments to provide incentives both for short-run and long-run scheduling decisions, as well as second-best situations where the availability of the pricing instruments is restricted. All of them imply a dispersed distribution of short-run preferred arrival times. The extent of dispersion in the unpriced equilibrium, however, is higher than socially optimal.

How the Financial Crisis is affecting the European Transport Policy

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Changes in the discipline of transport economics in Europe have implications for different modes, topics, and agents within the field. This article presents some of the most important changes, with a focus on the situation within the European Union and how the financial crisis is affecting the European Transport Policy. The EU offers a coherent institutional basis for presenting some important regulations toward liberalization, in this case, those that are part of so-called European Common Transport Policy. The selection of the topics has depended largely on the interest and expertise of the author; obviously, other important topics developed by experts from individual countries or even transport authorities within their boundaries could expand the discussion.

RS. C - Transport Policies

ROOM V; Chair: Kenneth Button

[41] WIDER BENEFITS IN TRANSPORT – CAN THEY BE MEASURED?

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For several decades there has been a debate concerning the so called wider benefits from transport infrastructure. This debate occurs on several levels, between theoreticians whether 'wider benefit' is a fruitful concept at all, between analysts whether a correct way of measuring the size of such benefits can be found and between policy makers who need a basis for judging whether a particular investment should be supported or not. During several decades economists and others have tried to investigate the hypothesis with varying results depending on model as well as on data. Infrastructure improvements lead to benefits in the form of e.g. reduced travelling time, improved traffic safety and reduced emissions. Wider benefits, presumably implicate that the total net benefits of the project are greater than the sum of net benefits of the road users. The question is whether these wider benefits exist and if so if whether they are of any practical importance or if they might as well be ignored in ordinary economic evaluation. The aim of the presentation is to bring up and discuss some of the various methodological approaches to this field of problems. Measurement may take place on different levels, macro level as well as marked level and micro level. How do these mechanisms work on the different levels of detail, and how can the effects be measured? We also follow up on our own studies in the field, concerning whether road investments contribute to economic growth, which our earlier studies gave little support for. The newest study shows a little bit more promising results. The data describes regional road capital and production in industry sectors within each county or region.

[43] REGULATING THE FORMATION OF TRANSPORT NETWORKS

Harry van der Weijde, Erik T. Verhoef and Vincent A. C. van den Berg

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Privately constructed and operated railways have a long history, and private investors are now again increasingly being looked upon to fund the necessary new infrastructure. The interest in private road supply is also increasing. However, if private operators not only control road prices or fares, but also decide which transport links are built, this could result not only in sub-optimal road prices or fares, but also in a network that looks much different than the social optimum. We therefore examine the effects of different policies to control the formation of transport networks by private operators. To do so, we construct a simple network with a limited number of nodes, and possibilities to build congestable travel links between each pair of nodes. We vary the sizes of the nodes, which allow us to analyze the different spatial structures that can be found in real-world transport networks. We use a simple gravity model to calculate the potential travel demand between nodes, and a generalized nested logit (GNL) model to determine the actual travel demand on each constructed link; this allows for partially overlapping routes. Through numerical simulations, we then obtain fares, profits and social welfare. We examine two multi-stage allocation policies: 1. 'link-by-link' allocation, in which one or more operators are allowed to build one link in every stage. This represents a situation in which operators can apply for permits, one at the time, to construct and operate new links. Operators either have perfect foresight, such that they can maximize their total profits over time, or they are myopic, such that they only maximize their profits in every stage, disregarding the fact that there will be more investment opportunities in the future. 2. 'operator-by-operator' allocation, in which, in each stage, one operator is allowed to build as many links as it wants. Again, operators may either have perfect foresight, allowing them to keep competitors from constructing new links in future stages, or they may be myopic, which in this case means that they disregard the contestability of their market. In each case, operators can set fares on the links they have constructed. In addition to these allocation policies, we also examine the effects of fare-based restrictions, such as price caps and restrictions specifying that fares must be a linear function of the link length, and their interaction with the allocation policy. For all these policies, we examine the resulting transport network, and compare the structure of the network, the fares, and social welfare to the social optimum. We also determine to what extent these results depend on the relative sizes of the nodes, and conclude with policy recommendations.

[11] IS IT JUST GEOGRAPHY THAT MAKES THE US FREIGHT RAILROADS SO EFFICIENT?

Kenneth Button and Rui Neiva

George Mason University, USA

The empirical evidence shows that the US freight railroads are the world's most efficient and this paper considers why this should be so. Much attention has been placed on their geographical advantages, and in particular the, the size of the market, lengths of haul, the types of commodity shipped, and the almost ideal spatial pattern of cities that allows economies of scale, density, and scope to be exploited. But the expansion of the European Union has seen its aggregate income exceed that of the US, and its population is now about 50% larger, although the differentials narrow if the comparison is with NAFTA. The focus here is less on these physical considerations, although they cannot be ignored and remain highly relevant, and more on the institutional differences that exist between the US and other rail freight systems. The questions addressed also go beyond the matters of differential regulation, to those of finance, specialism, intermodal competition, and market structures. The analysis will embrace primary analysis where this is tractable but will also make use of secondary works, and include meta-analysis where this is possible.

SS 1. C - A Future for Non-Motorized Transport Modes: Walking and Cycling Networks (III)

ROOM VI; Chair: Moshe Givoni

[57] SUBSTITUTING CAR USE BY BICYCLING?

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The invitation to this cluster raises the question, as one of several aspects, the following question: Are non-motorized transport networks the solution for low carbon future mobility? Non motorized transport is hardly the final or complete solution in our efforts to establish a low carbon future mobility, but the use of cycling and walking can make a contribution to less motorized transport. This paper aims at discussing the potential the bicycle may have to satisfy the necessary transport work in various cities. The basis for discussion will be the theories of mode choice and empirical data from travel surveys. The Norwegian national travel surveys show high stability over time of the use of different modes, and also to some degree stability in the average length of daily travels conducted by various modes. But the data also show that results vary to a large extent across urban communities and sub regions. Thus there seems to be possibilities for change. The paper will initially present some characteristics of bicycle users and discuss factors that can explain different levels of cycling in different cities; factors such as facilitation for use of bicycle, urban structure, climate, topography, and political and cultural factors. This will be a background for discussing the potential for the bicycle to take a larger share of the transport work in different cities, and the consequences of such a development for reducing the rush hour problems. We have investigated the possibilities of reducing the traffic amount and the queuing problem with data from the Norwegian, national travel survey used on thirteen cities in Norway. We have used two possible approaches. First, changes in transport work by bicycle and change of the cycling portion of modal split. We assume in the calculations a tripling of transport work by bicycle in cities regardless of the bicycle use already. We also assume that all the increased use of bicycles comes from the motorists ranks. Indirectly, we also assume that all traffic during rush hour periods represent queuing situations. In effect, a substantial portion of the congestion traffic goes upstream, and on roads without congestion. The alternative approach is using different travel modes share of trips, and reallocate the shares between drivers and cyclists. This shows that the proportion of short car trips (trips less than three kilometres) account for a larger share than the bicycle share we achieve in each city when we triple bicycle share. This applies to all cities. Theoretically, it is thus possible to achieve a tripling of bicycle share only by transferring the short trips from car to bicycle. The realism of this assumption is discussed. Performed calculations show that the bike will acquire 2.5 to 12 percent of car traffic kilometres if it was possible to achieve a tripling of the transport work bicycle currently perform. Achieving such a triple is a significant challenge, and the paper discusses the conditions for such a change in transport behavior to occur. Also the possibility for further increase is discussed.

[20] WHEN IS THE USE OF BICYCLES FEASIBLE?

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The use of bicycles has been widely spread in many developed countries. It is considered as a healthy and sustainable mode of transportation. This article demonstrates that bicycles riding does not always present net social or economic benefits, and hence should not be automatically praised. Social features of bicycles riding consider accidents frequency and severity. Economic feasibility is measured by minimal costs calculations. The economic comparison is done merely between cars and bicycles. The analysis considers vehicle operating costs as well as the value of travel time. Per passenger-km results are matched up, under different assumptions, and facilitate the determination of boundary conditions of preference between car and bicycle. The results of the research point out clearly, that bicycle should not always be considered superior to car in social or economic terms. The findings demonstrate that the network and usage of bicycles should be carefully planned and applied. As well, for some trip purposes, car was clearly found to be less expensive than bicycle. The direct implication of the research, regarding bicycle development, is the strict recommendation for the need of a complete and segregated bicycles network.

[130] BIKE SHARING SYSTEMS

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Among the possible strategies to promote new standards in sustainable mobility comes the planning and design of Bikesharing systems considering interconnection with public transport and pedestrian mode. This interconnection has two main advantages. On the one hand, and from the standpoint of the user of public transportation, allows certain distances on public transport become more attractive due to the possibility of performing the so-called 'last mile' using Bikesharing systems. On the other hand, and from the standpoint of Bikesharing systems, allows making longer journeys or the overcome of certain difficulties such as orography. The case studies will be Coimbra and Lisbon. Due to the limited information available in Portugal this work will focus on the determination of demand based on the experience of other countries, in defining the locations of Bikesharing using maximum coverage models, in the determination of different scenarios for the connections with public transportation and in the system operation. The management of system operation will involve, among other things: the definition of heuristics that can improve models of maximum coverage with consideration of bikes replacement and the definition of a network from the optimal location of points. Starting from this it is possible to define a hierarchy, and the consequent changes to the infrastructure. It is expected that this optimized infrastructure can serve all bike users - in addition to Bikesharing systems - considering that public transport modes are able of carrying bicycles.

[132] THE INCLUSION OF HEALTH BENEFITS IN THE COST-BENEFIT ANALYSIS OF WALKING AND CYCLING INFRASTRUCTURES

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Non-motorized transport modes and related health impacts have been neglected in transport planning and appraisal. In recent years, however, increased attention has been given to the health economic assessment as a key part of cost-benefit analyses of walking and cycling infrastructures. This paper is built upon the contracted study for the World Health Organization (WHO) on the economic appraisal of health benefits of walking and cycling investments at the city of Viana do Castelo. This city, located in the North Region of Portugal, integrates the WHO European Healthy Cities Network. This is the former study in Portugal for evaluating the health benefits of non-motorized transport at the city level using the WHO Health Economic Assessment Tool (HEAT). The study comprised the evaluation of the following actions: a) Improvements of the urban public space for pedestrians; 2) Promotion of cycling (implementation of a cycling plan for the city). The following questions were addressed during the study: a) If x people cycle (or walk) a distance of y kilometres on most days, what is the economic value of the correspondent health benefits? b) What levels of uptake of cycling are required in the future for the cycling plan to be economic viable? c) What health benefits are associated to a projected increase in the traffic levels of pedestrians (% increase from the reference level)? d) Do health benefits of cycling (and walking) investments outweigh their costs? The study included the collection of local-level data for using HEAT, noting that the quality of economic appraisals in highly dependent on data availability in each context. The relative risk values adopted in the HEAT refer to adult population of the age group 20-64 years and the assessment focus is on average activity/regular behavior of groups of people (pedestrians and bicycle users for commuting from home to work or leisure activities). During the case study, it was developed and implemented a mobility survey targeting actual and potential pedestrians and cyclists. The survey collected complementary data on perceived barriers and other factors that can influence a higher uptake of cycling and walking in the city. Results from this study will add novel evidence for the Portuguese urban context on the potential health benefits of walking and cycling (maximum and mean annual health benefits) and other useful cost-benefit ratio indicators for walking and cycling infrastructures. These indicators are expected to be useful for policy makers and city officers involved in the promotion of sustainable mobility practices. Besides contributing for the cost-efficiency objective, knowing estimates of the potential benefits of walking and cycling may encourage people to uptake active mobility styles.

[8] HEALTH IMPACT MODELLING OF ACTIVE TRAVEL VISIONS FOR ENGLAND AND WALES USING AN INTEGRATED TRANSPORT AND HEALTH INTEGRATED MODELLING TOOL (ITHIM)

Moshe Givoni¹, James Woodcock² and Andrei Scott Morgan³

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Objectives: Achieving health benefits while reducing greenhouse gas emissions from transport offers a potential policy win-win; the magnitude of potential benefits, however, is likely to vary. This study uses a novel Integrated Transport and Health Impact Modelling tool (ITHIM) to evaluate the health and environmental impacts of high walking and cycling transport scenarios for English and Welsh urban areas outside London. Results: This study found considerable reductions in disease burden under all three scenarios, with the largest health benefits attributed to reductions in ischemic heart disease. The pathways that produced the largest benefits were, in order, physical activity, road traffic injuries, and air pollution. The choice of the dose response relationship for physical activity had a large impact on the size of the benefits. Modelling the impact on all-cause mortality rather than through individual diseases suggested larger benefits. Using the best available evidence, we found fewer road traffic injuries for all scenarios compared with baseline but alternative assumptions suggested potential increases. Methods: Three scenarios with increased walking and cycling and lower car use were generated based upon the Visions 2030 Walking and Cycling project. Changes to carbon dioxide emissions were estimated by environmental modelling. Health impact assessment modelling was used to estimate changes in Disability Adjusted Life Years (DALYs) resulting from changes in exposure to air pollution, road traffic injury risk, and physical activity. We compare the findings of the model with results from generated using the World Health Organization Health Economic Assessment of Transport (HEAT) tools. Conclusions: Methods to estimate the health impacts from transport related physical activity and injury risk are in their infancy; this study has demonstrated an integration of transport and health impact modelling approaches. The findings have implication for transport and health policy, and for future empirical and modelling research. Overall, there is a strong case to promote non-motorised transport as an alternative to the car, and for health, environment and economic reasons.

SS 2. C - Car Sharing and Alternative Transport Modes

ROOM VII; Chair: Helga Jonuschat

[87] INNOVATIVE COLLECTIVE MOBILITY SOLUTIONS - A NORWEGIAN P2P CARSHARING CASE

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The pressure towards low-carbon mobility, limitation of greenhouse gas emissions, local pollution and congestion has increased the search for new modes of organizing and reducing car use. Carsharing means that car drivers use cars owned

by others – by a business, workplace, community or organization, or simply by other single consumers, like in a peer-to-peer (P2P) market place. Carsharing offers the advantages of car use, while at the same time getting rid of the costs and hassles of car ownership. With fast urban growth and progress of ‘smart mobility’ services connecting cars with users, carsharing might escalate as a significant alternative to use of private car in the years to come. Objectives: The paper aims at studying the conditions for innovative urban mobility solutions to escalate from a small niche market product to an environmentally significant, large-scale mobility service. Empirically, the focus is on carsharing in the Norwegian context. Norway may be seen as particularly prone to adopting innovative new technology based mobility services, because of an extraordinary high share and fast growth of e.g. Internet and smartphone and elcar users. Also, the strong Nordic traditions in collective organization and solutions, both in civil society and in politics, would make it a strong hold for innovative collective mobility solutions. Theoretically, we draw on theories of social innovation and transition governance to explore and explain the potential for societal transitions – by reaching a certain critical mass and tipping points for further diffusion and escalation. Data/methods: Methodologically, the paper is based on a critical case approach and the principles from formative or process evaluation. We’ll follow the launching of a highly innovative, technologically and organizationally, mobility service providing a peer-to-peer exchange of cars for use. The case study will make use of informant interviews with key actors in the innovative car sharing arrangement, both the business partners providing the service, and users. Expected results: The paper aims at discussing what are the premises, and barriers, for a larger break-through for carsharing in the years to come, particularly by use of new mobility services through the user-friendly application e.g. on the smart phone. The study is primarily explorative, as a discussion and knowledge base for policies and further studies. In urban areas, in particular, the push factors against private car ownership seem to increase, such as high costs, difficult parking and increasingly better mobility alternatives. Recent studies find that carshare member use car one third less than car owners and use alternatives more – walking, biking and public transport. A shared car substitute 5-15 owned cars, and reduce emissions and congestion (www.momo-cs.eu). We also bring in a theoretical perspective on the conditions for carsharing to reach a tipping point from a minor niche product to becoming a significant societal innovation. Finally, we discuss some policy requirement and implications of a larger launching of carsharing in the Norwegian context.

