IVe Institut für Verkehrswesen

DAVeMoS

BMK Endowed Research Group for Digitalisation and Automation in the Transport and Mobility System

Newsletter

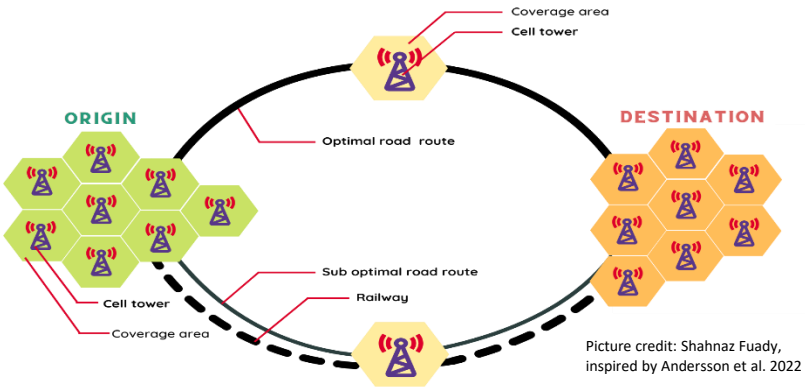
Newsletter Vol. 02/2022

DAVeMoS is an Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (*Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie*, BMK)'s Endowed Research Group with a mission to strengthen the competitiveness and knowledge building in the field of digitalisation and automation in the transport and mobility system at local, regional, national, and the EU levels.

Read more about DAVeMoS at:
www.davemos.online

Head of the group:
Univ. Prof. Dr. Yusak Susilo
yusak.susilo@boku.ac.at

Hosted by BOKU Institute for Transport Studies: www.boku.ac.at/en/rali/verkehr



Picture credit: Shahnaz Fuady, inspired by Andersson et al. 2022

1. Lessons from using GPS data for long-distance travel modelling

Utilising GPS data as an alternative solution for travel choice modelling is an inspiration that has been floating around for about a decade, if not longer. This wish has been triggered by a combination of different conditions, which include: (1) the realization of the importance of providing more individual-centric strategic planning and services, (2) the urgent needs for more detailed data to improve the quality of existing traditional models, (3) the declining of national surveys' participation rates, (4) the significant increase of sensor deployments in supporting transport infrastructure and (5) the raise of the use of communication devices and digitalised lifestyles which produced a stream of (by-product) information that can be utilized for detailed planning and individual-centred analyses purposes.

Whilst in the last 5-10 years there have been a number of companies providing information based on these datasets, only few, mostly within marketing and ICT service domain, used these data for modelling and forecasting. In transport domain, many studies that used large-scale passive data to extract travel patterns provide only very limited validation. Even then, the validation is often only performed on a very aggregated level, leaving open questions concerning the quality of the individual level outputs (Chen et al., 2016).

To take a step forward on this matter, I would like to share a reflection based on one of the outputs of DEMOPAN project (Kristoffersson et al., 2022) where I was part of the original team that was tasked by the Swedish Transport Administration to see how mobile network data can be used to estimate forecast models for choice of means of transport, in particular for long-distance journeys, a type of journey which we rarely have enough evidence on through our regular national travel surveys. *(...)*

Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie
FFG Forschung wirkt.
Stadt Wien
LAND NIEDERÖSTERREICH
LAND SALZBURG
WIENER LINIEN
WIRTSCHAFTS FORUM WALD VIERTEL

One of the tasks within this project is to develop methods to identify, from antenna connections, the start zone, destination zone, time and most likely means of transport of the long-distance journeys. The works should be able to be carried out without the data leaving the mobile operator's servers and has therefore been able to make use of more detailed data on antenna connections.

During this activity, it was learned that to achieve this objective, the right setup needed to allow executing queries needed to process the data, including spatial queries and GIS operations, at the very beginning of the work, are very essential. This means it is important to understand the characteristics of the data, prior to designing a data processing method. First, such data processing framework, should not only allow data visualization, but also flexible analysis options. Second, the setup needs to allow for the processing of large-scale datasets in a reasonable time. Third, the setup needs to preserve the privacy of individuals. Fourth, the results should be reproducible, and it needs to be transparent how the results have been produced (Breyer et al., 2020, 2021).

To preserve individual privacy when processing large-scale passive data, the approach of “bring the code to the data” was adopted and only the aggregated results that do not allow to draw any conclusions about individuals are exported. For debugging and verification of the code, a second server, with a small sample dataset was used for development purposes.

The results from this work (Breyer, 2021) show that trips can be identified from mobile network data and classified as road-, rail- or airborne with high accuracy. That is said, it also exposed two main limitations of using large-scale passive data for travel pattern analysis. First, the nature and quality of the data matters. All datasets are limited by their resolution in time and space. Understanding this is very crucial to understand whether such a dataset is able to help us to capture very short trips reliably in areas where the cell density is low. If not, perhaps using such datasets for micromobility users’ route choice analysis, for example, may not be a straightforward exercise.

Second, even though large-scale passive data sources cover large portions of the population, by the end of the day, those traces are from sensors owned by a particular group of travelers only. Whenever the number of samples is not abundant enough, there will always be a risk of sample bias, which, due to the nature of the dataset, would be difficult to control and to be statistically corrected.

Nevertheless, such a dataset allows us to analyse individuals’ travel choices based on observations in a large scale. Furthermore, given that a large scale of sensors are already spread and installed in the society (as smartphones), the data can be updated much easier than, for example, deploying another large scale travel survey.

For further read of works, you can refer to:

Kristoffersson, I., Andersson, A., Börjesson, M., Rydergren, C., Breyer, N., Gundlegård, D., Engelson, L., Susilo, Y., Daly, A. (2022) DEMOPAN Skattning av prognosmodell för färdmedelsval för långväga resor baserat på mobilnätsdata, Swedish Transport Administration.

Breyer, N. (2021). Methods for Travel Pattern Analysis Using Large-Scale Passive Data. (Doctoral dissertation). Linköping: Linköping University Electronic Press.

Yusak Susilo

References:

Chen, C.; Ma, J.; Susilo, Y.; Liu, Y.; Wang, M. (2016). The promises of big data and small data for travel behavior (aka human mobility) analysis. Transportation research part C: emerging technologies, 68:285–299.

Breyer, N. (2021). Methods for Travel Pattern Analysis Using Large-Scale Passive Data. (Doctoral dissertation). Linköping: Linköping University Electronic Press.

Breyer, N., Gundlegård, D. & Rydergren, C. (2021). Travel mode classification of intercity trips using cellular network data. In: Transportation Research Procedia: . Paper presented at 23rd Euro Working Group on Transportation (pp. 211-218). Paphos, Cyprus: Elsevier.

Breyer, N., Rydergren, C. & Gundlegård, D. (2020). Comparative Analysis of Travel Patterns from Cellular Network Data and an Urban Travel Demand Model. Journal of Advanced Transportation, Article ID 3267474.

Kristoffersson, I., Andersson, A., Börjesson, M., Rydergren, C., Breyer, N., Gundlegård, D., Engelson, L., Susilo, Y., Daly, A. (2022) DEMOPAN Skattning av prognosmodell för färdmedelsval för långväga resor baserat på mobilnätsdata, Swedish Transport Administration.