[78] SCENARIOS FOR ELECTRIC BICYCLE USE: FROM ON-ROAD MONITORING TO POSSIBLE IMPACTS OF LARGE INTRODUCTION

Patrícia Baptista, Gonçalo Duarte, Catarina Rolim and Tiago Farias

Technical University of Lisbon, Portugal

Increasing energy costs, energy consumption and emissions profiles have made the use of bicycle more common in cities around the world, due to its efficient use of resources, lower environmental impacts and well-known health effects. One solution to reduce the impact of the transportation sector, particularly in urban environments, is to decrease the demand for energy intensive modes of transportation and by promoting alternatives that can provide a cheaper, less noisy and more sustainable alternative than a day-to-day car commute. Generally, three alternative transportation models can be identified: public transportation systems (bus, trains, subway systems and others), vehicle sharing schemes (such as cars or bicycles), and human-based modes such as walking, private bicycles or others. The promotion of each of these alternatives requires the development of diversified transportation policies that encourage people to use them, with each of them having their strengths and drawbacks. The specific case of bicycles enables people to travel longer, faster and with less effort than walking, while having a low impact on environment, thus making it an efficient transportation mode for urban mobility. This research work looks into the energy and environmental impacts of these solutions as well as of a large scale adoption of electric bicycles, using second-by-second trip data (including, speed, location, altitude, energy use, etc.) collected under real operation conditions for conventional and electric bicycles in the city of Lisbon. Despite the high expectations for electric bicycles, very few studies have tried to understand the real world benefits of such bicycles in an urban environment. Furthermore, while previous studies addressed the estimated environmental impacts of electric bicycles compared to other transportation modes in China and the users’ characterization and acceptance of this alternative technology in the United States and in China, the experimental monitoring of bicycles has only been addressed for conventional bicycles. Therefore, the necessity to develop monitoring methodologies in different regions rises, in order to obtain comparable situations. Therefore, an analysis of electric assist use strategies adopted by the bikers and their impact on electric autonomy and consequently on energy and CO₂ was addressed. From this point, it is possible to define a model to estimate large scale effects of electric bike use on both energy and environmental perspectives and assess which measures may be more effective.

[23] TRANSIT IN THE USA: EXPANDING NEEDS IN AN ERA WITH UNKNOWN RESOURCES

Richard Quodomine

New York State Department of Transportation, USA

In an era of extreme scrutiny over government spending, GIS can often prove a case against sceptics. GIS can help identify markets that are underutilized for transit. Transit needs in the USA have been growing, due to aging populations, new émigrés and relatively high costs of gas,. Utilization of better analysis tools can lead to a more smooth system, improving usability encouraging transit usage and sustainable, transit-oriented development, and a more environmental and economically positive future. With the patchwork of American transit providers: public, private and non-profit firms; all provide rides for people who cannot or opt not to drive a car. If the USA is politically unwilling to consolidate into a singular national transit system, then it must coordinate these systems. There is only one realistic modern way to coordinate

systems: utilize GIS in concert with a payment system to harmonize the operation of both. Additionally, even a well-coordinated system must continually develop new ridership. Research in the US has indicated that hospitals, universities and dense retail locations attract transit ridership. Aging, lower income, and limited English proficiency populations create transit demand as well. GIS can create Origin-destination modelling that helps provide the case for mass transit. Ultimately, no matter how 'good' or 'green' public transportation is viewed as by the general public, there must also be a return on investment basis for its utilization. GIS can help prove the case by increasing its utility. Long-term, investments in public transportation design and user-friendliness, such as advanced traveller information systems, including text messages to phone and better variable signing at stations, will be necessary. These designs and improvements in the system will lead to better utilization of transit, and the US transit system as a whole can improve the sustainability of the massive transportation system necessary to sustain a wealthy nation of over 300 million people.

[80] PROMOTING ACCESS TO (SEMI-)PUBLIC TRANSPORT BY IT-BASED MOBILITY SERVICES

Helga Jonuschat and Korinna Stephan

InnoZ GmbH, Germany

Public transport can only compete with individual car transport, if travelling becomes as comfortable as driving with the own private car. However, especially for people using public transport only occasionally, the sheer number of information needed and obstacles to overcome is almost endless: Where is the next train station, what are the actual departure times, from which track does the train leave, will it be crowded, how do I get a ticket, and how will I get back etc In addition, there are limited spatial and temporal travelling options, as well as often only limited access to up-to-date information on the issues mentioned above. With regards to limited public transport networks, new „semi-public' transport services like carsharing, bikesharing or „Hail & Ride' will expand existing subway and bus systems to a dense multimodal transport network that could indeed compete with the private car in terms of flexible and individual travelling. However, considering the fact that public transport users already demand better and up-to-date travelling information today, travellers will need even more information when using more than one transport mode on a trip in future. Information platforms for multimodal travellers will therefore be a decisive success factor for each mobility service involved in an integrated multimodal network. In cooperation with business partners, we have developed and tested a multimodal routing app that integrates information on several travelling modes from railway over local public transport to carsharing and bike rental systems. From accompanying lead user workshops, interviews and surveys, we can indeed confirm that mobile and up-to-date information is an important key factor for multimodal travelling. Users already demand integrating further travelling options like carsharing and bikesharing in current routing services for smartphones. In the near future, location based services and the integration of social networks will furthermore open up new opportunities. The first part of our presentation will therefore deal with current information systems, but also with future mobility services for multimodal travelling integrating location based services and social networks. In contrast, we have also discovered a feedback loop resulting from more reliable real-time information on the actual travelling behavior, since travellers have actually adapted their mobility behavior due to a better mobile access to information on intermodal transport chains. Especially flexible (one-way) carsharing systems and the increasing number of (rental) bikes become a lot more attractive for visitors and occasional users, but also for residents. As a consequence, the limitations and obstacles of (semi-) public transport may increasingly be outweighed by a whole new set of activities and benefits discovered by mobile information systems on multi- and intermodal transport. Thus, the second part of the presentation will focus on the effects that intermodal routing apps can have on mobility patterns.

SS 4. A - Housing and Labour Markets

ROOM VIII; Chair: Anette Haas

[134] HOUSING MARKETS AND THE AGGLOMERATION WAGE DIFFERENTIAL

Uwe Blien, Phan thi Hong Van and Alexander Vosseler

Institute for Employment Research (IAB), Germany

Regional labor markets and regional housing markets are closely connected. This can be seen in analyzing the agglomeration wage differential in nominal and in real terms. In western Germany the differential is about 25 % in unadjusted nominal terms, but it nearly vanishes after controlling for regional price differences, for prices of regional building land and for the composition of the local work force. This leads to the conclusion that the net nominal agglomeration wage differential mainly balances out consumer price differences and differences in housing prices. By tracing this even further, regional price level differences can also be attributed at least partly to price differences on real estate markets. Migration between regions is one important equilibrating force for wages and the differentials in consumer and housing price levels. Regional price differences are normally unobserved, in general only very little information is available. In the present context a cross-sectional survey on regional price levels is used for the empirical analyses. The collected information is applied to extrapolate the price levels on regions not covered by the survey. In addition region-specific inflation rates are used to generate a time dimension in the data. The analyses are done by using state-space models.

[33] WHICH FIRMS BENEFIT FROM CULTURAL DIVERSITY?

Thomas de Graaff and Ceren Ozgen

An increasing amount of research in the migration literature shows a positive association between migrant diversity and firm productivity. However, the potential bias due to unobserved heterogeneity remains a challenge. In this paper we analyse the impact of cultural diversity on firm innovativeness, while using finite mixture modelling to control for observed and unobserved heterogeneity. In particular, we explore the possible ways of firm-level knowledge exchange among the employees with different cultural backgrounds and its impact on firms' product and process innovations. To do so, we construct a linked employee-employer dataset through merging datasets on both workers and firms. We find that workforce diversity is beneficial for all type of innovations in capital-intensive sectors. However, it only positively impacts large firms that operate in high-level services, manufacturing, mining and R&D sectors, which are predominantly found in the non-urban areas in the Netherlands. In labour and land intensive sectors, the impact of cultural diversity on innovativeness is inconclusive.

[135] JOBS OR AMENITIES – WHAT DETERMINES THE MIGRATION BALANCE OF CITIES?

Annekatrien Niebuhr, Tanja Buch, Silke Hamann and Anja Rossen

Institute for Employment Research (IAB), Germany

Striking disparities characterise the population growth of cities in industrialised countries. Some cities suffer from ongoing population decline. Other cities experience resurgence in form of an increasing number of inhabitants in recent years. Whether labour market conditions or amenities primarily account for differences in cities' demographic development is an important issue in this context. In this paper, we investigate the determinants of the migration balance of German cities between 2000-2007. We focus on mobility of workers and the significance of jobs and amenities. Our findings suggest that labour market conditions as well as amenities impact on the net migration rate. Furthermore, large cities seem to be *ceteris paribus* more attractive than small cities, possibly because of the importance of amenities such as cultural infrastructure and matching externalities in urban (labour) markets that are linked to city size.

[1] THE IMPACT OF MIGRATION ON REGIONAL DISPARITIES IN GERMANY - EVIDENCE FOR DIFFERENT SKILL LEVELS

Anette Haas, Nadia Granato, Silke Hamann and Annkatrin Niebuhr

Institute for Employment Research (IAB), Germany

Differences in regional unemployment are still pronounced in Germany, especially between the Eastern and the Western part. However, evidence by skill level is rather mixed. Whereas for the high skilled work force there is virtually full employment in both parts of the country, unskilled workers suffer from high unemployment especially in East Germany. The educational attainment of the workers is not only relevant with respect to the unemployment risk and regional disparities. Theoretical models suggest that the skill level influences the propensity to migrate and the impact of labour mobility on regional disparities. Although qualification therefore seems to be of utmost importance for the relationship between regional disparities and labour migration corresponding empirical evidence is scarce. We investigate the impact of labour mobility, differentiated by educational attainment of the workers, on regional disparities in Germany between 2000 and 2004. The results of dynamic panel estimates point to differentiated effects of migration on regional unemployment disparities. The impact of low and medium skilled migration is in line with the implications of traditional neoclassical models, suggesting that labour mobility reduces regional disparities. In contrast, migration of high skilled workers has no significant effects or even tends to increase differences in regional labour market conditions in Germany.

SS 8. B - Disruptions and Emerging Patterns in Infrastructure Networks (I)

Amphitheatre III; Chair: Richard Connors

[128] REPRESENTING THE RESILIENCE OF AIR TRANSPORT BY MEANS OF COMPLEX NETWORKS.

Massimiliano Zanin

The Innaxis Foundation & Research Institute, Spain

One of the most actual topics inside Air Transport Management (ATM) is the problem of the assessment and improvement of the resilience of the system, understood as its ability to remain stable after a disturbance occurs. Yet, even the basic problem of defining what resilience is for a complex system like the air transport, with a plethora of elements interacting between them in a non-linear fashion, is not a trivial one. In this contribution, we propose to move from a bottom-up to a top-down approach; in other words, instead of defining the resilience of each single low-level element in the system and deriving the global property by aggregation, we propose the use of data mining techniques to map the relationships between these elements into a network that represents the whole system. In order to clarify this approach, let us focus on the capacity of each airport, which can be simply mined from historical traffic data. Several techniques, e.g. Granger Causality or Permutation Entropy Causality, can be used to detect causality relationships between the different airports of the network. In other words, they allow us to assess if a change in the capacity of an airport is affecting the capacity of a second airport. When all relationships between all pairs of airports have been calculated, this information can be represented in a network format. The creation of such functional network representation of resilience allows us applying all networks theory techniques to this problem: specifically, the most central nodes (through betweenness or eigenvector

centralities) should be the one targeted by mitigation strategies, in order to reduce the propagation of perturbations through the system.

[71] EMERGENCE OF CONGESTION IN ROAD NETWORKS

Serdar Colak, Christian M. Schneider, Pu Wang and Marta C. Gonzalez

Massachusetts Institute of Technology, USA

The first requirement a road network needs to fulfil is overall connectivity: there must be an adequately functioning path between any two places. Roads have limited capacity and queues of vehicles accumulate; therefore it is of great interest to study the effect of both network topology and travel demand on traffic flow leading to the emergence of congestion. Upon a certain threshold in the number of vehicles, the capacity of the roads is exceeded, retarding the efficient functioning of the whole network. Transition to congestion emerges for the rate of trips starting per time step, R , exceeding a certain threshold R_c . A network is considered to remain functional, if an equilibrium in the number of vehicles travelling at any time is reached. First, we study the influence of the network topology on the emergence of congestion. Inspired by models investigating network resilience in the context of information packets and of the Internet, we propose a model to analyze the resilience of urban road networks described as follows: At each time step R vehicles with randomly assigned sources and destinations enter the system. Roads have different capacities for delivering vehicles, at each time step every segment can deliver at most C vehicles one step towards their destinations following a fixed routing table. A vehicle, upon reaching its destination, is removed from the system. We are interested in the critical value R_c , measured by the number of trips beginning at each time step, at which a phase transition takes place from free flow to congested traffic. This critical value reflects the network's capability of handling its traffic demand. Particularly, for $R < R_c$, the numbers of starting and completed trips are balanced, leading to a free traffic flow. For $R > R_c$, traffic congestion occurs as the number of accumulated vehicles increases with time simply because the capacity of the roads is exceeded. The travel time dimension is incorporated into this model using a point-queue (PQ) macroscopic link model. Vehicles move along the road at the speed limit before they reach its end where a point queue is formed if the traffic arriving is greater than the capacity at the exit. The PQ model is enhanced to a spatial PQ model (SPQ) by limiting the number of vehicles a road segment can contain at once. We analyze both theoretical and real road networks by performing simulations on periodic and non-periodic lattices, random networks as well as on the real San Francisco road network. Our analytical and numerical findings indicate that the critical point of the transition is determined by the ratio of the capacity to a modified maximum betweenness centrality. Moreover, the network response can be analytically obtained by iteratively solving a set of coupled equations. We also show that at R_c , the timespans during which the congested road operates at its flow capacity exhibit no characteristic time scale, as the timespan distribution follows a power law with an exponent around -0.5.

[74] THE IMPACT OF RESERVE CAPACITY ON PUBLIC TRANSPORT NETWORK RESILIENCE

Oded Cats and Erik Jenelius

KTH Royal Institute of Technology, Sweden

The resilience of the transport system is acknowledged as an important policy objective. Resilience refers to the extent to which a system is affected by various disturbances, and its capability to recover from such disturbances and restore its level of performance. Public transport networks (PTN) are subject to recurring service disruptions. However, most studies on transport network resilience have focused on the physical degradation of the road network. Hence, their findings have limited transferability to the PTN context. Previous studies on PTN resilience have considered vulnerability in terms of connectivity reliability. Graph theory principles were used to analyze the impact of network structure on robustness with respect to random and intentional attacks. Such analysis allows the comparison of alternative network design properties. However, it does not capture many of the PTN features that we believe are essential for analyzing its resilience. The underlying principles of PTN design and operations make it fundamentally different from road networks and potentially more vulnerable. PTN are usually less dense than the underlying road network, resulting in fewer alternative paths. Moreover, PTN operate close to capacity due to the increasing marginal operation cost during the peak period. In addition, PTN exercise discontinuity in time and space, inducing varying and stochastic waiting, walking and transfer times. Stochastic travel times arise from the inherent and interdependent underlying sources of uncertainty. Another matter that needs to be taken into account is that PTN are often multimodal, consisting of several independent infrastructures. As a result of these characteristics, service disruptions in the PTN have wider direct implications compared to the road network due to the escalating impacts on service availability and capacity further downstream. We develop an analysis framework for PTN resilience. The framework integrates stochastic supply and demand models, dynamic route choice and limited operational capacity. Moreover, the plausible correlation between degraded capacities among network elements is captured through the dynamic modelling of network performance. The criticality of a link is evaluated as the increase in system travel time due to a capacity reduction of the link. In general, criticality depends on the flow on the link and the availability of alternative paths in the PTN. We analyze the influence of the capacity of alternative paths on the criticality of a link. High volume to capacity ratios on neighboring links suggest that the effects of the initial disruption can cascade to the surrounding network and lead to severe impacts for many travellers. Further, we analyze the potential of increasing network resilience by increasing capacity on alternative links in response to disruptions. This implies operational strategies such as increasing the frequency on existing lines, or running replacement lines for the disrupted line. This analysis thus enables the evaluation of alternative mitigation measures designed to improve network resilience.