Andersson, A., Engelson, L., Börjesson, M., Daly, A., & Kristoffersson, I. (2022). Long distance mode choice model estimation using mobile phone network data. Journal of Choice Modelling, 42.

2. Public transport annual ticket ownership model for metropolitan commuters in Eastern Austria

Metropolitan commuting is one of the major challenges for sustainable transport in Austria. Higher shares of sustainable modes are desired and targeted in numerous policies and programs. Introducing subsidized public transport (PT) annual tickets is one of the most popular transport policies, at least in central Europe (365 € ticket in Vienna, Klimaticket, pass for regional PT in Germany, etc.). Previous studies have shown that the ownership of mobility tools (like a vehicle or a PT annual ticket) is a highly significant determinant for the mode use, as this represents a commitment to specific travel modes through long-term financial investment (Busch-Geertsema et al. 2021). E.g., owning a car makes it much less likely to use PT on a regular basis. Despite this importance, very few studies focus on determinants of mobility tool ownership, even less on the ownership of PT annual tickets. The ones that do exist, typically only provide person/household and generic built environment/infrastructure data to explain ownership, whilst alternative-specific trip data & information on commuting trips is often not available.

The study area is the wider Vienna metropolitan region ("Ostregion"), consisting of the federal states of Vienna, Lower Austria and Burgenland, comprising about 3.9 million inhabitants (44 % of Austria's population). In 2010, 79 % used car, 21 % PT for trips to Vienna (Rittler 2010). For PT commuters, cars and bicycles play an important role as feeder modes to the train (Park & Ride (P+R), Bike & Ride (B+R)).

The core data of this study consists of a full data set on the share of PT annual ticket holders amongst commuters to Vienna on the municipal level. The main interest of the work is to identify what supply- and demand-related attributes determine the ownership of public transport annual tickets and in which way.

For each commuting relation (from sub-municipal "Zählsprengel" within metropolitan municipalities to the respective district in Vienna), detailed mode- (car, PT, P+R) and trip-specific information (travel times, changes, intervals) are queried via routing services VAO and Google Maps API. Together with aggregated socio-demographic and spatial variables, these data are fed into a discrete choice model, where the ticket share per observation/municipality is the dependent variable and also handled as a choice weight.

In this model, confounding effects are eliminated, that means correlations between variables (strong e.g. between education level and income) are controlled for and the resulting effects stem only from the respective variables themselves.

Table 1 shows preliminary results of the strongest determinants for two models. Model a considers only supply and trip-related variables, whereas model b includes sociodemographic and spatial variables aggregated on municipal basis as well.

Table 1: Preliminary results on strongest determinant variables of PT annual ticket share for two models

Model a) only supply/trip variables		**Model b) all variables included**	
Min. trip duration of P+R trip's car portion	-	Population share with secondary education	-
PT trip's in-vehicle duration	-	Avg. commuting distance	+
PT frequency	+	PT trip's in-vehicle duration	-
Min. trip duration by car	+	Min. trip duration of P+R trip's car portion	-
Parking management at destination	+	Population share 15 to 64 years	-

Thus, preliminary implications are to minimize the feeder portion of P+R trips with dense, PT-oriented spatial development and a high density of stations. Fast PT and a high frequency play a similarly large role.

Demand-wise, further implications of this study may be the specification of target groups (e.g. people with secondary education) for PT marketing/awareness campaigns. To find out about personal attitudes and motivation within these groups, dedicated surveys could be of interest for future research.

The work was presented at NECTAR 2022 conference in Toronto (Canada) in July.

Martin Hinteregger,
Maria Juschten & Reinhard Hössinger

References:

Busch-Geertsema, A., Lanzendorf, M., & Klinner, N. (2021). Making public transport irresistible? The introduction of a free public transport ticket for state employees and its effects on mode use. Transport Policy, 106(April), 249–261.

Rittler, C. (2010). Kordonerhebung Wien in den Jahren 2008-2010. URL https://www.planungsgemeinschaft-ost.at/studien/ansicht/detail/studie/kordonerhebung-wien-in-den-jahren-2008-2010

Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie
FFG Forschung wirkt.
Stadt Wien
LAND NIEDERÖSTERREICH
LAND SALZBURG
WIENER LINIEN
WIRTSCHAFTS FORUM WALD VIERTEL

3. The urgency to capture activity participation beyond physical realm

" … with your phone, you won't have to venture that far because we can bring almost anything to your doorstep with food, mart, and express deliveries." – Grab (2022)

Information and Communication Technology (ICT) advancement has opened various opportunities on new economy, creating new jobs, and providing various activities engagement alternatives. Mokhtarian and Tal (2013) have underlined that the impacts of ICT to travel activities are myriad and complex and the concern is getting higher with more mobile phone applications available for doing various activities, even for ones unthinkable of previously. In 2020, there were already more than 8.9 million mobile apps available in the market (Koetsier, 2020).

With time and cost saving, convenience, and more available opportunities/alternatives (i.e., products, brands, etc.), more people are participating in activities virtually, instead of physically. Now some people prefer to buy various things on the internet or have an online rather than physical meeting (Asgari & Jin, 2017; Baert et al., 2020). Given the complexities that these virtual activities bring and the fast changes occurred in society in adopting such virtual-based living, there are concerns on the reliability of the previous transport planning modelling or data collection procedures.

The cross-sectional (data collection at a specific point in time) or longitudinal (over a period of time) are the notable methods for existing travel behaviour research.

These methods have been modified to capture the changes in human daily activities due to the social or cultural changes or new technological advancement. However, to date, most of our data collection activities fail to capture the interaction between virtual and physical activities on the nowadays heavily present daily travel activity.

To understand this further, over the summer 2022 period, DAVeMoS deployed a cross-dimension one-week time and app use survey. The survey is observing combinations of virtual and physical daily activities, the impact of mobile app use on daily travel activities, and multitasking behaviour. To comprehensively capture the individuals' behavior, the survey also registers the details of subjective and objective characteristics (i.e., motivation and personality traits) and external environmental characteristics (i.e., built environment) along with details of their daily activities (virtual and physical) and travel.

The survey took place in the two Indonesian cities Denpasar and Bandung, which differ in population size and economic activity. Indonesia is one of the countries with the highest mobile phone market penetrations in the world (Newzoo, 2020) and home to a number of "super-apps". Therefore, conducting studies on the impact of mobile app use on travel activities in Indonesia is very relevant.