[100] BRIDGING THE GAP BETWEEN MODELS OF GLOBAL AND LOCAL NETWORKS

Richard Connors and David Watling

Institute for Transport Studies, University of Leeds, UK

Many infrastructure networks require analysis across different scales of representation, with high resolution local models used alongside less detailed regional/national models. Practitioners often face the problem of how to use outputs from detailed local models as inputs for aggregate national models (or vice versa), but underlying these practical problems is a gap in the science of networks: there is no systematic method for network aggregation. We lack methods to determine which network elements should be included in a simplified network model; we need theoretically sound techniques for network aggregation that can transform a detailed local network model into a simplified component appropriate to be included in a national model. We focus on the case of transport network models, which encompass a range of spatial scales from urban planning models where a highly detailed representation of the highway network is included, to more strategic analyses of interactions between demand and transport infrastructure at a regional level that include only a simplified representation of the network. Since the early days of traffic network equilibrium models, it has been known (e.g. Bovy & Jansen, *Transportation Science* 1983) that model resolution may significantly impact the predictions of a transport network model, yet little advance has been in understanding this issue, nor in devising methods to move between different scales of representation in a consistent manner. In this paper we consider the case of a road traffic network, wherein individuals wish to travel from their current location (origin nodes) to their desired destinations through the road network. This matrix of desired origin-destination movements results in interacting network flows, and hence congestion. Influenced by the cost of delays, individual travellers choose which route to take, seeking to minimise their expected cost following the RUM (random utility model) behavioural paradigm. In this context we propose an interpretation of the network aggregation problem, and derive mathematical expressions for the multi-dimensional aggregate relationships between network costs and flows. These approximate relationships can be viewed as non-separable cost functions over an aggregated network. A numerical example application is reported, and the approximating aggregate relationships are shown to compare very well with the 'true' relationships between the network costs and flows in the full resolution network model.

17:00-19:00 | Parallel Sessions IV

RS. D - Air Transport

ROOM V; Chair: Pierre Zembri

[138] AIR TRANSPORT AND ECONOMIC DEVELOPMENT: THE EXPANSION OF INTERNATIONAL HUB AIRPORTS

Andrew R. Goetz

Department of Geography and Intermodal Transportation Institute - University of Denver, USA

There is no question that airports and the aviation industry play a major role in the contemporary global economy. Air passenger and cargo transport has become indispensable for global commerce, especially in tourism, trade, logistics, and producer services. No other mode of transport provides such high-speed service over long distances, crossing both land and sea. Air transport provides superb accessibility between global air hubs and major spokes to facilitate economic development at these nodes and their surrounding regions. The International Air Transport Association [IATA] estimates that aviation has a global economic impact of \$2.2 trillion, or about 3.5% of global gross domestic product, and accounts for 56.6 million people employed in aviation and related industries (IATA 2012). This paper will first revisit the traditional and alternative theoretical perspectives concerning the relation between air transportation and economic development, followed by recent empirical evidence on the economic impacts of airports and air transport, including discussion of the 'aerotropolis' concept. An overview of the world's major airports, their levels of air service, expansion plans, and related economic impacts comes next, followed by a case study of the development of Denver International Airport.

[111] POLICY INSTRUMENTS IN AVIATION NETWORKS

Hugo Silva and Erik Verhoef

VU University Amsterdam, The Netherlands

Following the deregulation of the airline industry, we observed several changes in the way markets were served. The most notorious one being the adoption of hub and spoke (HS) route structure by carriers. Such a decision has been often explained with three arguments: economies of density, frequency effects and strategic advantages. The first refers to the fact that cost per passenger in a certain link decreases with the number of passengers, and the second to the fact that there are benefits for passengers of increased frequencies, e.g. reductions in schedule delay costs, the difference between desired and actual departure/arrival time. Both may be better exploited under HS. Finally, the strategic advantages refers to the fact that adopting HS route structures may bring, in oligopolistic competition, further advantages because of the effect it has on competitors. For instance, it can deter entry in spoke-to-hub markets. The outcomes of a deregulated environment where carriers can choose how to serve markets, has been well studied in the literature. On the other hand, literature on pricing and regulation in aviation markets has only focused on either on a single origin destination pair, hence

ignoring network effects, or in networks where carriers have fixed route structures, hence ignoring the endogenous nature of route structures. The objective of this paper is to extend the pricing and regulation analysis by elaborating on policy instruments to induce the social efficient outcome in a network setting where carriers with market power choose route structure in presence of congestion externalities. It is known from previous literature, that abstracts away from endogenous route structure, that a monopoly airline internalizes congestion and exerts market power, meaning that the only inefficiency that needs to be corrected is the dead-weight loss (e.g. with subsidies). It is also known that oligopolistic carriers besides exerting market power set too many flights from the congestion point of view and, as a consequence, a further correction is needed (e.g. slot constraints or congestion pricing). What we study in this paper is if the inclusion of route structure choice by carriers changes these conclusions. Specifically, do regulators need an additional instrument (on top of the ones that correct market power exertion and congestion inefficiencies) to induce the socially desirable outcome? Our results show that in the case of a monopoly, the instrument that corrects the market power exertion is sufficient to align carrier choice of route structure to the socially desirable. Our analysis of oligopolistic competition shows that an instrument that corrects the inefficiency due to market power and an instrument that corrects the congestion inefficiency is not always sufficient. We show that in some cases a regulator needs a third instrument in order to achieve the first-best outcome. This is a result of a 'strategic network inefficiency' due to competition in route structures. We also elaborate on which instruments are better to use when the regulator does not have the ability to use three instruments when needed.

[112] NETWORK STRATEGIES, TERRITORIAL AMBITIONS AND MAJOR CHANGES OF ACCESSIBILITY: THE RECENT EVOLUTIONS OF AIR TRANSPORT INDUSTRY IN THE ARABIC PENINSULA

Pierre Zembri and Ludovic Chalonge

University of Cergy-Pontoise, France

The emergence of new hubs in the Middle East since 10 years modifies considerably an Air transport market formerly concentrated on three poles: Western Europe, North America and Eastern Asia. This fast evolution serves the interests of small countries which anticipate the end of petroleum and gas exploitation around the Gulf, and which want to shift to commercial services and tourism. This is especially the case of the United Arab Emirates and of the Qatar. Three national operators, strongly supported by rich States, have developed new networks based at Abu Dhabi (Etihad), Doha (Qatar Airways) and Dubai (Emirates). This is a real gamble for several reasons : -there is no example of successful hubs based on a percentage of local patronage largely less than 50 %, -the main objective is to attract intercontinental flows (between Europe and Asia for instance), an interesting market for both Asian and European companies which operate direct flights : a stop in Dubai or Abu Dhabi is not a necessity, -the local traffic depends on the development of local amenities, which are not evident : luxury tourism, shopping opportunities, major events, etc. But it seems to work, even if the three competing hubs don't manage to develop themselves as far as expected. The success of Dubai is uncontested, and Emirates is now becoming a major company with 180 airplanes (plus 230 on order), and 120 destinations (2011). The network connects Europe to Asia, but also to India, to Australia, and to many destinations in Africa and Indian Ocean. These new services offer alternatives to national carriers which were unavoidable, expensive and in some cases dangerous. This is the case of companies like Air Seychelles, Air Mauritius, Air Madagascar, which are now threatened by a «global player». Some of these carriers should disappear in the next years. On the basis of a retrospective and nearly exhaustive database of reservations provided by the main GDS, we will try to describe the expansion of the new players in the Indian Ocean market and to analyze the consequences for local carriers, but also for the countries and their inhabitants. Is there a real gain of accessibility, or a risk of substitution of monopolies?

SS 3. A - Sustainable Logistics (I)

ROOM VI; Chair: Sandra Melo

[131] ELECTRIC VEHICLES IN CITY LOGISTICS: AN ANALYSIS OF FLEET MANAGERS PERCEPTION

Philippe Lebeau, Cathy Macharis, Joeri Van Mierlo and Kenneth Lebeau

Vrije Universiteit Brussel - MOBI, Belgium

Urban freight transport is essential in supporting the economic growth of the cities. But it generates also many negative impacts on urban welfare such as emissions of pollutants and noise. Urban freight transport was assessed to be responsible of 1/3 of transport related NOx emissions and 1/2 of the transport related particulate matter emissions while it only represents 10 to 15% of travelled miles in urban streets. It also causes 21% of the CO2 emissions in large European urban areas. In terms of noise nuisance, urban freight transport generates 5 times more decibels than the circulation noise of private cars during morning rush hour. These figures are largely explained by the dominance of road in the transport mode used in city logistics. In order to keep cities attractive, solutions for a more sustainable road transport in logistics start to come on the agenda of city authorities. In that context, electric vehicles receive here an increasing attention but many barriers refrain still vehicle fleet managers in switching from conventional vehicles. However, the most critical barriers according fleet managers such as costs and range limitations were found not to be relevant for small vans. There is a gap therefore between the perception of the firms and the state-of-the-art of the technology. Based on interviews of different vehicle managers, this paper aims at exploring this gap based on real cases among transport firms.

[109] URBAN FREIGHT ELECTRIC MOBILITY INITIATIVES IN THE NETHERLANDS

Rob Konings

Delft University of Technology, The Netherlands

This paper presents a review of initiatives in The Netherlands, in which electric vehicles are operated or tested in practice in urban freight transport and distribution. The aim of this review is to gain insights in drivers, enablers and barriers regarding the start-up and wider application of electric vehicles in urban freight transport. The findings can be used to define policies to accelerate the use of electric vehicles in urban freight transport. The core activity of this review consisted of interviewing companies involved in practical experiences with electric urban freight transport. The study included 13 cases covering experiences with different types of vehicles (e.g. size and weight), different applications (e.g. different types of deliveries and types of goods) and in different environments (e.g. different types of cities). In the evaluation of the initiatives the following issues were included: technical performance, financial performance, logistical impacts, environmental factors and the relevance of regulation, ICT and human factors, i.e. the behaviour and attitude of users, customers and the general public. A major conclusion of the review is that the conditions that determine whether an initiative is successful or not is largely case-specific. It is important that the type of vehicle matches with the type of transport activities where it is intended for. A strong driver for getting involved in electric freight transport is to have a green (sustainable) company image, as well as the believe that future policy regarding less environmental-friendly vehicles (diesel truck) will become more restrictive. As such, companies consider their involvement in pilots with electric vehicles as a way to explore (and get experiences) with electric transport, i.e. to be prepared for future policy and to get a frontrunner position in the transport sector regarding sustainability. This suggests that their involvement is based on a long term policy and this is supported by the fact that operating an electric freight vehicle is not profitable yet. To some extent operating an electric vehicle can be considered as a show case to demonstrate sustainable ambitions and hence to attract new customers or at least to reinforce its current market position. There is still a need to improve the technical reliability and performance of electric trucks, i.e. extend their range and loading capacity (including the availability of larger electric trucks), but when the trucks are used for appropriate applications it is not a problem. The applications in urban freight transport have shown in general satisfying experiences. The cases make clear that as long as the use of electric freight vehicles is in its infancy purchase subsidies and privileges granted to these vehicles (e.g. exemption of time window delivery restrictions and access to environmental zones) remain major incentives needed to start new initiatives.

[104] USING ELECTRIC COMMERCIAL VEHICLES FOR URBAN LOGISTICS AND CITY DISTRIBUTION: IN WHAT CONDITIONS CAN IT SUCCEED?

Sandra Melo^{1,2}, Patricia Baptista², Álvaro Costa¹ and Tiago Farias²

¹Faculty of Engineering - University of Porto, Portugal; ²Technical University of Lisbon, Portugal

Freight transport operations in cities only represent 10% to 18% of urban road traffic it accounts for 40% of air pollution and noise emissions (European Commission, 2006). Following the recommendation of the European Commission for a reduction of transport generated CO₂ by reducing dependence on carbon based fuels, (European Commission, 2001) many actions have been carried out within European cities with the aim of reducing the negative environmental impacts of freight transport (FREILOT, e.g. EU projects within CIVITAS I & II etc. as well as nationally financed demonstration projects). Fairly promising results have been reported with the increasingly popular initiative of the use of electric vehicles on urban freight transport. Many trials, experiments and demonstration projects on the usage of EV on urban freight transport demonstrated that often it can be reached a reduction of CO₂ emissions, lower noise emissions and improved energy efficiency. Some examples reveal the opposite results, raising the question about the circumstances on which EV should be supported. Along this paper, authors try to explore if the use of electric vehicles for distribution purposes is indeed a feasible option, considering the possibilities for the usage of EV. Moreover, this research tries to identify the factors that determine the success or failure of such solution.

SS 4. B - Commuting (I)

ROOM VII; Chair: Selima Sultana

[55] DIFFERENT WAYS TO GO – THE EFFECTS OF LONG-DISTANCE COMMUTING ON CAUSES OF DEATH

Erika Sandow, Olle Westerlund, Gunnar Malmberg and Urban Lindgren

Umeå University, Sweden

Commuting has been found to be a major cause for stress impacting on the individual's physical and psychological health and well-being. In particular longer commutes are associated with negative health outcomes such as higher blood pressure, obesity, poor sleep quality and low self-rated health. Recent research also found a higher mortality risk among long-distance commuters, in particular for women with a lower socio-economic status. The overall aim of this study is to gain an understanding of potential differences in causes of death among long-distance commuters as compared to people without commuting experience. The analyses are stratified by assessing differences between women and men and different socioeconomic positions. The paper utilizes a unique dataset with geo-referenced longitudinal data for the entire Swedish population. With information on health status and cause of death together with a number of demographic and

socioeconomic characteristics for the whole Swedish population it is possible to analyze the relationship between long-distance commuting and causes of death. In a nationwide study, the extent to which long-distance commuting increases the risk of dying due to a specific cause of death (cardiovascular disease, cancer, a cardiovascular disease and cancer or another cause of death) is investigated through event history analysis. Competing risks models will be employed with longitudinal data on all employed at age 57 between 1993 and 1997 to explore the risks of dying due to a specific cause of death following previous history of long-distance commuting, with a follow up period of nine to ten years.

[61] AN ANALYSIS OF THE EFFECTS OF NEW FREEWAY AND ARTERIAL CAPACITY ON COMMUTING OUTCOMES

Edmund Zolnik

George Mason University, USA

Additional capacity is one policy mechanism by which metropolitan areas can alleviate road congestion. However, the empirical evidence on this issue is by no means exhaustive and questions remain as to the efficacy of new capacity. This study analyzes the differential effects of additional freeway and arterial capacity on commuting outcomes in metropolitan areas across the United States in 2001 and 2009. The multilevel models in the analysis for 2001 and 2009 include individual data from the respective 2001 and 2009 National Household Travel Surveys (NHTS). They also include stock and flow versions of freeway and arterial capacity, congestion and economic growth variables for metropolitan areas. Taking into account differences in economic growth and demand for capacity by commuters the study adopts a multilevel model approach to estimate how new capacity affects commuting outcomes in metropolitan areas across the United States. Results indicate that new (freeway and arterial) capacity has a modest affect on commuting outcomes. Specifically, new freeway capacity seems to offer commuters the opportunity to locate further from their work locations. Interestingly, commuters were not responsive to local gasoline prices, but commuters in 2009 were responsive to changes in congestion. That is, increases in congestion led commuters to dramatically decrease their commuting distances and times. Overall, the results of the study suggest that additional capacity, neither freeway nor arterial, will adversely affect commuting outcomes. On the contrary, commuters seem to be much more responsive to changes in congestion on freeways and arterials in locating themselves to access home and work locations.

[70] URBAN GROWTH WAVES AND THE COMMUTING TRANSITION: EXAMINING VARIATIONS ACROSS U.S. METROPOLITAN AREAS

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In an earlier study it has been observed that just as the normal process of urban growth can be viewed as a wave, commuting patterns also pass through a transition as cities grow. Across most metropolitan areas in the U.S. neighborhoods built during the most recent housing boom show higher commuting time than residents of older neighborhoods. Typically commuting times subside as these new neighborhoods age over the following decades and new growth areas move outward. In this paper we examine census data for 1980, 1990, 2000, and 2010 for a set of 113 metropolitan areas to explore the characteristics of cities that explain the magnitude of this commuting transition. Block group data are used, as these are the smallest zones for which both housing and commuting data are available. A variety of housing, household, commuting, and highway network characteristics are used in multivariate regression to explain characteristics at the metropolitan level that determine whether a city's commuting transition fits the expected pattern, and if so, which variables best explain the intensity of that transition. It is expected that cities those are larger and growing in a less densely and faster pace fashion typically will have the strongest commuting transitions than cities that have high density with slower growth. Likewise, the extensiveness of a city's highway network will have power in explaining commuting variations.

[13] MODE CHOICE DECISIONS AND CONTEXT CHANGE – WHAT ABOUT ATTITUDES? A CONCEPTUAL FRAMEWORK

Annika Busch-Geertsema and Martin Lanzendorf

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Usually, everyday mobility decisions are strongly mediated by habits as it simplifies daily life. But in certain moments in life, at so called life events, habits are interrupted through changes in different life domains, for example through the birth of the first child or a residential relocation. Because of these changing circumstances, a window of opportunity is opening for behavioural change, like changes in mode decisions. But how exactly does that work? Which influences have mobility-related attitudes on travel mode decisions before and after such a context change? How do those attitudes and (new) spatial contexts interact? With our research, we are focusing on that question. Therefore, we are assembling and analysing the state of the art concerning context changes and mobility as well as attitudinal influences on mobility. The theoretical framework of our work is based on the one hand on the mobility biographies approach (Lanzendorf 2003) to cover the longitudinal view and the break of habits through key events in life course. On the other hand we will use the requirements, opportunities, abilities approach (Harms 2003) to explain mode decision behaviour, because this attempt is including both, external and internal factors: the individual life situation, personal values, the subjective norm perceived and formed by social context and external mobility conditions like infrastructure. Inspired by the theory of cognitive dissonance (Festinger

1957) we follow the assumption, that if mode choice and attitudes were dissonant before a life event, the individual tries to harmonise those two inconsistent cognitions by either changing behaviour or changing attitudes. On this basis, we are developing a conceptual framework to explain how mobility-related attitudes and spatial factors are interacting in situations of change and how this affects mode decisions. Further, we set up an empirical implementation to examine our conceptual framework by conducting a quantitative panel survey. In order to analyse the specific key event of the transition from university to working life, we will ask students in their final phase of studies regarding their mobility behaviour, mobility related attitudes, life situation and housing and university location. The survey will be repeated with the same respondents after six and after twelve month, when we expect, that the transition into working life has happened. With the results of this empirical study, we will gain more information regarding three fields of interest: (1) the stability of mobility-related attitudes, spatial context and mode choice; (2) the interaction of mobility-related attitudes and performed mode choice before and after the key event; and (3) the influence of spatial context concerning mobility towards mode decision. Our contribution in this paper will therefore include (a) a review and discussion of the three theoretical approaches above: the mobility biographies approach, the requirements, opportunities, abilities approach and the theory of cognitive dissonance; (b) a synthesis of the theories discussed and a description of the conceptual framework for the empirical research in the next step: a quantitative panel study with students before and after their transition into working life.

SS 7. C - Modelling the Relation between Accessibility and Environment

ROOM VIII; Chair: Stewart Fotheringham

[73] DIGITAL URBAN NETWORK CONNECTIVITY: GLOBAL AND CHINESE INTERNET PATTERNS

Emmanouil Tranos, Karima Kourtit and Peter Nijkamp

VU University Amsterdam, The Netherlands

The majority of cities in our world are not only connected through conventional physical infrastructure, but increasingly through modern digital infrastructure. This paper aims to test whether digital connectivity leads to other linkage patterns among world cities than traditional infrastructure. Using a generalized spatial interaction model, this paper shows that geography (and distance) still matters for an extensive set of world cities analysed in the present study. With a view to the rapidly rising urbanization in many regions of our world, the attention is next focused on the emerging large cities in China in order to test the relevance of distance frictions – next to a broad set of other important explanatory variables – for digital connectivity in this country. Various interesting results are found regarding digital connectivity within the Chinese urban system, while also here geography appears to play an important role.

[118] EXPLORING REGIONAL VARIATIONS IN GEOGRAPHIC HOMOPHILY USING LOCATION-SHARING SERVICES DATA

Laurie Schintler and Rajendra Kulkarni

George Mason University, USA

Online (or virtual) social networks and social media have given rise to a society that is increasingly networked. Through these networks, it is now possible to share content, collaborate, or connect within anyone in the world at literally any moment in time. These digital transactions, which number in the billions daily, are generating a massive collection of data that is very rich in detail. Within the last few decades, there have been significant efforts to mine this data for the purposes of examining human and social behaviour. Many of these studies have been aimed at understanding the geography of socialization. Thus far, this research has found that akin to offline networks, online and cyber-based networks are very much tied to space. Geographic proximity affects the probability of social ties and friendship, but also social ties influence location preferences and activities in space. But, to what extent are there regional variations in these patterns of association and in the degree and nature of geographic homophily? These questions have been only scantily touched upon in the literature. In this paper, we delve into this topic using a sample of Gowalla location-based online social network data (Source: Stanford Large Network Database). This dataset includes the latitude and longitude locations and times of check-ins of users for the period February 2009 to October 2010. For the purposes of the analysis, we specify a bipartite graph $G = (L, S, E)$, where L is a set of locations, S is the set of social ties (or individuals) associated with those locations, and E is the collection of edges between locations and individuals. In this model, an edge is formed between a location and an individual if either the person has visited the location or he/she is an immediate social tie of someone who has been there. From this structure, we extract the 1-mode network which has locations as vertices and common ties as edge weights. This network is further refined by introducing information on the contiguity of locations. With this, we then use a combination of community detection algorithms, spatial statistics and geographically weighted regression to examine regional variations in geographic homophily. The analysis will be applied to a select set of metropolitan areas in the United States.

[120] THE PHYSICAL INTERNET INFRASTRUCTURE NETWORK AND THE LOCATION DECISIONS OF INFORMATION INTENSIVE FIRMS

Edward Oughton

University of Cambridge, UK

Infrastructure supply, with regard to the location decisions of firms, is relatively poorly researched. This is particularly true in relation to the physical Internet infrastructure network. In the digital economy this network is responsible for the efficient distribution of information and other forms of capital across space, as it increasingly functions as a necessary enabling device for all economic activities. However, much like the preceding rail and road networks, the spatially uneven provision of the digital network creates locations which are either advantaged or disadvantaged as a result of their high-speed capabilities or lack thereof. The geographic position of a location within the structure of the digital network can impact on its importance and attractiveness. Information intensive firms require high bandwidth to exchange information with other firms and users in disparate places, and they must therefore obtain a high degree of connectivity from their physical location by being proximate to the Internet backbone. Consequently, this paper postulates that the inter-city and intra-city location decisions of information intensive firms are influenced by the physical Internet infrastructure network. Existing empirical studies which examine the impacts of the digital infrastructure network on the spatial economy generally take a quantitative approach at a relatively high spatial scale. Yet, this methodological approach can lack the rich depth of detail provided by qualitative research methods, as they are able to focus on the micro-location decisions of individual agents. For this paper I use a survey of British information intensive firms to investigate inter-city and intra-city location decisions in relation to the physical Internet infrastructure network. After processing the results I conduct follow-up qualitative interviews with those firms which indicate in their response that proximity to the physical Internet infrastructure network is a necessity. The expected conclusion is that information intensive firms opt to locate in nodes relatively central to the inter-city network, and in intra-city locations proximate to the physical Internet infrastructure, in order to satisfy their need for a high degree of connectivity.

SS 8. C - Critical Networks in Spatial Economic Processes

Amphitheatre III; Chair: Olaf Jonkeren

[44] A MODEL OF STRATIFIED PRODUCTION PROCESS AND SPATIAL RISK

Tatsuaki Kuroda

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In 2011, Japanese firms suffered great losses due to the Great East Japan Earthquake as well as Thailand floods. One of the reasons for their repetitive damages is that they depend on spatially dispersed supply chain. Basically, outsourcing becomes more attractive for final goods producers due to prevailing scale economy in modern machinery industries. The fragmentation of trade also works as dispersion or disintegration force as well. In addition, some firms have dispersed their plants against the risk of big earthquakes assumed around Tokyo or Nagoya (i.e., more developed metropolitan areas). In this case, however, such behavior brought about the contiguous damages for firms ironically. In order to capture the characteristics of supply chain over space and cascade of spatial risks, we set up a two level structure of circles where firms locate in the present study. On the second circle, there are final goods producers, for whom intermediate goods producers provide differentiated inputs from the top circle. We assume that scale economy works with respect to variety of intermediate goods and thus final good producers would buy inputs from some intermediate goods producers located at different places, paying transport costs by themselves. Then, we evaluate it by the location risk such as earthquake. The more dispersed the supply chain is, the smaller yet the more likely the final good producers suffer losses by the spatial risk. Therefore, we could examine the optimal location of firms including location risk for a given 'utility' function of firms. For example, the expected damage may be smaller for intermediate goods producers by more dispersed location. On the contrary, for final goods producers, it may be better to concentrate spatially according to the simulation results.

[119] FIRMS' NETWORK FORMATION THROUGH THE TRANSMISSION OF HETEROGENEOUS KNOWLEDGE

Massimo Ricottilli, Franco Nardini and Rainer Andergassen

University of Bologna, Italy

Recent literature has highlighted the importance that networks have in spreading innovation-relevant information among interacting firms. It is widely recognised that firm interaction is the process that accounts for much of the learning and knowledge acquisition that enable firms to innovate eventually rendering some of them technological leaders. In this context, the economy appears as a large interactive system. In this paper, we distinguish two different but definitely complementary and overlapping ways through which searching and learning occur. The first exploits the spillover potential that lies in a firm's network and thanks to which gathering innovation-useful information is actually possible. The second rests with the autonomous capacity that a firm possesses in order to carry out in-house innovative research. We integrate, therefore, a knowledge diffusion mechanism that propagates technological capabilities with an independent stochastic process capturing innovation arrivals due to internal R&D. In a bounded rationality framework, firms normally explore a limited part of the firms' space and require a protocol to target their information gathering efforts. The paper addresses this issue by designing a routinized behaviour according to which firms periodically reshape the neighbourhood that they observe by reassessing other firms' contributions to their own capability. This feature is modelled by changing the span of network observation from the whole economy to the most proximate neighbourhood membership. As a result, there are two distinct but overlapping neighbourhoods which are relevant for firms' interaction. The first is the neighbourhood whose members are observed by each firm and from which capability contributions are obtained. We term this

neighbourhood inward. The second is the one made up by a firm's observers, i.e. by firms observing and learning from it: it evolves as an active search for new inward members is carried out. We call this neighbourhood outward. The model we construct is simulated to determine the emergent properties of neighbourhood formation and stability together with average capability. We aim to identify (i) under what conditions the emergence of technological paradigm setters occurs, (ii) the pattern of neighbourhood formation and (iii) the average relative efficiency in terms of technological capability of the economy as a whole. Our findings suggest that the type of searching routine chosen is crucial to determine the emergence of paradigm setters. Furthermore, while average innovative performance is strongly affected by the selected routine it also shown that its performance crucially depends on how knowledge-heterogeneous the economy is. These findings shed light on the process of diffusion of information and the strength and resilience of the informative structure that emerges in consequence and therefore how capable the system is to generate innovations.

[101] INTERDEPENDENT MULTI-LAYER MODEL FOR TRADE

Simone Caschili, Francesca Medda and Alan Wilson

University College London QASER Laboratory, UK

Economic systems as trade flows are constituted by intertwined networks such as the global supply chain, international bilateral agreements, trans-national credit and foreign direct investments, as well as non-economic components (i.e. infrastructures, cultural ties and spatial barriers). Due to the interactive nature of these networks, in order to study their interrelationship and impacts on trade flows we construct the Interdependent Multi-layer Model (IMM), based on the theoretical concept of dynamic spatial interaction. Our aim here is to investigate horizontal and vertical interdependency among networks. We calibrate the interaction model for a set of 150 countries by examining the influence of shocks such as natural disasters on the interdependent networks (physical, political and sociological layers). The model allows us to provide a measure of bilateral trade vulnerability and an understanding of the propagation of cascading effects (both positive and negative) at national and global scales.

[21] A COMBINED SYSTEMS ENGINEERING AND ECONOMIC MODEL FOR CRITICAL INFRASTRUCTURES IN THE EUROPEAN UNION

Olaf Jonkeren, Bogdan Dorneanu and Georgios Giannopoulos

European Commission JRC-IPSC, Italy

The European Programme on Critical Infrastructure Protection of the European Commission is in search for a methodology to analyse economic losses following from Critical Infrastructure failure in the European Union. Therefore, a combined Systems Engineering and Dynamic Inoperability Input-Output model (SE-DIIM) is being developed at JRC. The Systems Engineering component analyses the performance degradation and recovery of an infrastructure system resulting from a disruption. Both geographical and functional (inter)dependencies are taken into account. The first type of (inter)dependencies are automatically extracted from the network topology, while for the second type further information on the type and behavior of the network must be known. Next, economic losses are estimated with the DIIM component using Input-Output data from the World Input-Output Database (WIOD) and information on the size of the failure provided by the SE model. The DIIM component analyses how an initial perturbation propagates into the economic system due to the existence of economic interdependencies taking into account the economic resilience of Critical Infrastructures and other sectors. More specific, the model distinguishes between three types of resilience: 'restorative resilience', which is the speed of recovery after the disruption, 'adaptive resilience', which is the change in the speed of recovery of a sector during the recovery period and 'absorptive resilience' which refers to the ability of an infrastructure or sector to maintain operability following a disruptive event. Contrary to existing DIIM's, the SE-DIIM is able to model inoperability propagation in the immediate aftermath of a disruptive event, when recovery activities have not started yet. To illustrate the functioning of the model, it is first applied to a simple two-sector system. Next, assuming a hypothetical disruptive event in Europe, the model is applied to a system of Critical Infrastructures.

Tuesday, 18 June 2013

09:00-11:00 | Parallel Sessions V

RS. E - Logistics and Market Accessibility

ROOM V; Chair: Ann Verhetsel

[34] ADVANTAGED BIDDERS IN FRANCHISING

Vincent van den Berg

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How is an auction affected if one bidder owns a complement or substitute to what is auctioned? Such a bidder will be referred to as an 'incumbent'; the other bidders are 'new bidders'. For example, when the government auctions a franchise

for the right to operate an airport, one bidder could own another airport in the region, an airport that is frequent destination, or competing high-speed rail. Further examples include auctioning a telecommunication network, a utility, a public transport, a road or mobile-internet frequencies. With a 'standard auction' on the payment to the government, the incumbent is advantaged. If the government regulates with a 'price auction' on the price to be asked to consumers, it depends who is advantaged: with complements, the incumbent is advantaged; with substitutes, the incumbent is disadvantaged. In many settings, the advantaged bidder always wins, and at a very low payment to the government or a very high consumer-price. All this can have great consequences for the franchising in network markets, as this could severely limit the competition for the field. This is especially true for the 'standard auction', whereas the 'price auction' often gives smaller advantages, and may even give advantages to new entrants, thereby fostering competition in the field.