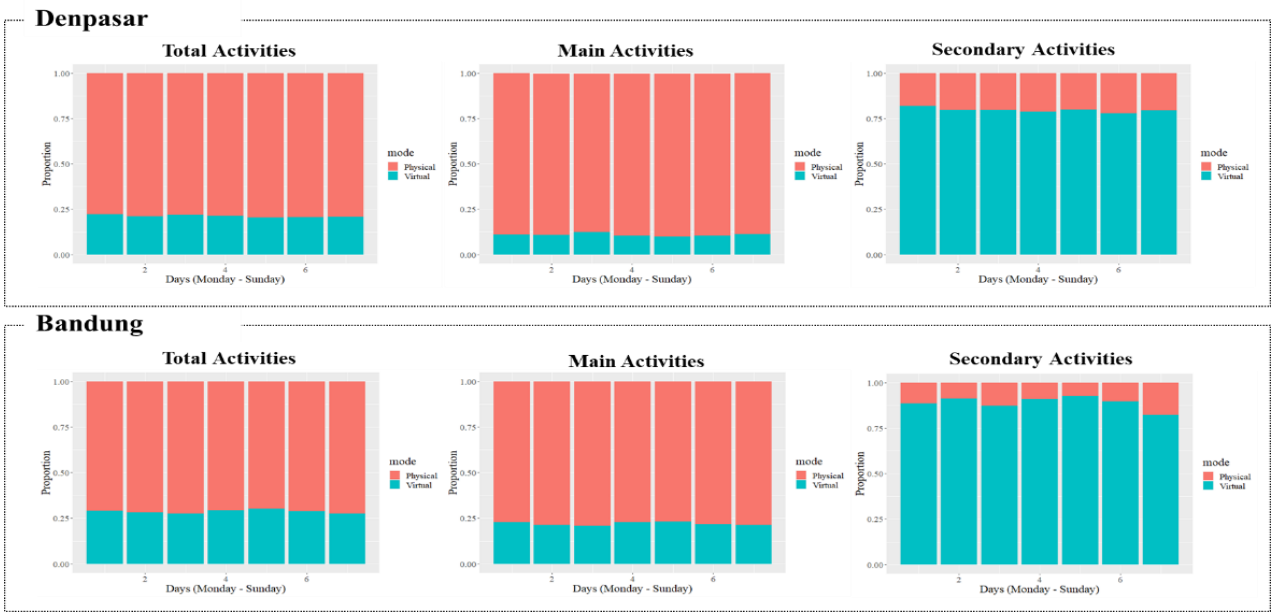


Figure 1. Proportion of virtual and physical activities duration for Denpasar (N=135) and Bandung (N=105)

The survey started in May 2022 after a pilot phase in April. By July 2022, after a series of validation, we collected data from 240 respondents over 18 years, which is only 31% of the total respondents approached from both cities. The low success rate underlines the complexities to capture longitudinal and multi-dimension time and app use diary.

It was reported that the virtual realm had a major role in secondary activities and was most likely to be used for leisure and maintenance rather than mandatory activities. The average duration of virtual and physical activities was relatively similar. Preliminary results show that virtual activities contributed to 18–30% of individuals' total daily activities. Respondents who have utilitarian and/or hedonic motivations on using the app tend to contribute on generating travel. The app use for leisure activities is reported to less likely replace travel than app use for maintenance activities. The app also reported to be a platform to comparing products before performing out-of-home activities. With that result, it is underlined that virtual activities hold important part in individuals' daily activities and how ICT facilitate the reduction and generation of travel.

Muhamad Rizki and Yusak Susilo

References:

Asgari, H., & Jin, X. (2017). Impacts of Telecommuting on Nonmandatory Activity Participation: Role of Endogeneity. Transportation Research Record, 2666(1), 47–57. https://doi.org/10.3141/2666-06

Baert, S., Lippens, L., Moens, E., Weytjens, J., & Sterkens, P. (2020). The Covid-19 Crisis and Telework: A Research Survey on Experiences, Expectations and Hopes (SSRN Scholarly Paper ID 3596696). Social Science Research Network. https://papers.ssrn.com/abstract=3596696

Grab. (2022). Grab Superapp. Apple Store. https://apps.apple.com/ma/app/grab-superapp/id647268330

Koetsier, J. (2020). There Are Now 8.9 Million Mobile Apps, And China Is 40% Of Mobile App Spending. Forbes. https://www.forbes.com/sites/johnkoetsier/2020/02/28/there-are-now-89-million-mobile-apps-and-china-is-40-of-mobile-app-spending/

Mokhtarian, P. L., & Tal, G. (2013). Impacts of Ict on Travel Behavior: A Tapestry of Relationships. The SAGE Handbook of Transport Studies, 241–260.

Newzoo. (2020). Top Countries/Markets by Smartphone Penetration & Users. Newzoo. https://newzoo.com/insights/rankings/top-countries-by-smartphone-penetration-and-users

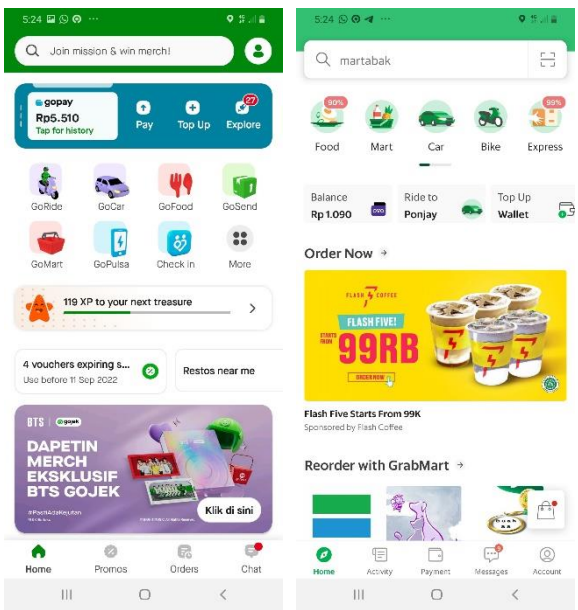


Figure 2. A SuperApp, a multi-purpose, multi-function app which enables users to execute multi-tasking activities and virtually travel and complete multiple interactions simultaneously

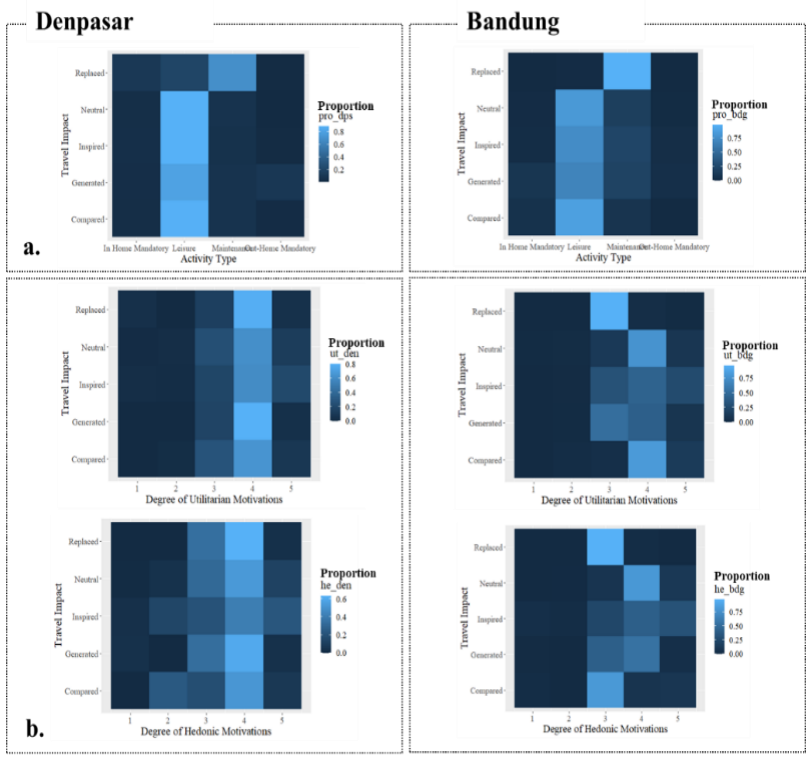


Figure 3. Heatmap impact of mobile apps to travel a.) per activity type; b.) per motivation

Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie
FFG Forschung wirkt.
Stadt Wien
LAND NIEDERÖSTERREICH
LAND SALZBURG
WIENER LINIEN
WIRTSCHAFTS FORUM WALD VIERTEL

4. What would e-commerce bring to us and our cities? Do we have to continue clicking?

Many people do not realize the significance and importance of freight transport to their daily life and to the transport network in general. For example, during morning peak hours in Vienna, freight traffic reaches 12.5%, contributing to traffic congestion (Kummer et al., 2021). The growth of e-commerce significantly contributed to freight traffic. Thus, according to the Statista portal, the total revenue due to online food delivery in Austria reached 617 million USD in 2021 and is expected to be over 1.2 billion USD by 2027 (Statista, 2022). The same situation is observed in the parcel deliveries sector. The total volume of parcels delivered within Austria grew from 160 million in 2012 to 323 million in 2020 (Statista, 2021). The Austrian online market comprises a large number of online stores, and the top 10 of them are presented in Figure 1.

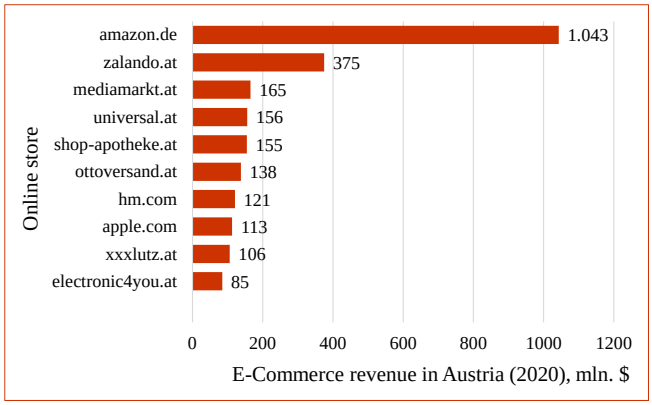


Figure 1. Top online stores' net sales in Austria in 2020 (source – www.statista.com)

Online shopping has become an everyday activity for the vast majority of people around the globe. The Austrian consumers are not an exception. The number of e-shoppers has changed dramatically during the last decade, and COVID-19 contributed to that.

The sample-based surveys show that about 50% of Austria's population already use the online channel. In doing so, service's quality and price play an important role in influencing consumers' decisions (Figure 2). Such a possibility, on the one hand, can provide better consumer-oriented service and can generate more economic activities. However, on the other hand, the consumers and society may not realise the negative direct and wider impacts of such activities to the environment and society in general.

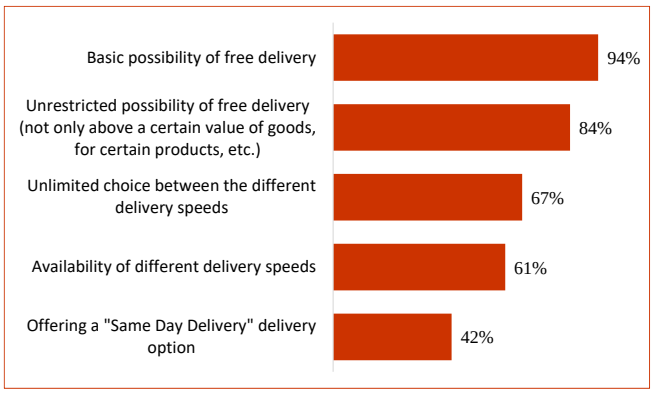


Figure 2. Main factors that attract online shopping in Austria (source – www.statista.com)

The number of delivered parcels in Austria doubled from 2012 to 2020 (Figure 3). Such an amount of delivered parcels without a doubt generated new traffic, not only in main roads, but also in residential areas, which not only negatively influenced the environment, but also increased the traffic safety risk in local neighbourhoods.

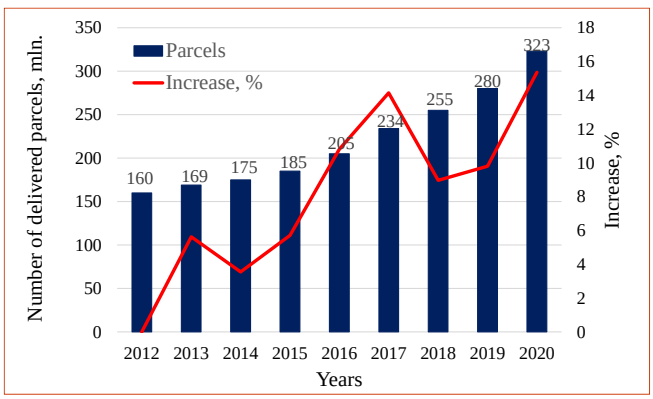


Figure 3. Number of parcels delivered in Austria from 2012 to 2020 (source – www.statista.com)

Such impacts of freight traffic beg a serious attention, in particular as the scale of such problems will keep increasing with the raising of digitalisation. A decision support tool that allows us to estimate the traffic situation during the day hours and predict the possible direct and indirect costs due to e-commerce growth is needed. The reduction level of livability can only be demonstrated and evaluated on a system-wide simulation exercise.

Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie
FFG Forschung wirkt.
Stadt Wien
LAND NIEDERÖSTERREICH
LAND SALZBURG
WIENER LINIEN
WIRTSCHAFTS FORUM WALD VIERTEL

The DAVeMoS team at BOKU is now working on developing the agent-based model in MATSim software for the eastern Austria region. The model's current state allows the DAVeMoS team to simulate private cars, public transport and bike mobility on the loaded network. But the developed platform can be enhanced with other forms of mobility, and freight transport is very important in this case. The simulations can provide us with a list of parameters from the traffic distribution (an example for Germany is presented in Figure 5) to environmental pollution estimates.

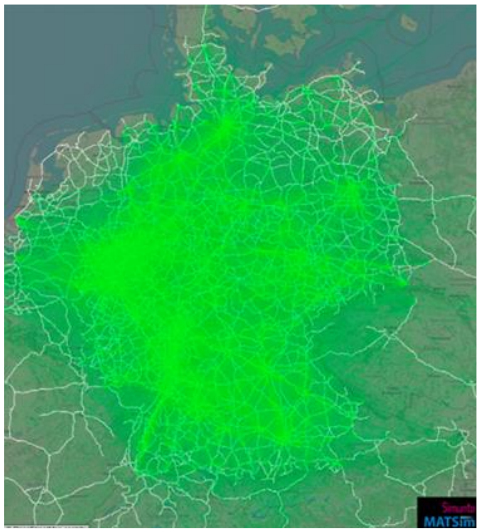


Figure 5. Illustration of long-haul freight traffic for Germany based on MATSim simulation (source – Lu et al., 2022)

The information on transport system infrastructure and vehicles leveraged for the delivery process allows us to assess different scenarios, which provide insights on what may happen and what should be done to prevent it. New technologies for last-mile delivery services like automated parcel lockers (APL) are supposed to reduce the negative impact of e-commerce on the urban environment (Lachapelle et al., 2018). Currently, the studies in this area focus on the behavioral sides of the APL systems deployment, e.g., revealing the readiness of consumers to use it (Vakulenko et al. 2018). However, the question of "how it will influence the urban environment" is still not solved. The agent-based modeling is one of the possible ways to reveal it, and the DAVeMoS team at BOKU is encouraged to implement it.

Oleksandr (Alexander) Rossolov

References:

Kummer, S., Hribernik, M., Herold, D. M., Mikl, J., Dobrovnik, M., Schoenfelder, S. (2021). The impact of courier-, express- and parcel (CEP) service providers on urban road traffic: The case of Vienna. Transportation Research Interdisciplinary Perspectives, 9, 100278.

Lachapelle, U., Burke, M., Brotherton, A., Leung, A. (2018). Parcel locker systems in a car dominant city: Location, characterisation and potential impacts on city planning and consumer travel access. Journal of Transport Geography, 71, 1-14.

Vakulenko, Y., Hellström, D., Hjort, K. (2018). What's in the parcel locker? Exploring customer value in e-commerce last mile delivery. Journal of Business Research, 88, 421-427.

Lu, C., Martins-Turner, K., Nagel, K. (2022). Creating an agent-based long-haul freight transport model for Germany. Procedia Computer Science, 201, 614-620.

5. New research team members

EVA-MARIA UNGER, B.Sc., is the newest student assistant at DAVeMoS. Eva-Maria Unger supports DAVeMoS in the area of research and updating the "Knowledge Pool". She is currently writing her master's thesis with the working title "digital infrastructures for traffic management in the city of Vienna", focusing mainly on intelligent traffic solutions for cyclists.

MARIA LUCIA BATTISTINI is a statistics student from the University of Bologna, Italy, who is currently working with Dr. Fidler and Mr. Su on biometric data, to better understand the decision-making process for micromobility users. Her main research interests are consumer behavior analysis and methodological statistics for social and economic applications.

6. Change of Travel Time Ratios (TTR) due to COVID-19 Pandemic in Austria

This study is based on a survey of a 7-days' travel and time-use diary in Austria that has been conducted in three waves before and during the COVID-19 pandemic. To assess the trade-off between travel time and activity time required for a person to perform a specific out-of-home activity at a specific location, the DAVeMoS team examined travel time ratios (TTR) in one pre-pandemic and two pandemic phases. The TTR expresses the travel time required by one unit of activity time at the destination. All observed journeys were classified in five types (Figure 1). Base locations (B) are those where it is assumed that people are not free to choose where and possibly also when to go; this is typically true for their home, work place and/or school.

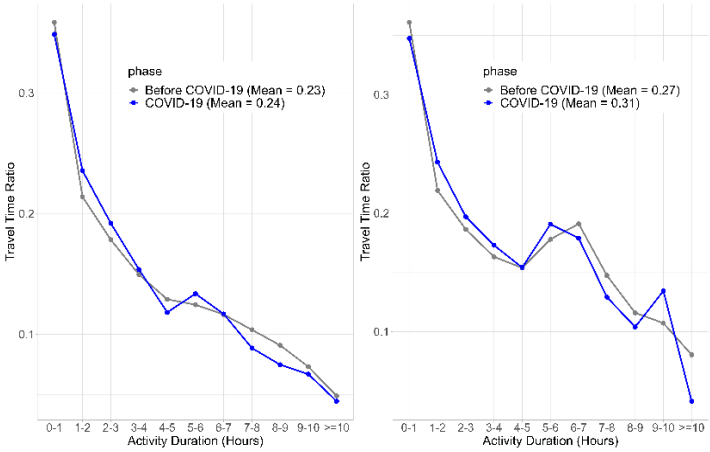


Figure 2. Travel Time Ratio (TTR) for all activities (left) and discretionary activities of male respondents (right)

While it is well-known that the number of journeys largely decreased during COVID-19, this applies even more to the activity duration that people spent out of their base (home, work, or school), as indicated in the left part of Figure 2. The overall TTR for all activities increased during COVID-19 by 4 percent on average, which means that the respondents either visited more remote destinations, used slower travel modes to go there (walking or cycling instead of motorized modes), or spent less time at the destination. A closer look reveals that the TTR increased particularly for activity durations between 1 and 4 as well as 5 and 6 hours. The changes can be significantly larger for some activity types and/or person groups. As an example, the right part of Figure 2 shows the TTR of discretionary activities (excluding home, work and school) of male respondents; it increased by almost 15 percent (from 0.27 to 0.31).

The analysis revealed further changes in the TTR not shown in the figure: it increased significantly during COVID-19 among individuals with ages between 24 to 39 or more than 60 years, with a high school or university degree, with an income between 1,000 and 5,000 Euros, as well as students and self-employed persons. With respect to activity types, it increased for journey type 1 and type 2 (home-based) as well as type 3 (H-S-H) by 4.3 %, 8.5 %, and 21.7 %, respectively. There are only few results which indicate a decrease of the TTR, i.e. less travel duration by unit of activity duration during COVID-19: journey types 3 (H-W, W-H, H-S-H) and type 4 (H-W) show a significant decrease of 21.7%, 29.1%, 16.6%, and 28.2%, respectively. This means that for these journey types, people choose to either spend more time at the destination, seek a closer location, or choose a faster travel mode. The model further revealed that socio-demographic, travel-related, household, and land-use characteristics also affected the TTR during COVID-19, causing significant in both directions.

Anugrah Ilahi,
Yusak Susilo,
Reinhard Hössinger

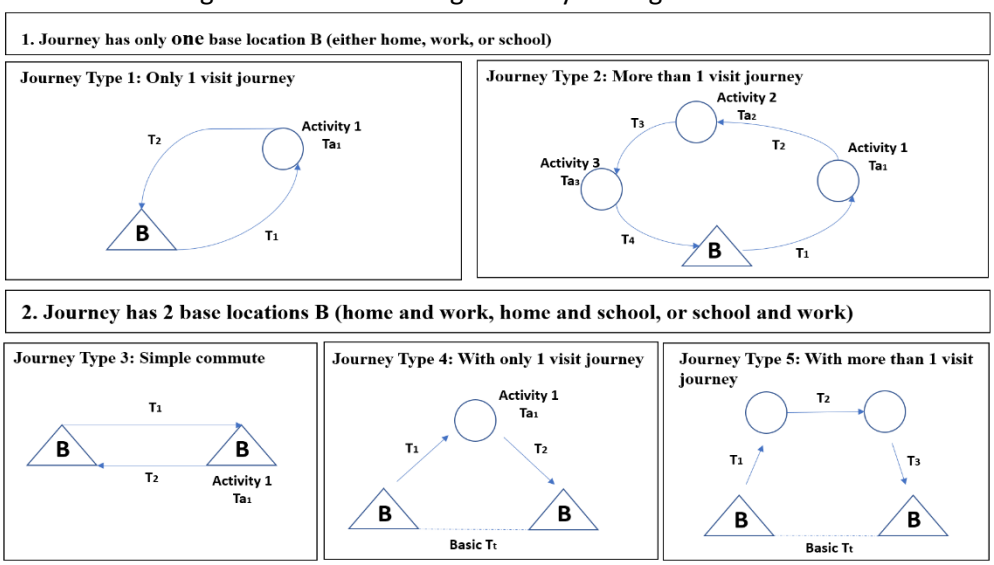


Figure 1: Calculation of the TTR by type of journey (Ilahi et al. 2022)
B = base activity, which can be home (H), work (W), or school (S)

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie
FFG Forschung wirkt.
Stadt Wien
LAND NIEDERÖSTERREICH
LAND SALZBURG
WIENER LINIEN
WIRTSCHAFTS FORUM WALD VIERTEL

7. Satisfaction with demand-responsive public transport systems in Salzburg

Almost one-third (30.6%) of Europe's population lives in rural areas. Rural areas and overall areas with lower population density quite vastly suffer from decreased accessibility to mobility offers (European Commission, 2019). Demand-responsive transport (DRT) systems have been mentioned as a solution to the increased mobility burden in non-urbanised areas (Velaga et al., 2012).