[50] REGIONAL SPECIALIZATION AND PUBLIC INFRASTRUCTURE INVESTMENTS: EMPIRICAL EVIDENCE FROM GREECE

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This paper aims to decompose the effects of various types of public infrastructure investments and market accessibility on the regional specification and diversification of different sectors of economic activity. The study dataset originates from the Monitoring Information System of the Greek government concerning all public investment projects funded by the European Commission and national resources at the prefecture level during 2000-2008. A fixed-effects panel SURE methodology is employed, which comprises a system of panel regression equations corresponding to six broad sectors of economic activity: primary sector, manufacturing, construction, main (non-financial) services, financial services and other (public-sector) services. In this way, it is explicitly recognized that public investments in transport and elsewhere, market accessibility, agglomeration, human capital and other factors typically considered within the general trade theory and new economic geography framework can have diverse (non-uniform) effects on specialization-diversification patterns across different sectors in a region. The results verify the significance of spatially fixed effects and that the determinants of specialization vary with each specific sector. The role of market accessibility, as proxied by a market potential function, on specialization is found to be conflicting with that of regionally identifiable public infrastructure investments, especially with regard to road expenditure. Specifically, improvements in the market accessibility of a region are found to diminish the specialization of manufacturing, in contrast with the increased regional investment shares on roads, airports and seaports. Nonetheless, regional investments in roads reduce the specialization of main services, while those in ICT and R&D increase their specialization. The effects of various transport investment categories on specialization are generally found to act complementary with each other. Increased regional investment shares of road, airport and seaport infrastructure significantly enhance the specialization of financial/business activities. Rail expenditure significantly enhances the regional specialization of other (public-sector) service activities, while rail and seaport expenditures significantly reduce the specialization of construction activities. Finally, airport expenditures significantly diminish the regional specialization of the primary-sector activities. The findings can offer useful insights into the wider economic appraisal of transport and other infrastructure investments from national and EU structural funds.

[4] LOCATION OF LOGISTICS COMPANIES: MEASURING THE IMPACT OF ACCESSIBILITY BY DISCRETE CHOICE MODELING (IN FLANDERS - BELGIUM)

Ann Verhetsel, Roselinde Kessels, Nele Blomme, Jeroen Cant and Peter Goos

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In today's globalized world, major opportunities arise for logistics companies. Due to globalization and fragmentation of industrial production processes, the logistics sector that organizes the linkages between different plants is fastly growing and consequently the demand for new suitable locations is considerable. Previous research indicates that accessibility is one of the principal variables for location decisions by companies. Though the literature is extensive on this matter, few evidence can be found up till now on the role of the several dimensions of accessibility in the decision process of logistics companies. This research aims to assess the impact of different characteristics of accessibility on location decisions of logistics companies in Flanders (Belgium). Both a revealed (GIS analysis) and a stated preference study (Discrete Choice Modeling) are pursued; the revealed preferences were used to design the choice situations in the stated preference study. The respondents are confronted with a series of choice situations which include both accessibility characteristics and land rent information. Using discrete choice models, the relative impact of the different dimensions of accessibility is quantified. The results show that land rent is still the most important location determinant for logistics companies in Flanders. Next ports are major attraction poles, the accessibility to roads and inland shipping terminals and the location on a industrial zoning are somewhat less important. Rail terminals play no significant role in the evaluation of different sites for logistics companies.

[59] CHILDREN'S INDEPENDENT MOBILITY IN ISRAEL: A COMPARATIVE STUDY OF JEWISH AND ARAB GROUPS IN ISRAEL

Wafa Elias

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This study is among the first to examine levels of independent mobility among the Arab and Jewish school children in Israel, as well as their participation in active transport (e.g. walking/cycling) on journeys to school and to other local destinations. The objectives of this study are to explore how children's independent mobility varies within the Arab and Jewish communities in Israel; and to study the influence of the urban environment and the social and cultural context of children's lives on children's independent mobility. This study will provide insights on policies and campaigns that may help in promoting healthier and greener travel behaviour for children. This study is based on a questionnaire completed by 1738 children between 9-15 years old studying in 4th to 9th grades and to one parent or primary caregiver of each child participant. The questionnaire has been developed and piloted by the Policy Studies Institute team in UK and was adjusted to the Israel environment and culture and translated to both Hebrew and Arabic. The survey was conducted in three geographically distinct areas for each part of the Israeli population – Jewish and Arab. These areas are intended to provide a 'cross-section' of Israeli society. The methodology of this study is based on descriptive statistics comparing independent mobility licences and travel behaviour of two school children groups: Arab and Jewish children. In addition logistic regression models were developed to study the influence of different factors on independent mobility such as: car availability, gender, age, social class etc. In order to examine whether children with independent mobility have access to and participate in a wider range of activities than those who don't have it a linear regression analysis was performed with the dependent variable being the number of unaccompanied journeys to the various activities in the weekend. The results clearly show that differences exist in school commuting patterns between the two groups and that there is relationship between the different personal/household and environmental characteristics as well as gender and the actual commuting mode. These findings match results found in the literature concerning the role of socio-economic characteristics, and the built environment on children travelling behaviour. In this study, two fundamental aspects emerged. First, the children indicated that they were not interested in walking when asked about their mode preferences. By a substantial percentage they indicated, that they were interested in being driven. That is, regardless of the built environment and parent driving options, children prefer to be driven. Hence in order to bring children back to walking education concerning the advantages of walking is needed. The second aspect, which is more within the scope of this research, is an unsafe feeling about the environment in general and, specifically, a feeling of danger from car-pedestrian accidents. In order to increase the self-commuting of children, road safety should be a major concern.

[115] ASSESSMENT OF TRANSPORT TECHNOLOGIES: A MULTI-CRITERIA FRAMEWORK FOR DECISION MAKING

Arne Höltl and Philipp Gilka

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Reducing greenhouse gas emissions has constantly been an objective in transport policy making. One possible approach to reach this goal is to increase fuel-efficiency. Restrictive emission policies have already led to vehicle technology improvements and thus reduced fleet emissions. Another possible way to reach emission reduction goals is to increase traffic efficiency by means of information and communication technologies. Smooth traffic, less stops and constant speeds are indicators for higher traffic effectiveness and decreasing transport emissions. Certain changes in traffic behaviour are necessary to reach these goals. The potential of fuel efficiency increase through changed driver behaviour is significant and advanced assistant systems can play an important role to improve it on a sustainable level. In several research projects assistant systems which help drivers to reduce their personal fuel consumption and thus lower the overall traffic emissions are evaluated. The type of recommendation given to the driver (e.g. about speed adjustment) relies here on the current traffic situation and is provided via visual, acoustic or haptic messages. The assessment of new technologies includes the evaluation of all kinds of effects a certain technology such as the driver assistant system may provoke. In several technology assessment approaches the conclusion has been that there is not a single best procedure that could be applied to any assessment objective. It is rather intended to consider all relevant effects and reduce the probability of wrong judgements about the outcome. Helpful for those making decisions later on whether these technologies should be realized or not can be a multi-criteria framework which includes technical and non-technical information retrieved during the assessment process. Such a framework is based on available data – which may be qualitative (user perception, expert judgement) or quantitative (traffic simulation, field test measurement) – and used to compare alternatives and assist in decision making. The multi-criteria analysis as a feasible method for technology assessment and aspects of uncertainty will be discussed.

[92] MOVING TOWARDS A RESOURCE EFFICIENT MOBILITY SECTOR THROUGH SERVICIZING

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Integrating new paradigms to achieve sustainable, inclusive and smart growth into transport requires fundamental changes to transport policy agenda. So far, the efforts have intensified on the production side, with vehicle efficiency standards and

alternative fuels increasing employed across the sector and whilst encouraging travel behaviour change is increasingly discussed. There are further opportunities to be gained from a consumption-based approach which are less explored or understood. Servicing, whereby suppliers provide functionality rather than products, is a crucial aspect of the consumption-based approach to create a resource-efficient economy. However, the study of its use in the mobility sector has not been thoroughly analysed, particularly the role of Information and Communication Technologies (ICT) in facilitating the shift from provision of products to services. Drawing on the use of ICT in transport generally, this aim of this paper is to explore the potential of this concept to assist in the delivery of more sustainable concepts of mobility and subsequent policy development. It provides a synthesis of existing understanding of servicing which can be applied specifically to the transport sector. It goes on to examine current and future opportunities to promote policies that would enable serviced mobility. To frame this paper, servicing possibilities in transport are identified within two categorizations, namely passenger/freight transport and long/short term policy horizons. Examples include car-sharing schemes, smart choice measures including teleconferencing and teleworking for passenger transport and optimal routing for freight transport. Building eco-towns through good quality planning can be recognised as a long term measure, while travel-campaigns and public provision of manuals/maps for streets/public transport can be proposed for short term planning. Second, the existing policies and legislation at European Union level and case studies from the United Kingdom will be identified to illustrate the role of ICT in servicing transport. These case studies will highlight the areas where the greatest potential exists to promote the concept of servicing more broadly throughout the sector.

[121] MEASURING THE EQUITY EFFECTS OF CARBON CHARGE ON CAR COMMUTERS: A CASE STUDY OF MANCHESTER AIRPORT

Chikage Miyoshi¹ and Piet Rietveld²

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This paper attempts to quantify the equity effect of a hypothesized economic instrument, a carbon charge on car commuters, for reducing carbon dioxide emissions produced by commuters on airport surfaces. Manchester Airport is taken as a case study using Manchester Airport staff Survey data from 2008 and 2010 and the fuel consumption factors computed based on the analysis of Association of Greater Manchester Authorities and the National Atmospheric Emissions Inventory (2009). A bottom up approach is adopted for measuring the equity effects of carbon charge by user group. First, the individual carbon footprint in terms of gram passenger kilometre, and the damage cost of carbon dioxide emissions by commuters on airport surface access are estimated. Next, the impact of carbon charge on travel behaviour is investigated. It involves the nested logit model for estimating the change of mode share by the additional car travel cost. Finally, the net effect of carbon charges is assessed by travel mode user, gender, income group, and age group. The revenue distributions to commuters are also included for this analysis by considering the damage cost of carbon of each commuter. The results show some impacts of the carbon charge on public transport users, and the positive effects on lower income group and less carbon commuters. However, a very little impact of carbon charge is shown on car traveller's behaviour change, due to their low fuel cost elasticity of car commuting. The total net welfare benefits including revenue distribution are only £0.67 per person and per year as a result. Furthermore, the majority of travel mode, 'car alone' users belongs to the medium income group, which is the most affected negatively among all commuters. Hence, a combination of incentives (car sharing scheme) and disincentives (carbon charge on car users) can be the better solution. It generates additional financial resource to deliver transportation subsidies to public transport commuters and economic direct incentives to non-carbon travellers such as walkers and cyclist. The quantified results provide the evidences for the mitigation policies to combine monetary incentives with disincentives for travel behaviour change, and demonstrate the different equity effects among commuter groups.

SS 4. C - Public Policy

ROOM VII; Chair: Liv Osland

[42] RESIDENTIAL PARKING PERMITS AND PARKING SUPPLY

Jos Van Ommeren and Jesper de Groot

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We estimate (inverse) parking supply functions in shopping areas. This enables us to derive the order of magnitude of welfare losses of policies that provide on-street parking permits to residents almost free of charge. Our empirical results indicate that parking supply is far from perfectly price elastic, implying that there are substantial welfare losses related to these policies. Our results suggest that the provision of residential parking permits in shopping areas induces a yearly deadweight loss of at least €500 per permit about 30% of the supply cost of parking space in shopping areas. The full paper can be received upon request.

[29] ALLOCATION OF PUBLIC EXPENDITURES AND MIGRATION PATTERNS IN SUB-SAHARAN AFRICA, THE CASE OF HUAMBO PROVINCE IN ANGOLA

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Urban Population grew from 1990 to 2010, grew more in developing countries, but much of this growth is in slum areas in Sub-Saharan Africa. There, more than 70% of urban population lives in urban slums with all the environmental, social and economic structural and cumulative problems that the process represents. The problem is that more public investment in urban slums increases even more the attractiveness of urban areas leading to a cumulative effects of urban growth stimulated by the unchallenged idea that rural populations are poor and can be better off if concentrated in major towns with increased accessibility to public services, furthermore reducing the pressure of poor population on natural resources (farm land, mining fields, hydropower facilities) that then can be available for modern uses. This paper tries to understand the phenomena using a rural/urban migration model that relates migration flows with the regional differences in ratio formal/economy. Formal economy is the one that can be explained by the basic activities. Informal economy is associated with the population that is not involved in the formal economy. The model is calibrated for the various municipalities, rural and urban, of the Province of Huambo in Angola with an external area in Luanda, the capital of the country. We show that different spatial allocations of public spending can lead to different migration flows and urban patterns.

[136] VALUING LOCAL PUBLIC AMENITIES IN SEGREGATED NEIGHBOURHOODS

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Norway is considered to be a very egalitarian society. However, within the capital Oslo there still exist large discrepancies across neighborhoods in terms of well-being and living conditions. Groruddalen is a large, suburban area located to the northeast of the city center. It is characterized by lower levels of education and income and higher levels of poverty, unemployment and social benefit take-up than other parts of Oslo. Moreover, the share of minority households is high, as is the number of minority students in the local schools, which has caused some concern for 'white flight'. Starting in 2007, the area of Groruddalen has been subject to a large, publicly funded, intervention. Over a ten year period a total of one billion NOK will be spent on improving living conditions and making the area more attractive to both its current residents and potential newcomers. The amenities provided range from heavily subsidized child care and cultural events to physical improvements like parks, playgrounds and bike paths. In this paper we investigate whether the program has had any effect on the evolution of local house prices. Using market based individual house price data from the period 2000-2011 we compare house prices in four neighborhoods that have been targeted for more intensive intervention to that of the remaining program neighborhoods in Groruddalen. Moreover, we contrast the house prices of Groruddalen with those of another area in Oslo that has not been subject to the same intervention but that is comparable along socioeconomic and cultural dimensions. This paper will add to the empirical literature on whether local public amenities are valued by home buyers and reflected in the house prices.

[83] RURAL DEPOPULATION, LABOUR MARKET ACCESSIBILITY, AND HOUSING PRICES

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A process of rural depopulation may be initiated by relocations or closures of basic sector firms. Reduced basic sector employment can be expected to cause out-migration from the region, leading to an economic base multiplier process, where jobs follow people and people follow jobs, until a new equilibrium situation is reached, with a lower level of local employment and population. In addition, the out-migration can be enforced by interdependent migration decisions. The probability of migrating from a zone may increase if the population falls below some critical level, since depopulation may lead to the loss of amenities such as schools, shops etc. Housing market effects can be expected to pull in the opposite direction. A reduction in local employment reduces the labour market accessibility. This may reduce local housing prices, and cause a capital loss for households that are moving out of the area. In this paper, we consider the relationship between housing prices, labour market accessibility, and migration flows in a general spatial equilibrium model. Equilibrium results from an iterative process where changes in the spatial employment pattern affect housing prices, while changes in housing prices affect migration decisions and local sector employment. The model is used to discuss how the housing market can contribute to preserving the spatial residential location pattern, and to protect an area from unfortunate effects of exogenous shocks in basic sector employment and/or in the transportation infrastructure network.

SS 5. C - Accessibility Modelling

ROOM VIII; Chair: John Östh

[2] DISCUSSING THE LOGSUM AS AN ACCESSIBILITY INDICATOR

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In recent years the so called Logsum as an accessibility measure increasingly received attention. The advantages of the logsum measure (LM) are discussed in literature, but to the best of our knowledge no systematic discussions on limitations exist. The first aim of this paper is to fill this gap. Our second aim is to explicitly compare the LM with its main competitor: the gravity measure, or potential accessibility measure. Limitations of the logsum include, amongst others, the ignorance of option values and the related love for variation in consumption, limitations related to the willingness to pay, the fact that

the utility at the choice moment may differ from the utility of the choice option itself, limitations related to the marginal utility of income, the fact that the logsum relates to changes in accessibility, not the absolute level of accessibility, the fact that the logsum is a measure for the valuation of accessibility but not for accessibility itself, the fact that the indicator is difficult to communicate. Comparing the LM and gravity based measures we conclude that to go from the LM' measure (that is very close to the gravity based GM measure) to a welfare measure, the logarithmic transformation has to be used in combination with the $(1/\alpha)$ standardization. This reflects the difference between accessibility and the utility of accessibility: an absolute change in accessibility measured according to the LM' definition has a welfare impact that depends on the initial level of accessibility.