In this project, we investigate the potential of demand-responsive transport (DRT) systems in non-densely populated areas in Austria. The aim of the project is to explore the parameters that impact the level of usage of DRT services in such areas. For users of a service of any type, the level of satisfaction with the experienced service influences the intention to use the service again in the future (Lierop et al., 2016). Thus, we focus on the recognition of the factors which influence the satisfaction level of passengers of on-demand systems.

To gain insight into the aforementioned determinants of satisfaction, we analyse two different services in rural/suburban areas in the state of Salzburg, Austria. Although the two services share some common characteristics, they differ in terms of operations. One service is "station-flexible" between the desired address and designated places (e.g. city center, train station) with a fixed timetable (*W3Shuttle*) whereas the second system (*WalsieBus*) is a (virtual) station-based (stop-to-stop) service with a flexible timetable.

The analysis is based on survey data that were collected on both DRT systems in autumn and winter 2021/2022. Survey responses were gathered from both residents and tourists/visitors of the study areas. The overall level of satisfaction with services and individual aspects of it such as punctuality, safety, security, and cost are registered in Likert items, ranging from 1 (very dissatisfied) to 5 (very satisfied).

In Figure 1, the distribution of the satisfaction level reports for the service overall as well as for the individual service aspect is presented. Most passengers declared medium to high satisfaction with the DRT services overall. However, there is a differentiation in the level of satisfaction with the various service aspects. For example, while satisfaction with waiting time is very high among passengers of the flexible timetable with fixed stops service, travellers of the fixed timetable with flexible stops system are less satisfied with the waiting time for the next vehicle. On the contrary, the flexible stops system is rated higher in terms of the number of destinations that people can reach. The latter could be attributed to the high flexibility in terms of pick-up / drop-off locations that the service offers.

The overview of the satisfaction ratings with the various items reveals the weakest service aspects which could be prioritised in future service changes. Nevertheless, it does not provide insight into how each aspect affects overall satisfaction with the DRT services. For this purpose, we use correlation and regression analysis.

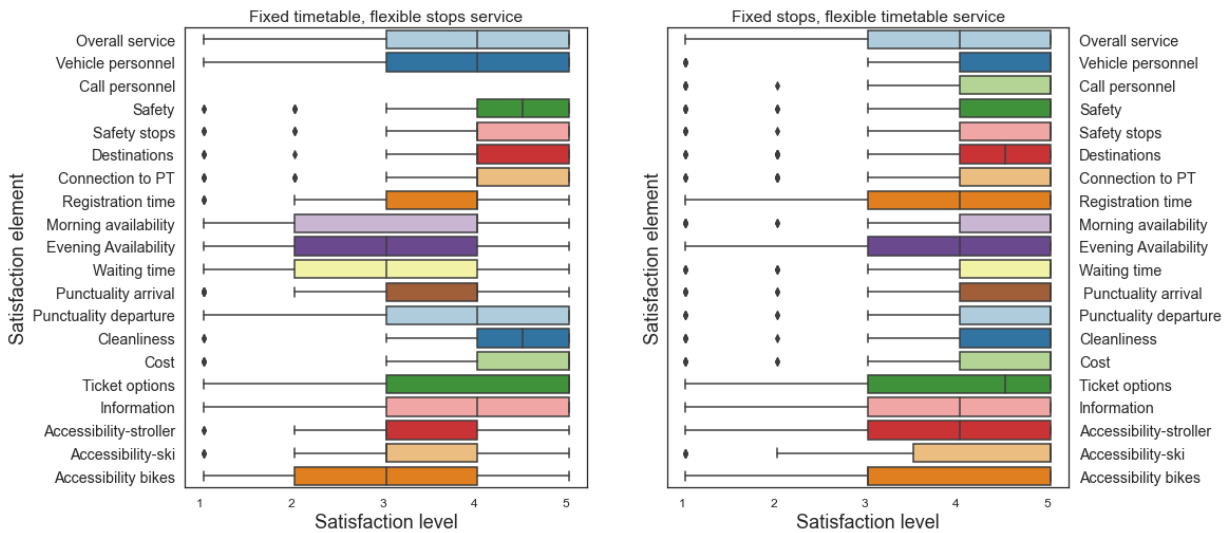


Figure 1. Overall satisfaction and satisfaction with service attributes for two on-demand systems in rural areas

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie
FFG Forschung wirkt.
Stadt Wien
LAND NIEDERÖSTERREICH
LAND SALZBURG
WIENER LINIEN
WIRTSCHAFTS FORUM

In Figure 2, the correlation between overall satisfaction and satisfaction with the respective service aspects is visualised. The figure refers to the flexible timetable service (*WalsieBus*). It is noticed that the degree that passengers are satisfied with the service overall is strongly (>0.3) and positively related to their satisfaction with the various system items.

For regression, logistic regression is applied with overall satisfaction as the dependent variable. Apart from service aspects, sociodemographic characteristics (gender, age, income), mobility habits (driving, public transport frequency), and the relationship to the study area (tourists vs. locals) are included in the model as potential determinants of the overall satisfaction with DRT systems.

The regression estimation reveals that individual characteristics do not significantly affect satisfaction with demand-responsive transport systems. In contrast, people who are used to travelling by public transport in their everyday life, tend to report higher satisfaction with the service provided by on-demand transport. Regarding the service attributes, aspects related both to the overall organisation of the system and the quality of the service offered per trip are significant predictors of overall satisfaction.

The project team will soon publish a paper in which the findings of the satisfaction analysis are discussed further. Stay tuned!

Roxani Gkavra, Yusak Susilo, Roman Klementschitz

References:

European commission. EU rural areas in numbers. URL https://ec.europa.eu/info/strategy/priorities-2019-2024/new-push-european-democracy/long-term-vision-rural-areas/eu-rural-areas-numbers_en#key-data-by-topic

Velaga, N. R., M. Beecroft, J. D. Nelson, D. Corsar, and P. Edwards. Transport poverty meets the digital divide: accessibility and connectivity in rural communities. Journal of Transport Geography, 2012. 21: 102-112.

Lierop, D. Van , and A. El-Geneidy. Enjoying loyalty: The relationship between service quality, customer satisfaction, and behavioral intentions in public transit. Research in Transportation Economics, 2016. 59: 50-59.

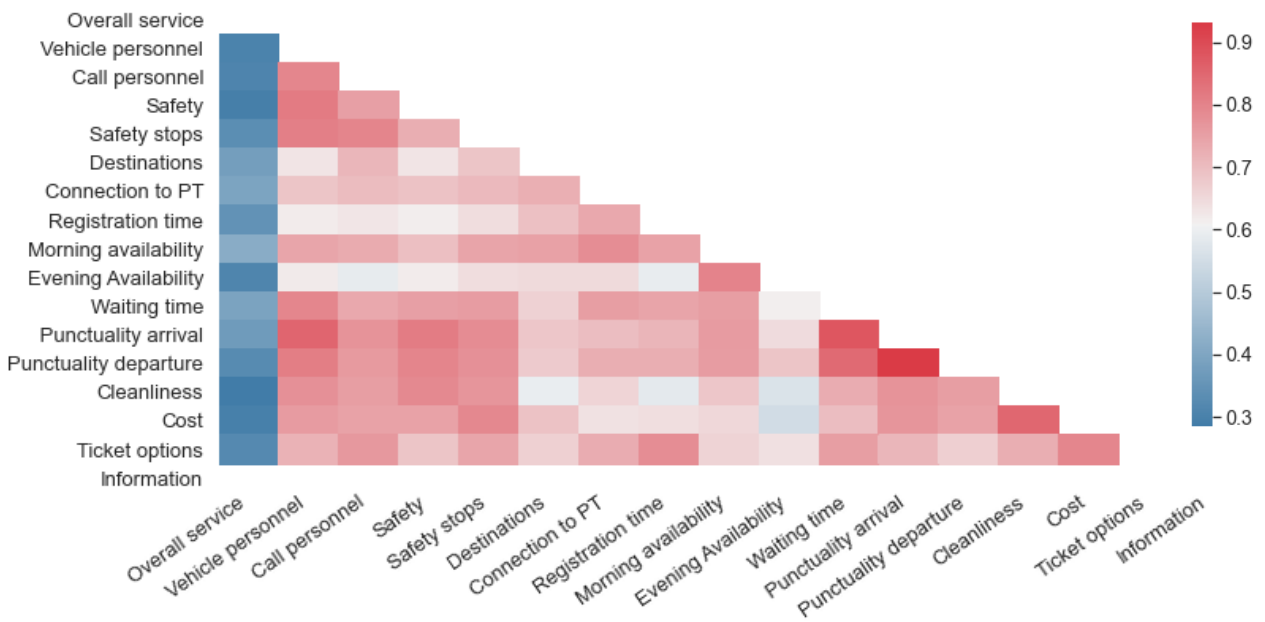


Figure 2. Correlation between overall satisfaction and satisfaction with service aspects for a flexible timetable, fixed stops DRT system

Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie
FFG Forschung wirkt.
Stadt Wien
LAND NIEDERÖSTERREICH
LAND SALZBURG
WIENER LINIEN
WIRTSCHAFTS FORUM WALD VIERTEL

8. SmartHubs International Symposium

SmartHubs is an international project examining mobility hubs, dedicated on-street locations where people can choose from different shared and sustainable mobility options.

On 16 September 2022 an international symposium was co-organized and participated by DAVeMoS team members at Seestadt Aspern (Vienna). Main topic of the event was the discussion on governance of multi-modality in public space and the options we have. The event was opened with key note statements of representatives from the Austrian Ministry of Climate Protection (BMK) and the Wien 3420 aspern Development AG.

After the welcome statements presentations were provided by Austrian stakeholders dealing with mobility hubs in urban and rural context including practical examples: (a) shared mobility concept in Vienna, (b) multimodal hubs in Salzburg and (c) mobility stations in Lower Austria (project *LISA*).

After the introduction of the SmartHubs project and its envisaged outcomes, participants had the opportunity to discuss in parallel workshops tools and guidelines to assess mobility hubs currently developed in the SmartHubs project:

(1) Appraisal tool for sustainability and stakeholder assessment
(2) Accessibility tool for mobility hubs in the urban space
(3) Resilience tool to assess accessibility, connectivity, and network resilience
(4) Public debate and citizen participation

As Aspern Seestadt is one of the largest development areas in Europe, a guided walking tour was finally offered to participants in order to introduce and discuss modern concepts of new city development.

Oliver Roider

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie
FFG Forschung wirkt.
Stadt Wien
LAND NIEDERÖSTERREICH
LAND SALZBURG
WIENER LINIEN
WIRTSCHAFTS FORUM WALD VIERTEL

9. Notes from FSV seminar “New Mobility – New Questions – New Models”

The DAVeMoS team co-organised the FSV Planning Seminar 2022 with the theme New Mobility - New Issues - New Models, which took place in Waidhofen/Ybbs on 5 and 6 May 2022.

Just like last year, the team in cooperation with the Austrian Research Association for Roads, Railways and Transport (FSV) contributed to the success of the event in 2022. This year, the planning seminar was dedicated to the topic of traffic models. These should represent the transport system in the best possible and most comprehensive way, but also be able to show the consequences of interventions or developments. In this way, they create a basis for foresighted planning and steering of the transport system in a desired direction. In recent decades, however, it can be observed that the transport system has become more complex, new forms of mobility and new services have emerged, but also new lifestyles and new strategies for the regulation of the transport system. Transport models must be able to take these developments into account in order to be fit for the future. Technical progress also opens up new possibilities for traffic models. More powerful computers, more precise and more comprehensive information enable further developments in this field. This can be done by refining or improving existing models, but also by completely new approaches to modelling the transport system.

In addition to the programme design and moderation by the DAVeMoS team, our guest professor Gunnar Flötteröd from Linköping University, gave a presentation on the transport policy benefits of different configurations of activity-based models from the perspective of Sweden. Building on the ten keynote presentations, this year's seminar discussed the consequences, possibilities and limits of transport model application in daily practice. As usual, this very well-attended event lasted two half-days and consisted of a mix of keynote presentations, workshops and group discussions reflecting on them.

Roman Klementschitz

10. The Institute for Transport Studies' 30 + 2 years celebration

In September 2022, DAVeMoS team, as a part of the Institute for Transport Studies (IVe), celebrated the 30th+ anniversary of its existence as well as the move into the newly-built Ilse-Wallentin-Haus that was postponed since 2020 due to the pandemic.

The celebration has been spread over two days. On 15 September an official ceremony took place that was well-attended by guests from the ministry, long-standing collaboration partners of the institute, emeritus professors and former staff members. The event was opened by the head of the institute, Prof. Astrid Gühnemann, followed by the speech from BOKU's Vice Rector for Finance and Infrastructure, Nora Sikora-Wentenschuh.

Next, Wolfgang J. Berger provided an interesting overview of the personnel as well as teaching activities carried out within the institute along the years. Next, in his presentation, Michael Meschik reflected on how transport research within the institute evolved with time, from being a rather narrow, engineering-focused discipline to a more socially oriented and much broader scientific field.

Finally, Prof. Susilo in his presentation provided insights into the current research activities carried out by IVe. The interlude between the presentations and the subsequent panel discussions was filled with live music performed by the *Presto Saxophon Quartett*.

The panel discussion titled 'Looking ahead - teaching and research for the transport system of the future' was moderated by department head Prof. Gernot Stöglehner while the podium speakers were Martin Eder from the Ministry of Climate Protection (BMK), Werner Pracherstorfer from Lower Austria's state government, traffic psychologist Bettina Schützhofer from sicher unterwegs GmbH, BOKU student Gregor Husner and IVe's head, Prof. Astrid Gühnemann. After the official ceremony, the guests were invited for an institute tour.