[105] ASSESSING THE IMPACT OF ADAPTIVE ACCESSIBILITY ON THE OPTIMAL TRANSPORT POLICY IMPLEMENTATION BY USING AN INTEGRATED LAND-USE/TRANSPORT MODEL FOR MADRID

Yang Wang, Andrés Monzón and Floridea Di Ciommo

Transyt, UPM, Spain

Accessibility is an essential concept widely used to evaluate the impact of land-use and transport strategies in transport and urban planning. Accessibility is typically evaluated by using a transport model or a land-use model independently or successively without a feedback loop, thus neglecting the interaction effects between the two systems and the induced competition effects among opportunities due to accessibility improvements. More than a mere methodological curiosity, failure to account for land-use/transport interactions and the competition effect may result in large underestimation of the policy effects. With the recent development of land-use and transport interaction (LUTI) models, there is a growing interest in using these models to adequately measure accessibility and evaluate its impact. The current study joins this research stream by embedding an accessibility measure in a LUTI model with two main aims. The first aim is to account for adaptive accessibility, namely the adjustment of the potential accessibility due to the effect of competition among opportunities (e.g., workplaces) as a result of improved accessibility. LUTI models are particularly suitable for assessing adaptive accessibility because the competition factor is a function of the number of jobs, which is related to land-use attractiveness and the number of workers which is related, among other factors, to the transport demand. The second aim is to identify the optimal implementation scenario of policy measures on the basis of the potential and adaptive accessibility and analyse the results in terms of social welfare and accessibility. The metropolitan area of Madrid is used as a case-study and two transport policy instruments, namely a cordon toll and bus frequency increase, have been chosen for the simulation study in order to present the usefulness of the approach to urban planners and policy makers. The MARS model (Metropolitan Activity Relocation Simulator) calibrated for Madrid was employed as the analysis tool. The impact of accessibility is embedded in the model through a social welfare function that includes not only costs and benefits to both road users and transport operators, but also costs and benefits for the government and society in general (external costs). An optimisation procedure is performed by the MARS model for maximizing the value of objective function in order to find the best (optimal) policy implementations intensity (i.e., price, frequency). Last, the two policy strategies are evaluated in terms of their accessibility. Results show that the accessibility with competition factor influences the optimal policy implementation level and also generates different results in terms of social welfare. In addition, mapping the difference between the potential and the adaptive accessibility indicators shows that the main changes occur in areas where there is a strong competition among land-use opportunities.

[85] INTERNAL TRAVEL TIME MEASURES: EXPLORING ICT DATA

Ana Margarida Condeço Melhorado, Elena Navajas Cawood and Panayotis Christidis

Joint Research Centre - Institute for Prospective Technological Studies, Spain

Accessibility is at the heart of the European Union (EU) policy. The EU underlines the importance of building trans-European transport networks (TEN-T) as a political tool for improving accessibility throughout the whole of Europe, and very particularly in border and peripheral regions hampered by a lack of access to the central markets. Equitable accessibility to markets is considered a factor which is crucial to the success of the social and economic integration of the EU and to the achievement of harmonious economic development. The Green Paper on TEN-T explicitly states that the main objectives of the TEN-T are to guarantee the adequate functioning of the interior market and to guarantee accessibility and reinforce socio-economic and territorial cohesion. Measuring accessibility at a European scale is not an easy task. Data is not always available for all countries and the amount of data required limits the use of more disaggregated accessibility indicators. On the other hand there is a growing potential of ICTs (Information and communication technologies) in providing new sources of data that can be used in accessibility computation and to the improvement of accessibility analysis performed at a European scale. In this study we will use TeleAtlas and TomTom data to calculate internal travel times for NUTS-3 regions in the EU. These internal travel times are estimated according to the level of congestion within each region as well as with its' total area. Internal travel times are an important aspect in accessibility indicators, especially those with a gravity formulation, because they allow the estimation of what is known as self-potential. The self-potential can be defined as the contribution of the internal accessibility of each zone to its overall accessibility. Several studies demonstrate the important role of this factor on accessibility outcomes, especially in the most urbanized regions where the higher agglomeration of economic activities leads to a higher contribution of internal accessibility. It is precisely in urban regions where internal travel times are more difficult to estimate because of congestion. Congestion levels may be influenced by factors such as urban density, urban morphology, network infrastructure, cultural differences in the use of transport modes, etc. Accessibility analysis usually use crude estimates of internal distances, generally based on the regions' area and in some

cases considering the level of urbanization of the region. The use of ITC data for this purpose is a qualitative step forward in the methodology to estimate the self-potential in accessibility analysis. These internal travel times can then be mapped at NUTS-3 level and be used to estimate more accurate accessibility indicators for the EU.

[99] NEW METHODS FOR THE ESTIMATION OF COST/DISTANCE DECAY IN POTENTIAL ACCESSIBILITY MODELS

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¹Uppsala University, Sweden; ²University of Bologna, Italy

In much accessibility research, arbitrary estimates of the cost/distance-sensitivity parameters have been used to represent the cost/distance deterring-parameters in potential accessibility models. These estimates are arbitrary, since the choice of value and the choice of the cost/distance-deterring function is often motivated by general statements about goodness-of-fit. An important reason for the use of such unsatisfactory representations of cost/distance-sensitivity parameters is the complexity of their estimation, especially if we adopt a doubly-constrained spatial interaction model from which we extract the potential accessibility. Starting from these considerations, in this paper we illustrate a simple procedure, originating from the natural sciences, to estimate distance-decay parameters. This method is compared with conventional methods for the calibration of both unconstrained and doubly constrained distance decay parameters – originating from regional and transportation science. The exploration of these methods focuses on empirical analyses of accessibility in Sweden, at the municipal level, for the years 1993 and 2008. This contribution concludes with some methodological/empirical remarks on the adoption of these methodologies, in the light of possible forecasts and related policy analyses.

SS 8. D - Disruptions and Emerging Patterns in Infrastructure Networks (II)

Amphitheatre III; Chair: Francesca Medda

[12] ANALYSING AND MODELLING CONSEQUENCES OF THE LARGE SCALE DISRUPTIONS OF AIR TRANSPORT NETWORKS

Milan Janic

Delft University of Technology, The Netherlands

This paper deals with analyzing and modelling vulnerability and resilience of the hub-and-spoke air transport networks affected by the large scale disruptive events. Generally, these can be extreme (bad) weather (rain, snow, strong winds), natural disasters (earthquakes, volcano's), and (unpredictable) failures of components of the air transport system at airlines, airports, and air traffic control/management. The most vulnerable and difficult resilient component of these network(s) has considered to be the main network node, i.e., the hub airport. Both effects – vulnerability and resilience – are considered from the aspects of the affected airline(s) and its passengers, and the airport operator. In the former case, the large-scale disruptions at the hub airport considerably compromise the integrity and schedule of the airline hub-and-spoke network(s) set up there, causing the long flight delays and cancellations spreading both upstream and downstream of the affected node, i.e. the hub. In the latter case, the affected airport undertakes measures to mitigate the impacts during the disruptive event and then, after it is over, takes some time to fully operationally recover. The affected airline(s) experience dis-benefits in terms of the long delays and cancellations of the affected flights and related costs. The air passengers suffer from the increased costs of their (lost) time while waiting, and an overall travel discomfort. The airport(s) is imposed direct additional costs for managing operations during the disruptive event and then for recovering up to the full operational capacity. In order to estimate some of these costs, the appropriate analytical models based on the deterministic queuing theory are developed and applied to the given airline/airport cases using 'what-if' scenario approach. The results from this application indicate that the total costs for the three main affected actors generally increase with the strength, duration, and time of the day the disruptive event occurs, and the number of affected flights, passengers, and their costs.

[129] EXPLORING ROAD NETWORK VULNERABILITY DUE TO SEA LEVEL RISE IN EUROPE

Hande Demirel, Mert Kompil and Françoise Nemry

European Commission, Joint Research Centre (JRC), Institute for Prospective Technological Studies, Spain

Reliability and robustness of transportation network is vital for flourishing economy and welfare of people. An unplanned degradation within the system may lead to severe consequences and may be induced by natural and/or man-made disasters. Recently, several studies have focused on assessing the vulnerability of transportation network to climate change. Depending on future global warming and consequences at regional level, transport modes and system components could be affected by one or several simultaneous changes in the climate conditions. Sea level rise and sea storm surges might have severe consequences on transportation vulnerability and coastal region economies since a significant and increasing share of the EU population lives in coastal areas. The vulnerability of road transport network to future sea level rise and sea storm surges has recently been assessed in a JRC/IPTS research conducted in the framework of the JRC PESETAI project assessing the future impacts of climate change in Europe. That study used the Teleatlas data and applied the 'bucket fill' approach to determine the coastal areas in Europe that would be inundated in case of a one meter sea level rise and sea storm surge events. The water levels were assigned by means of projecting them on Digital Elevation Model (DEM), where

SRTM data was used. This approach is considered robust for such a first order risk analysis. The two types of inundated areas (permanently or temporarily) are then overlaid with the transport network infrastructure, to identify the linear distance in kilometres affected within each scenario. As a result, the sensitive multi-dimensional network elements (nodes and links) towards sea level rise were explored. Building upon that first assessment, a subsequent step, assesses the consequences of episodic flooding-induced infrastructure disruption on traffic conditions. Both single and area based failures of road network are analyzed in terms of vulnerability. A case area is selected from the PESETA II project. The selected region has both dense population and dense network, where most severe consequences are expected. The In order to explore the likely impacts of network degradation, changes in travel times and generalized transport costs, alterations in traffic flow and accessibility pattern will be analyzed as metrics of network vulnerability. The changes in transport costs and travel demand are modelled using TRANS-TOOLS (TOOLS for TRansport Forecasting ANd Scenario testing) and then change in accessibility patterns will be analyzed using gravity type of accessibility indicators – e.g. potential and daily accessibility indicators. Teleatlas road network is generalized in order to match the network with TRANS-TOOLS network. Changes in level of services and transport activity are expected, where impacts might be more significant in regional accessibility patterns.

[66] ASSESSMENT FRAMEWORK FOR URBAN INFRASTRUCTURE ASSETS

Francesca Medda and Ioannis Rotskos

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Critical infrastructures of a city or region often show significant levels of interdependency which constitute a key element in the assessment of their adaptability. The objective of the paper is to develop an assessment framework of infrastructure assets that aims to evaluate the adaptability of infrastructure systems while shedding light on the capital value of the infrastructure portfolio assets that a city/region operate and manage. Agent-based complex network modelling is used in order to analyse the various scenarios that a shock may provoke to the infrastructure system. The information encoded in and by such scenarios is conveyed and expressed in the form of graphs. Infrastructure components and the relationships between them are conceived as having a one-to-one association with vertices and edges respectively, in a directed graph. Two types of links are considered: connectivity and dependency. Connectivity input links are the least failure conducive, whereas dependency are more prone to cause a failure. The functional state of the agent/infrastructure is in direct accordance with the existence and loss of different input edges. By deciphering local interrelations between agents, i.e. infrastructural components, the simulations illustrate emerging system interdependency dynamics, hence bypassing the need to define or obtain knowledge of global interdependencies a priori. The model allows us to evaluate the adaptability of the infrastructure system and test the capital value of the infrastructure portfolio assets. By doing so, this will provide an indicator for the optimisation of infrastructure investments and financial risks.

14:30-16:30 | Parallel Sessions VI

SS 3. B - Sustainable Logistics (II)

ROOM V; Chair: Cathy Macharis

[107] AN EXTERNAL COST CALCULATOR TOOL FOR ASSESSING THE SUSTAINABILITY OF LOGISTIC SOLUTIONS

Tom van Lier and Cathy Macharis

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Objective of this paper is to describe the development of an external cost calculator tool that can be deployed in the sustainability assessment of logistic options. In the case of transport, the existence of mostly negative externalities causes the market prices of transport to not fully reflect the societal cost of the transport activity. As a result, transport activity levels are generally above the social optimum. Therefore, in order to identify more sustainable transport options, it is essential to be able to assess the external transport costs associated with these options in an accurate but cost-efficient way. However, different external cost categories are influenced by different parameters, making a calculation based on average external cost key figures often misleading and inaccurate. A more differentiated approach is required. Therefore, the vast amount of scientific literature on emissions (both greenhouse gasses and air pollutants), accidents, noise, up-and downstream processes, congestion is studied in detail in order to gain insights into the range of external cost key figures. Based on this, the paper describes in detail which parameters should be taken into account for the different external cost categories. In addition, the paper studies if and/or how less studied externalities such as visual intrusion, separation effects, use of public space, soil contamination, etc. can and/or should be taken into account in (particular) external cost calculations. If any, data gaps are identified and solutions proposed. Goal is to arrive at a feasible, practical but sufficiently diversified tool that can be applied on all sorts of (freight) transport options with differing complexity. A prototype of such an external cost calculator tool is presented and results of some case studies where the tool is applied are discussed.

[14] IMPACTS OF CLIMATE CHANGE ON TRANSPORT BY INLAND NAVIGATION A MULTIMODAL APPROACH FOR THE RHINE AND THE DANUBE

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Melted snow, rainfall and evaporations affect the rivers water level and that it may impair transport by inland navigation during a number of days. The FP7 ECCONET project endeavors to measure the potential effects of these phenomena on the Rhine and Danube in the context of the observed weather variability and expected long-run climate change scenarios. Using a number of inputs from several ECCONET reports and applying the NODUS transport model, the paper focuses on a transport analysis of how the competitive position of inland waterways transport may be affected by a climate change. The reference data for the modelling are 2005 and projected 2050 matrixes of Continental Europe origins-destinations transport flows per mode and per type of commodities, and transport cost data. As the transport cost of vessels are function of their loading and draught, the model can be used to analyze the effect of changes in the rivers water depth on transport costs, tonnages and modal splits between the three competing modes, rail, road and inland waterway transports, as well as on the use of the different types of vessels. After calibration, the model can be applied for simulating the outcomes for a set of observed years with various yearly water depth distributions as well as for some climate and economic projections in 2050. Through a variety of assignment algorithms, the model assigns transport traffics between modes and means over the multimodal trans-European network of roads, rails and rivers or canals. Given the spatial scope of the research, traffics on the Rhine and Danube, the network includes all the regions potentially involved in these traffics. Transport costs include variable and fixed costs of carrying goods by the three modes, road costs to places of loading/unloading on wagons or vessels, plus the costs of these operations. The outputs are the changes induced by the waterways conditions in the modal split between the three modes. These outcomes are computed for some observed years as well as for a set of water depth distributions that are selected from two modelled climate scenarios extending from 1977 to 2050. Further on, it is possible to show what would be the likely impacts on modal shares of the general economic evolution until 2050, the induced changes in the spatial spread of activities throughout Continental Europe and the new infrastructures in its TEN-T Priority program. An analysis of the climate change effects on the use of the different types of waterway vessels is also provided. The paper describes the modes' networks, the transport demands that can possibly make use of waterway transport on the Rhine and Danube, and the cost data. The following section explains how the effects of water level variations are modelled, and presents the results of some simulations relative to the reference period 1977-2006, the impacts of climate change over the period 1977-2050 and some elements on the use of different types of vessel. The concluding remarks underline some limitations inherent to that type of modelling, and sum-up the research main results.