On 16 September the festivities continued in a more informal setting, together with family and friends, where everyone enjoyed delightful food, music and group games.

Martyna Fidler

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie
FFG Forschung wirkt.
Stadt Wien
LAND NIEDERÖSTERREICH
LAND SALZBURG
WIENER LINIEN
WIRTSCHAFTS FORUM

11. Lange Nacht der Forschung (Long Night of Research)

On 20 May 2022 a nationwide initiative called *Lange Nacht der Forschung* (LNF) took place. LNF is a biannual event that gives an opportunity for the general public to experience research and science first hand and in a fun way. This year the LNF programme featured 2700 exhibits across Austria, among them was a research station prepared and operated by DAVeMoS team members. The station featured a virtual reality headset and a customised e-scooter which participants used to ride in the simulated scenarios situated in the familar context of Viennese inner city.

The station attracted numerous visitors interested in the use of augmented technologies in the scientific research and those who were willing to experience the immersive environments for the first time. The virtual rides seemed particularly popular among the younger audience who gathered in great numbers around the station. Overall, the event was enjoyed by visitors and researchers alike and we are looking forward to meet the public again during next edition in 2024!

Martyna Fidler

12. Invitation: DAVeMoS Day 2022, 28 November 2022, 13.30-16.00

One of DAVeMoS' initiatives to stimulate research exchanges and collaborations between stakeholders and researchers is to host a DAVeMoS day, where we dedicate a few hours to hear and discuss different study outputs in digitalisation and automation related topics.

This year, DAVEMoS Day will be held on 28 November 2022, from 13.30 to 16.00. To kick the event, DAVeMoS team will start the discussion with presenting our current activities. Examples of expected presentations include:

- Results of a study on demand-responsive public transport in the state of Salzburg
- Progress in development and applications of our virtual reality lab
- Impact of the COVID pandemic and digitalization on travel time budgets
- Current status of the agent-based simulation model in the eastern region with applications for micromobility
- etc.

There will also be an opportunity for discussion and personal exchange. Everybody is welcome, and online participation will be possible as well.

On: Monday, 28 November, 13:30 – 16:00
At: Universität für Bodenkultur
1190 Wien, Peter-Jordan-Strasse 82
Ilse-Wallentin-Haus, SR23 and online via Zoom

For more information and registration, please contact: davemos.admin@boku.ac.at

Yusak Susilo

13. List of DAVeMoS activities (05/22 – 09/22)

In Management:

1. In May 2022, Mr. Gregor Husner left DAVeMoS team, whilst Ms. Eva-Maria Unger joined the team. Ms. Unger, with guidance of Dr. Fidler, is the one who is currently responsible with updating DAVeMoS' knowledge pool database.
2. In the first week of September 2022, Ms. Maria Lucia Battistini joined us as an Eramus Trainee from Bologna University. During her stay with us, she will support the analysis of biometric data that DAVeMoS' VR research team has collected to date.

In Research:

1. In the last five months, DAVeMoS team has published 4 web-of-science publications, 6 conference articles, 3 invited/keynote lectures.
2. DAVeMoS has co-organised another 2-days FSV (the Austrian Research Association for Roads, Railways and Transport) seminar with a focus on "New mobility - new questions - new models". The seminar took place in Waidhofen/Ybbs on 5-6 May 2022.
3. During the same period, DAVeMoS has also organized 2 seminars in freight and superapps topics.
4. In September 2022, together with colleagues from aspern.mobil LAB and TU Wien MOVE group, DAVeMoS organised an international symposium on "Governance of multi-modality in public space – what options do we have?"
5. Over summer 2022, DAVeMoS has organized two data collections. The first one was on the use of mobility as a service in medium-sized cities in Lower Austria. The other survey was a large-scale data collection on travel and app-use diary in two cities in Indonesia.
6. DAVeMoS has completed its data collection and analysis of demand-responsive transport *W3Shuttle* and *WalsieBus* services in Salzburg Region. The report has been presented to the state of Salzburg and a publication based on the same dataset has been accepted for presentation at the 2023 Annual Meeting of the US Transportation Research Board, Washington, D.C., USA.

In Education:

1. DAVeMoS participated at the 2022 *Lange Nacht der Forschung* event at BOKU, presenting agent-based modelling and e-scooter simulator technologies, which proved to be very popular especially among the younger audiences.

14. List of DAVeMoS publications (05/22 – 09/22)

Peer-reviewed journal:

1. Julio Castillo, R., Susilo, Y.O., Monzon A., (2022) Identifying key elements for user satisfaction of bike-sharing systems: A combination of direct and indirect evaluations. *Transportation*, doi: 10.1007/s11116-022-10335-3.
2. Alhassan, I.B., Matthews, B., Toner, J., Susilo, Y. (2022) Public Transport Users' Valuation and Willingness-to-pay for a Multi-regional and Multi-operator Integrated Ticketing System. *Research in Transportation Business & Management*, doi: 10.1016/j.rtbm.2022.100836.
3. Hartwig, L., Hössinger, R., Susilo, Y.O., Gühnemann, A. (2022) The Impacts of a COVID-19 Related Lockdown (and Reopening Phases) on Time Use and Mobility for Activities in Austria—Results from a Multi-Wave Combined Survey. *Sustainability*, 14, 7422, doi:10.3390/su14127422.
4. Alhassan, I.B., Matthews, B., Toner, J., Susilo, Y. (2022) Seamless ticket inspection: Proposing and exploring users' reaction to a next generation public transport ticket inspection solution. *Journal of Public Transport*, 24, 100004, doi: 10.1016/j.jpubtr.2022.100004.

Conference Presentations:

1. Fuady, SN., Susilo, Y. and Pfaffenbichler, P.C. (2022) The potential impacts of micromobility on urban transport: adaptation of land use and transport model of Vienna, Austria. The 5th World Planning Schools Congress (WPSC) Congress, Bali, Indonesia.
2. Ilahi, A., Susilo, Y., and Hössinger, R. (2022) Investigating the shifting of time use and travel time budgets before and during COVID-19 in Austria. The 2022 NECTAR conference, Toronto, Canada.
3. Hinteregger, M., Juschten, M. and Hössinger, R. (2022) The roles of built environment and transport supply quality to public transport annual ticket ownership in Vienna, Austria. The 2022 NECTAR conference, Toronto, Canada.
4. Bogacz, M., and Susilo, Y. (2022) Cognitive approach to hazard perception on the road: validation in virtual reality environment. The 10th symposium of the European Association for Research in Transportation (hEART), Leuven, Belgium.
5. Susilo, Y.O. and Birgfellner, L. (2022) Implementing Social Value Orientation in Measuring the Health and Environmental Dilemmas of Autonomous Driving. The 10th symposium of the European Association for Research in Transportation (hEART), Leuven, Belgium.
6. Castillo, R.J., Monzon, A., and Susilo, Y.O. (2022) Key e-bike-sharing system attributes. A combination of explicit and implicit methods for user satisfaction assessment. The 10th symposium of the European Association for Research in Transportation (hEART), Leuven, Belgium.