[103] THE CARGO TRAM: CURRENT STATUS AND PERSPECTIVES, THE EXAMPLE OF BRUSSELS

Mathieu Strale

Universite Libe de Bruxelles, Belgium

In addition to the many issues about passenger transport, the renewed interest in urban public transport is also related to freight. Indeed, freight traffic in urban areas is a major source of pollution, especially. However, it is also an indispensable tool for the economic and social life of cities. In this context, the use of tramway for freight transport is mentioned as a possible solution. Its use is envisaged for off-peak or night delivering, for parcel deliveries and shops supplying. However, many obstacles exist: noise and other nuisances related to this transport mode, inadequate network or equipment, lack of space for unloading areas etc. The purpose of this paper is firstly to establish a state of the art about the cargo tram. What are the initiatives in this field in Europe? What are their stages of implementation? What are the results achieved and could we draft a best practices guide? This first step will be carried out through a study of the literature. Then, to concretize these elements, the Brussels situation will be studied in detail. Indeed, this city is interesting for several reasons. First, unlike many west European cities, Brussels has preserved part of its historic tram network. If the trend was to deleting lines until the 90s, the current enthusiasm for this mode results in an increase in frequency, the purchase of new equipment and the creation of new lines on separated lanes that are added on the old network. Thus, the tram network configuration has contradictory effects on its potential use for the distribution of goods. It offers a fine and extensive coverage. However, in return, many old lines are not on separated lanes and narrow streets and dense urban fabric makes their conversion difficult. Several prospective studies on the use of this mode for freight were carried out but no concrete initiative has emerged yet. This combination of a theoretical approach and a field approach of the case of Brussels will allow us to conclude our study. We will trace the current outlook regarding the use of cargo trams, in Europe in general and Brussels in particular. Obstacles and opportunities and interest for municipalities for the implementation of such infrastructure will be specified.

[58] SUSTAINABLE CITY DISTRIBUTION: OPTIONS AND EVALUATION

Cathy Macharis, Lauriane Milan and Sara Verlinde

Vrije Universiteit Brussel - MOBI, Belgium

Urban areas face particular challenges for freight transport, both in terms of logistical performance and environmental impact. A range of regulatory, technological and logistical measures has been tested, most of them suffering from a lack of

systematic evaluation and assessment of their short and long term effects which impedes knowledge transfer and the adoption of best practice. As a consequence, large scale or long term adoptions often fail, although many initiatives seemed successful in pilots and demonstrations. There is a clear need for a comprehensive approach to evaluate urban freight solutions in order to assess whether they stand a chance. The evaluation framework has been worked out within the Straightsol project (Strategies and measures for smarter urban freight solutions, EC FP7). This evaluation framework has to allow a thorough evaluation of the seven demonstrations that will be executed during the Straightsol project but should also be a framework for other evaluation situation within the context of city distribution and urban-interurban interaction. Many innovative city distribution concepts fail because not all stakeholders were taken into account (Macharis & Melo, 2010). That is why within Straightsol, we take these actors and their objectives as the primary focus within the evaluation framework. The Multi-Actor Multi-criteria analysis (MAMCA) methodology developed by Macharis (Macharis, 2000, 2005 & 2007) suits in this aim and is complemented with other methods such as the Cost Benefit Analysis and Business modelling. Within this paper, the evaluation framework is fully described with its methodological and step-by-step approach. Also the combination of complementary methodologies is presented. The relevant stakeholders within urban and interurban freight transport context are shown together with their important criteria.

SS 4. D - Commuting (II)

ROOM VI; Chair: Jos van Ommeren

[26] COMMUTING AND PLACE ATTACHMENT IN CITY-REGIONS

Kerstin Westin

Umeå University, Sweden

In many Western countries larger cities expand geographically and smaller surrounding communities (i.e. hinterlands) become integrated into a larger city-region. In the first years of the 21st century there were more than 300 city-regions across the. An argument for city-regions is to ease and promote labor market interaction, i.e. to balance geographic mismatch of labor supply and demand. Consequently, a rationale for growth of cities and regions (into city regions) is to accomplish territorial entities that will be competitive, economic strong and part of important global networks. A consequence of interaction between people and businesses in different parts of the region is increased transport and travel. A large number of people travel long distances to work. In Europe, commuting times are increasing; 15 percent of the employed have travel times of 60 minutes and more to work, and the trend is that distance as well as number of people engaged in long-distance commuting is increasing. This means that for many people the working-hours are spent in another municipality or city than the residential municipality, i.e. an increasing number of people spend their awaken time outside their residential municipality. In order to manage the puzzle of daily activities within the individual's time-space frame, a number of service and leisure amenities might have to be carried out outside the residential municipality. Municipalities provide basic services (education, care, infrastructure, residential planning etc.) to its residents and exercise taxation power. Public participation is thus restricted to residency, and frequent visitors (e.g. in-commuters) lack the possibilities and rights to participate in politics and decision-making. At the same time, living in one municipality but spending a large part of the active hours in another limit the time available for participating in different social and political activities in the residential municipality. Being non-present for long hours can influence the citizens' identity and responsibility to the residential municipality. This raises the questions if commuting (in this case within the city regions) strengthens or weakens attachment to the residential municipality and city-region respectively, and if the propensity to migrate is affected by commuting? The empirical results in this presentation are based on a questionnaire survey in two city-regions in Sweden. The survey was carried out in 2010, and directed to citizens in the larger Göteborg region in the south, and the smaller Umeå region in the north.

[52] COMMUTING TRAVEL BEHAVIOUR: THE IMPACT OF FRINGE BENEFITS

Linda Nijland and Martin Dijst

Utrecht University, The Netherlands

It is well known that the transportation system, residential location, firm location, and work-related fringe benefits entail travel conditions which affect travel demand, transport mode choice, and departure time. For transport policy makers, it is essential to have an understanding of the underlying driving forces of travel behaviour. In particular, when high density areas are considered, where traffic jams, mainly during rush hours, are an everyday problem. In order to keep congested areas accessible, more research is required on the influences of work-related fringe benefits offered by employers (e.g., use of company cars, travel subsidies, telework, flexible working hours) on travel decisions of employees. Commuting travel behaviour of individuals is highly influenced by the firms they work for, the household of the employee, and the (national) government. The behaviour of firms, by means of locational decisions such as firm location and other mobility management policies, directly or indirectly affects employees' commuting distance, commuting time, and transport mode use. The impact of mobility management on employees' commuting behaviour may be undesirable (e.g., company cars, employer-paid parking), but can certainly also be beneficial (e.g., work schedule flexibility, telework, spreading of workers' starting times, local recruitment, residence relocation subsidies, etc.). The purpose of this paper is to analyze the effects of the following transport-related fringe benefits: telework, work schedule flexibility, public transport and general travel subsidies, and the possession of a company car, on commuting travel behaviour. For the analyses we use the Dutch Time Use Survey

(TBO). This survey provides data on all of the commuting-related fringe benefits mentioned above. Furthermore, this dataset contains commuting and other travel behaviour data and spatial, household and work-related information of respondents as well as their partners. Approximately 2000 individuals took part in the TBO survey. The results of the analyses will indicate to what extent the fringe benefits and other occupation and household characteristics will affect travel decisions (like transport mode and departure time choice) of employees on working days.

[90] COMMUTER MOBILITY: AN INDICATOR OF MUNICIPALITY ATTRACTION

Gunnar Andersson and Siv Schiele

Stockholm University, Sweden

In Sweden, as in other parts of Europe, the concept of region and regions has gained increased attention in recent decades. In the Mälars region surrounding Stockholm various investments in infrastructure are pursued and different settlement structures have been discussed (the Regional development plan for the Stockholm region, RUF2010). To get better insight on the feasibility of different settlement structures, we need better data on commuting, domestic migration, and people's changes of workplace. Most municipalities want to increase their population. A question that many municipality planners may pose is whether it most efficient for a municipality to aim at promoting a better infrastructure for workplaces or for dwellings. In the present paper, we study the behavior of commuters in the Mälars region to get better insight into what factors that may be related to municipalities' different levels of attraction. We study the extent to which commuters stop commuting by means of change of residence to the municipality where their workplace is located or by changing the workplace to the municipality where they live – and the factors that contribute to or dampen such behavior. Our main focus is to determine which municipalities are more attractive in terms of residence and which are mainly attractive in terms of workplace location. We study individual commuter behavior by means of Swedish register data on place of residence and place of work place. Our baseline year is 2005 and we study the extent to which commuters change their behavior during a one-year follow up. Longitudinal micro-data on place of residence, place of work place and commuters' various individual socio-demographic characteristics are linked to data on a range of municipality characteristics. Our data are complemented with standardized data on travel distances and travel times, these data are available at very detailed small-area geographic level. We analyze the propensity of commuters to end commuting by means of multinomial logistic regression. Migration rates and change of workplace rates are shown to decrease with the number of years being a commuter. The relative risks of domestic migration are strongly related to socio-demographic variables, whereas the relative risks of change of workplace mainly vary with individuals' economic variables such as earned income and commuting distance. The relative risks of migration and change of workplace also vary with the characteristics of the municipalities involved. We demonstrate that the attraction of a municipality in terms of residence increases with the general accessibility to workplaces in the municipality and decreases with its level of house prices. The increased supply of new dwellings in a municipality has a greater impact on the propensity to increase its population than has an increased supply of workplaces.

[95] COMMUTING DURATION AND HIGHER EDUCATION STUDENTS' PRODUCTIVITY

Martijn Kobus, Jos Van Ommeren and Piet Rietveld

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We study the effect of commuting duration on student productivity. To this end, we employ survey information on 2,825 students of a Dutch University. In the estimation procedure, we control for student socio-economic characteristics and the student's geographical region of origin. Endogeneity of travel duration is addressed using an instrumental variable approach. Because of a government-sponsored program, most students travel by public transport for free. Students who live nearby commute mainly by regional public transport, by active commuting (i.e. by bike, walking), or by train. Commuting between cities is mainly by train. The average commute duration is 48 minutes (door-to-door). We use several indicators for student productivity, which relate to inputs and outputs of a student production function. Observed production function inputs are the number of days and hours that a student is present at the university, the number of attended lecture hours, and hours of study-related IT use. As outputs of the student production function, we observe the average study grade and study progress. In the week of study, students were present at the university on average about 15 hours divided over 3 days. We find that students who live farther away come to the university less often. In particular, one additional commuting hour reduces university presence by about 0.2 to 0.7 days per week (depending on the specification), which is substantial. However, conditional on visiting the university on a given day, students with longer commutes also stay more hours. As a result, one of our main findings is that students with longer commutes are present at the university an about equal number of hours per week. The latter result could be attributable to productive or non-productive behaviour. For example, it could in principle be the case that students with longer commutes more often miss lectures, but spend an about equal number of weekly hours at the university, because they bridge time between lectures in a non-productive manner (while students who live close by go home in between). So, we also estimate the effect of commuting distance on study-related activities (e.g. number of attended lecture hours, IT use) and study results (i.e. study progress, average study-grade). Our expected result is that, contrary to the literature on worker productivity, commuting duration does not influence the latter student productivity indicators much. One of our preferred explanations for this is that students can use their time productively while commuting by train, among other reasons.

[88] UNDERSTANDING PROFESSIONAL RELATIONS WITHIN PERIPHERAL AREAS OF POLYCENTRIC URBAN REGIONS: RADIAL VERSUS TANGENTIAL MOBILITY PATTERNS' BY

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Transport networks represent a clear influence on settlements structures and vice versa. Improvements carried out in transport systems during the last few decades have played a key role in the complexity of metropolitan regions, since more distant territories are accessible within the same travel time (minimizing distances is not the one and only factor in deciding residence and work locations). Both, transport systems and urban structures, modify functional relationships among different locations, establishing the main features of a region and setting its mobility patterns. Nevertheless, this impact is also bidirectional, since commuting relations also influence urban structures. We are attending to a crucial transformation in territorial articulation: in contrast to traditional monocentric metropolitan areas, where most of the movements directed to their central core (a hierarchical model where population sizes play a meaningful influence in organizing functional relations), although the role of this main center is still crucial, the relevance of horizontal relations (among their peripheral locations) is increasing to the detriment of the radial ones (within or to the centre). While previous studies have already faced those changes of mobility patterns, they have focused on commuting data and have not deepened in the socioeconomic attributes of the travellers. The main aim of this paper is to characterize professional relationships within peripheral areas of Polycentric Urban Regions and to what extent communication improvements and new radio-concentric transport infrastructures have changed mobility patterns, from a predominantly asymmetrical and directed to the central city model towards a polynodal one. In order to analyze these commuting flows, an application to the central area of Spain, particularly to the provinces of the Castilla La Mancha region, adjacent to the Madrid Metropolitan Area, is undergone. The methodological approach followed to understand those relations consists in a mobility survey. Own elaborated questionnaires were addressed, completed and collected via internet. The questionnaire focused on work-related contacts regarding both, the ones with and without (email, telephone, etc.) displacements, collecting data of origins and destinations, frequencies and transport modes. The empirical findings show that although incipient transversal movements between locations far away the metropolitan centre are gaining relevance favored by better infrastructures and more efficient transport services, relationships occurring within the same province of residence and with Madrid already characterize regional mobility patterns.

SS 5. E - Accessibility and Spatial Distribution of Services and Resources

ROOM VII; Chair: Tomaz Dentinho

[48] A MULTI-CRITERIA APPROACH TO ANALYSE THE ACCESSIBILITY OF NEIGHBOURHOODSAna Vasconcelos¹, Juan Carlos Martín², Concepción Román² and Tiago Farias¹¹Technical University of Lisbon, Portugal; ²University of Las Palmas de Gran Canaria, Spain

We first study the individual accessibility for different units (blocks of a certain neighbourhood) to some local facilities, namely pharmacy, grocery, bakery and primary schools within a distance of 2 km. The individual accessibility for each block is calculated according to the inverse logistic function in which the parameters -impedance value and others - are calibrated with data from surveys. Thus, we obtain an accessibility index for each unit, transport mode and opportunity under analysis. Afterwards, we will use the flexibility of Data Envelopment Analysis (DEA) methodology to analyse the relative accessibility of each individual block in two neighbourhoods in Lisbon, and to fully rank in terms of accessibility all the units under analysis. In previous literature blocks have been analysed using partial accessibility indicators; however, this approach does not provide a good understanding of the overall accessibility of each unit. In this paper, we will use the well-known method of cross efficiency DEA, in which each block is evaluated according to its weights and their counterparts' weights. We will finally compare the accessibility for each neighbourhood which is characterized by significant differences in their urban planning, mobility patterns, concentration of services and availability of public transportation.

[75] THE ACCESSIBILITY OF FOOD: EXAMINING FOOD DESERTS IN FLANDERS

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Problem statement and objectives: Food deserts are areas where the access to affordable healthy food is restricted due to physical or economic barriers. Residents may experience detrimental impacts on diet and health because of them. Despite growing interest in the subject in Anglo-Saxon countries, food deserts have barely been researched in continental Europe. Research is however not readily transferable due to socioeconomic, institutional and planning differences. This paper includes a literature review of food deserts in Canada, the UK and the US and an empirical study of food deserts in Flanders, the Dutch-speaking north of Belgium. We first identify food deserts and the affected population groups in Flanders. Then the relative influence of supermarkets and smaller shops on the prevention of food deserts is examined. Finally the differences between Canada, the UK, the US and Flanders can be studied to assess the impact of societal factors on food deserts. Methods and data: We first define food deserts as an area at a distance of more than 500m or 1,000m (plausible walking distances) from either a supermarket or a cluster (distances measured in GIS). In this context a cluster is a grouping of a bakery, a butcher shop and a mini-supermarket or fruit and vegetable shop and is calculated using a newly developed

GIS-tool. Subsequently a gravity model is introduced to further quantify these results. The information of these analyses will be combined with socio-economic data to see who suffers most from food deserts in Flanders. We apply georeferenced data from Locatus (private entity) of all supermarkets and food stores in Flanders. Used cartographic and socioeconomic data are freely available. Results and discussion: The accessibility of food is generally high in deprived urban areas and low in affluent suburbs. Some deprived urban areas, primarily outside of the city centers, with low access to food were however identified. Supermarkets generally are the principal source for food in Flanders. Clusters of small shops are however important in some migrant neighborhoods where they have prevented the occurrence of some food deserts. Despite institutional and socioeconomic differences, these conclusions more or less follow the results of British and Canadian research. In the US food deserts are much more prominent in deprived neighborhoods.

[65] ASSESSING SOCIAL SUSTAINABILITY: ACCESSIBILITY AND SPATIAL JUSTICE OF RESOURCE DISTRIBUTION FOR THE ELDERLY IN SHANGHAI

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Shanghai, as the most rapidly aging city in China, is facing a serious challenge of the 'silver tide' in terms of providing sufficient elderly services like hospitals, leisure facilities, and good living environment. These resources and their accessibility matter the elderly's quality of later life and happiness. Nevertheless, hindered by the historical and institutional factors, the immigrant elderly compared with the natives are generally more disadvantaged during the resource competition in the sense of having worse accessibility and location. This spatial injustice between the native and immigrant elderly undermines the general well-being of the seniors, and the social sustainability in Shanghai. This issue, however, has hardly been addressed in existing literature. Accordingly, this paper aims to measure the accessibility of and spatial justice between the native and immigrant elderly in Shanghai by accessing and comparing their accessibility level to the basic needs related resources. First, Lindenberg's theories of needs will be employed as the theoretical basis, with which the index system for the specific social and physical sources is proposed. The 2000 Shanghai economic census provides information of the physical facilities. Second, the spatial differentiation of the two elderly groups in Shanghai central city will be revealed, based on the finest spatial unit of 2000 Shanghai population census. Third, the road-network and location based accessibility analysis will be conducted in five travel modes for instance walking, cycling, bus, metro, and car. The shortest distant measure and potential measure are employed for different types of basic needs respectively. Thereafter, by comparing the spatial concentration of the elderly with their accessibility level, the spatial injustice issue is interpreted between the native and immigrant elderly groups over various travel modes. This paper argues that numerous immigrant elderly still are excluded in the outer fringe of Shanghai central city with poor accessibility level in all travel modes, whereas native elderly are highly concentrated in the core area and enjoy a high level of accessibility and needs satisfaction. However, differentiations within each elderly group, each needs category and travel modes still exist, which provide deeper insights into the elderly' spatial inequity. In conclusion the consequences of the spatial injustice for planning suggestions will be elaborated upon.

[28] REFLECTIONS ON ACCESSIBILITY TO PUBLIC EQUIPMENTS

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Public equipments such as schools, hospitals and police stations represent a major part of public spending. Furthermore there is the general idea that remote and small places have always lower access to public equipments than central and larger ones. Nevertheless many times small and medium size places can have higher accessibility to public equipments because, on the one hand, there is the obligation to provide public services to all the population and, on the other hand, those places are small and concentrated leading to more accessible services. The aim of this paper is to analyze the spatial pattern of accessibility to public equipments looking at the case of the Azores. First we identify and measure indicators of accessibility based on the location and level of public equipments. Then we cross that information with a measure of centrality. Finally we discuss the results confronting them with concepts of efficiency, equity and governance.

SS 5. D - Accessibility to Train Stations

ROOM VIII; Chair: Karst Geurs

[124] FROM THE NETWORK TO THE SERVICES: UTILITY AND ACCESSIBILITY INDICATORS FOR HIGH SPEED RAIL

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The High Speed Train (HST) was originally conceived to connect big metropolitan areas, able to compete against air transport and suitable for distances between 400-600 km. In Europe, several countries faced its development with different schemes and configurations, and step by step, a real European network is being configured. Since the opening of the first HST, several studies have been undertaken in order to evaluate the increase in accessibility generated by HST. These accessibility indicators consider the characteristics of the new transport system (speed, layout, stops, etc.) basically related

to the infrastructure itself. However, many studies on HSR have highlighted the importance of the provision of services (timetables, frequencies, fares, etc). A high performance infrastructure such as HST may not be so useful in terms of accessibility and reducing travel times unless adequate services are provided. Considering this service approach, the paper develops a utility indicator for HSR services. This indicator is based on principles of the Time Geography, considering the available time at destination and its associated travel costs for different travel purposes. The comparison of this utility indicator with the traditional accessibility ones for the Spanish HST network provides a new perspective of the real usefulness of this infrastructure. This comparison evaluates to what extent provided services in each city allow reaching the potential accessibility of HST network. The methodology provides a useful for transport planning and a better design for city strategies.

[123] ACCESS TO HIGH-SPEED TRAIN: DEFINING CATCHMENT AREAS AT STATION LEVEL

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Transit ridership has been always an interesting topic in transport research, especially for transport modes transport modes attached to hubs (stations). In these cases, the access to the hubs is crucial to define the potential of use of transit. This is even more interesting in the case of High-Speed Train (HST) because it's defining characteristics: an 'anchored' transport mode, with few stops, mid and long run services and its integration within the cities (station location) and with other modes. In mid and small cities, where opportunities of transport are scarcer, these factors are of relevance when defining the access to HST services. The paper aims to define the catchment areas of the HST stations in the Spanish network by setting out a methodology which combines surveys of users at station level with accessibility models based on distance-decay weighted regressions. All this has been carried out at station level, taking its integration within the city and with other transport modes, car mainly. The main outcome is twofold: in one hand we are able to measure the extent of the influence of the HST services based on empirical surveys. On the other hand, the paper is able to connect the issue of the station location with the mode integration and modal coordination to fully take advantage of the opportunities given by the HST.

[94] SPATIAL ANALYSIS OF ELDERLY COMMUTERS' ACCESSIBILITY TO TRAIN STATIONS: A CASE STUDY OF PERTH, WESTERN AUSTRALIA

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Objective: Approximately 12% of Perth's population is aged 65 or older. Projections suggest that this proportion will continue to increase as a result of the large number of children born after the cessation of World War II (1946-1964); commonly known as the baby boomer generation. Accessibility to train stations for the aging population has become a more important issue as the number of elderly commuters continues to grow. The aim of this paper is to develop a complex accessibility measure at a fine spatial scale for understanding elderly commuters' accessibility to train stations. Data and methods: A two-day intercept survey was conducted at seven, highly distributed, train stations in Perth, Western Australia, to collect accessibility data including origin and destination of commuters, departure and access time, trip purpose and activities and commuters' perception and attitudes towards the facilities and service quality of train stations. Only data for patrons aged 60 years or more was used for this study. Three indices, including a network connectivity index (gamma index), market share index and service quality index are used to measure the accessibility of elderly commuters. The market share index is calculated from Smartrider data, which is a kind of electronic ticketing system used in Perth, Western Australia, that records when a user boards (colloquially 'tags-on') or leaves ('tags-off') a public transport vehicle. A doubly constrained spatial interaction model is used to estimate service quality index based on a function of generalised journey time (GJT) and the service quality survey data. Finally, a gravity model is used to generate an elderly commuters' accessibility index for each station based on these three indices and individual travel time. Expected Results: The results from accessibility analysis will provide useful information on: a) perceived facility and service quality at each of the seven stations examined and thus feed service quality improvement strategies; and b) reveal any possible factors affecting elderly commuters' accessibility to the train stations, thereby targeting the key areas that may need improvement.

[15] BICYCLE ACCESSIBILITY AND ACCESS MODE CHOICE TO RAILWAY STATIONS IN THE NETHERLANDS RANDSTAD SOUTHWING

Lissy La Paix and Karst Geurs

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The main objective of this paper is to examine cycling accessibility to the railway station. Particularly, the study verifies the Influence of impedance factor of a cycling route to the railway station. StedenbaanPlus is a regional transit oriented development with aims to densify urban areas around 35 railway stations approximately. This paper is based on data and analysis from the NWO project called 'Transit Oriented Development in the Randstad South-Wing'. This research project studies pedestrian and cyclist accessibility to Dutch stations under the program StedenbaanPlus. The data set in this paper is mainly composed by: sociodemographic, land-use and bicycle network data spatially georeferenced. The analysis is composed by three parts: 1. Station index: includes the status of bicycle and pedestrian facilities at station, amenities, cleanness, safety, etc.. 2. Diversity index: represents the station as node. This index is composed by measures such as

number of jobs, population, companies, and places for shopping within the influence area. 3. Connectivity index: represents the network connectivity, from both local and regional approaches. This index is composed by measures such as number of railway lines, type of trains reaching the station, quality of bicycle and pedestrian network, lightness, etc. Spatial and statistical analyses are conducted to calculate an impedance factor of the route to the railway station. These results are used as input of two discrete choice models for both walking and bicycle access share. The expected results will show: (1) the perceived utility of the route by pedestrians and cyclist; (2) the influence of connectivity measures in the bicycle and walking access share. Hence, the main findings will contribute to improve both walking and bicycle access share in Dutch railway stations, as consequence to increase the number of train passengers.

SS 6. A - Transportation Safety and Security Issues

Amphitheatre III; Chair: Luca Zamparini

[18] NON-RECURRENT ROAD CONGESTION, ACCIDENTS AND INCIDENT DURATION

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Road congestion is one of the main externalities of car use. We focus on the effects of car accidents and other types of incidents (e.g., breakdown of car) on non-recurrent road congestion on the Dutch highway network. By estimating a location-fixed-effects model, we aim to determine the causal effect of incident duration on non-recurrent congestion. We demonstrate that conditional on an accident, incident duration has a strong, concave effect on non-recurrent congestion for the first three hours of incident duration. For example, an increase of incident duration from 60 to 70 minutes increases non-recurrent congestion by 160 vehicle-loss-hours. From the macro perspective, this increase of 10 minutes in average incident duration on the 25,000 reported annual accidents entails a 40 million € loss to society. This suggests that there are strong benefits of incident management.

[31] WILLINGNESS TO PAY TO REDUCE THE RISK OF TRAFFIC ACCIDENTS: A STATED CHOICE EXPERIMENT IN THE CANARY ISLANDS

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We compute the willingness-to-pay (WTP) for reducing the risk of fatal and serious road accidents and also derive, for the first time in Spain, the value of a statistical life using discrete choice models estimated using data from a pivot-based stated choice experimental design. Specifically, we estimated a series of discrete choice models incorporating the risk of accidents via the use of variables referring to the expected number of annual fatalities, seriously injured passengers and pedestrians (either fatal or seriously injured). Our results clearly identify the importance of differentiating among frequent and occasional drivers. We found that the estimates for frequent drivers were more reliable, and used values for this type of drivers to derive WTP. Specifically, a value of € 4.49 million was derived for reducing the risk of having a seriously injured passenger, which is approximately 17 % of the value obtained for reducing a fatality (a proportion that is in line with values reported in the literature). The study also obtained (for the first time in Spain) a value of approximately 9.35 million Euros for reducing the number of pedestrian victims in a road accident. This value is, quite reasonably, an intermediate figure between the previous two values.

[62] IMPACT OF SECURITY ISSUES ON CYCLING MOBILITY: A SURVEY IN THE APULIA REGION

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The economic literature has often analysed cycling mobility through a safety perspective since the risk of injury is considered as the most significant barrier for the increase in bicycles' use worldwide. The huge number of accidents involving cyclists represents a great concern for both public administrators and citizens' communities. For example, in the UK, 19,215 accidents involved cyclists, with 107 fatalities (Rospa, 2012), while in the United States the number of fatalities in 2010 was 618 (NHTSA, 2012). The recent international campaign 'Cities fit for cycling' demonstrates how sensitive is the public opinion with respect to this problem. Empirical evidence shows that, alongside safety issues, the level of security are another important factor, which needs to be considered when examining cycling mobility (see Jain and Tiwari, 2010). Nevertheless, the problem of cycling security has not yet been investigated punctually and has been sometimes underestimated. The lack of security for both cyclists (muggings, robberies) and bikes (vandalism, thefts) can considerably affect the effectiveness of local transport policies for sustainable mobility. In Southern Italy, cycling mobility is still underdeveloped. There is nonetheless a growing public interest towards the promotion of this transport mode. In Apulia Region, transport policies have increasingly been oriented to the promotion of cycling mobility by improving cycle tracks and lanes, cycling facilities, bike sharing stations, promotional and communicational activities for enhancing citizens' attitude towards this transport mode. The aim of this paper is to investigate the current state-of-the-art of security of cycling mobility in the Apulia Region. The chosen methodology is an empirical survey based on questionnaires to be

submitted to regular bike users and to bike tourists travelling in Apulia. The survey purpose is to examine the role of security as a possible cause for the low levels of cycling in the area considered, offering at the same time a useful framework of regional cycling security to policy makers and mobility planners for the implementation of policies and the prioritization of potential improvements. References: Jain, H. and Tiwari, G., 2012, Road safety and security issues among urban cyclists and non-cyclists, *Injury Prevention*, 16(supplement 1), A214-A215. NHTSA, 2012, Traffic Safety Facts, Bicyclists and other cyclists, 2010 data. Available at: <http://www-nrd.nhtsa.dot.gov/Pubs/811624.pdf> accessed on 29th November 2012. Rospa, 2012, Cycling accidents facts and figures for 2011. Available at: <http://www.rosipa.com/roadsafety/adviceandinformation/cycling/facts-figures.aspx> accessed on 29th November 2012.

[19] SECURING HAZARDOUS MATERIALS TRANSPORTATION: EUROPEAN UNION FRAMEWORK AND COUNTRIES' PECULIARITIES

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Huge amounts of hazardous materials are continuously being transported among some of the largest chemical clusters within Europe (e.g. Antwerp, Rotterdam, the Rhein-Ruhr region, Tarragona, etc.) and between Europe and the rest of the world. These transportation activities are subject to all kinds of safety and security risks and problems such as potential pollution, overuse of road and railway infrastructure, etc. In case of (even minor) incidents, dangerous freights strongly attract the attention of the general public, of policy makers and of industrialists. It is thus essential that these hazardous transports are made safe and secure and that they are organized as efficiently as possible across Europe. However, at present this is not the case and some key difficulties need to be overcome to advance the current European setting. Despite different existing European legislations for hazardous materials (e.g. ADR, RID, ADN(R), Seveso), European countries all have a country-specific risk policy and -culture and employ individual risk assessment methods (probabilistic, deterministic, quantitative, semi-qualitative, qualitative, etc.). Hence, transport risk assessments are carried out according to Member States' self-elaborated risk practices and as a result risk values and perceptions vary from country to country. However, hazardous transportation risks themselves do not change depending on the country. To ameliorate the efficiency and the effectiveness of risk communication, -perception, -prevention, -mitigation, etc. and making the risk assessment process regarding dangerous transports across Europe more transparent and objective, a European-wide accepted risk assessment concept/system should be developed, employed, maintained and coordinated at a supra-national level. Various conceptualisations and software packages (GIS-based or not) for dangerous freight risk assessments capturing one or several of the transport modes have been elaborated in different Member States (e.g. France: Global; Belgium: TRANS; Italy : several packages; The Netherlands: Basisnet; etc.) Nonetheless, due to a number of reasons, these software applications are rarely used by policy makers or indeed by the industry. For a novel risk assessment concept/system to be widely accepted, it should take into account the various existing Member States' risk cultures, the available risk assessment software packages, individual Member States' regulations and legislation on transportation of hazardous goods, various transport modes characteristics, cost-benefits of operational, tactical and strategic decisions, security issues for the different modes, etc. The study thus will be based on a multicriteria analysis that should lead to an accepted integrated risk assessment concept/system to be used throughout Europe for optimization of the chemical supply chain. The multimodal optimization process should take a variety of country-specific parameters/criteria of consideration into account: existing Safety and Security (S&S) policies/legislation, existing S&S software, existing S&S risk assessment practices, economic factors, logistics constraints, and sustainability topics. European societies as well as the chemical industry and its Logistics Service Providers would gain from a financial (optimized routes, smaller insurance premiums, etc.) as well as from an intangible (largely improved perception, avoidance of incidents, etc.) point of view.

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