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Transportation

STRATEGIES
Sustainable mobility made in Germany

BEST PRACTICE
Urban transport in Namibia and in China

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Urban transport – a big challenge

Sustainable urban transport becomes an integral part of the "Smart Cities" concept, which seeks to maximize the use of available information and telecommunication technologies for the urban agglomerations management. This will allow close integration of different sectors such as transportation, logistics, safety or energy supply, which in turn will lead to synergies that help improve the quality of life in cities. For example, urban transport accounts for 40 % of CO_2 emissions and 70 % of pollutant emissions arising from road transport.

Urban traffic management uses many different types of sensors, ranging from traffic detectors to satellite image processing (weather forecasting, urban heat island maps, or air pollution maps). In fact, with the Smart Cities concept, even private cars can function as smart sensors, providing important data about the current traffic situation or other environmental parameters.

For processing the resulting large volumes of data, systems increasingly rely on supercomputers, including Cloud computing services. This is gradually shifting urban traffic management away from the original traffic-actuated signal systems towards adaptive control systems that are able to coordinate traffic across the entire urban area. Microscopic simulations are very often used to validate different control strategies. Real-time validation even allows optimizing the control algorithms directly.

Urban traffic management technology includes advanced actuators, either in the form of physical signalling devices on the infrastructure side, or virtual navigation systems offering convenient route recommendations based on the available information. In the future, reliable navigation of autonomous (driverless) cars will also be possible. Driverless subway trains are already in operation today, and in rail transport there are successful development projects for automatic train operation systems (CBTS - Communications-Based Train Control).

In future public transport, electro-mobility in a broad sense – i.e. including also trams, trolleybuses and fuel-cell-powered vehicles (hydrogen and other) – will play an invaluable role since they emit only minimal local pollution. In particular, their motors do no emit nano-particles, which have been proven to be very harmful to human health. Currently the widespread introduction of electro-mobility is still slowed down by high costs and limited battery capacity. However, if batteries continue to become 5 to 7 % cheaper every year while their capacity increases by 5 to 7 % in the same period, the turning point will be reached in 2020: Then electro-mobility will become an economically advantageous way of transportation.

Urban traffic management will also increasingly depend on various sharing models for means of transport, such as bikesharing, carsharing or taxi-sharing concepts, which must be integrated not only into the overall transportation concept, but also into planning stationary traffic infrastructure (including monitoring parking availability, vehicle navigation to the parking areas). And there is definitely a need to develop new business models for sharing or maximizing the freight transport capacities in city logistics.

Future users will treat the urban transport system as a mobility service, which they will expect to deliver high-quality services, just like they do today in the area of telecommunication services (SLA – Service Level Agreement). The use of smartphones for the optimization of individual routes, door-to-door navigation, or mobile payment for these services will help guarantee the quality parameters of mobility.

In the context of increasing urbanization, urban mobility is progressively becoming a decisive factor for the further sustainable development of cities. Ensuring efficient urban mobility through the adoption of new technologies, innovative business approaches and novel organizational models is going to be a big challenge – for all of us.

Yours

Miroslav Svítek,
Prof. Dr. Ing., dr. h. c.
Czech Technical University in Prague (CZ)
Chairman, European Platform for Transport Sciences (EPTS) Board

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International Transportation

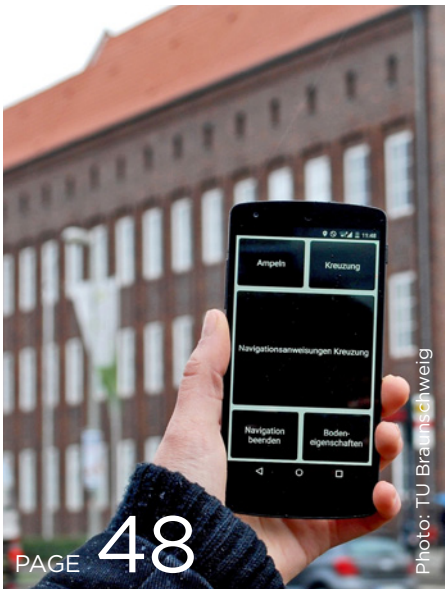
PAGE 8
Photo: Helmer

PAGE 30
Photo: Schmorl

POINT OF VIEW

STRATEGIES

BEST PRACTICE



CONTENT

May 2015

PRODUCTS & SOLUTIONS

SCIENCE & RESEARCH

COLUMNS

INTERNATIONAL TRANSPORTATION 2/2015

Mobility 4.0 – Advanced transportation solutions
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"Transport policy matters!"

The world of mobility is becoming ever more complex. Increasing traffic volumes in rapidly growing metropolitan regions contrast with numerous opposing phenomena such as 'peak car', climate change or digitalization, which are not really tangible for most citizens, however. We must do something – but what? Our interview with José Viegas, Secretary-General of the International Transport Forum at the OECD.

Professor Viegas, let us talk about the real challenges for tomorrow's mobility. Where are we today, and what do we need to focus on?

The world is changing faster than ever. There is a great transport transformation, too: Bits and bytes are replacing oil, steel and concrete as the drivers of transport. Disruptive business models and non-traditional players are challenging the established champions, for instance – think of Uber's ride-sharing service or Google's role in taking forward automated driving.

Against this backdrop, there are challenges in all shapes and sizes. Without particular order I think, first, of the rapid digitalization, growing connectivity and increasing automation. This is driving massive change in transport and goes to the core of how the sector works and thinks. As in other sectors, automation will advance and bring to the fore very serious social issues, as job profiles change and certain job profiles will disappear.

Second, there is the massive urbanization in emerging regions of the world. For cities to be hubs of economic opportunity and social inclusion, they need to offer equitable access to jobs and social services, which requires sustainable, affordable, accessible transport provision. Third, climate change requires the de-carbonization of transport, which contributes roughly a quarter of global greenhouse gas emissions. Technology alone is not the answer; significant contributions must come from a more efficient organization of mobility. And, last but not least, road safety is another major challenge. 1.3 million people die on the world's roads every year, with 90% of these fatalities occurring in developing nations.

What about freight transport?

Looking at the freight and logistics side, we are facing rising uncertainty for global supply chains. One of these uncertainties is more extreme weather – events like the massive floods and tsunamis of recent years, which have demonstrated their potential to cause large-scale disruptions in global goods exchange and production. Consequently, one challenge is to make our transport systems, both infrastructure and services, more resilient to such external shocks.

Then there is the twin challenge of dramatic growth of global freight volumes and shifting trade patterns. We have modelled scenarios for international freight volume growth up to 2050 in the recently published ITF Transport Outlook 2015, and we believe it could more than quadruple over the coming decades. That will create enormous pressure on the capacity of our transport infrastructure.

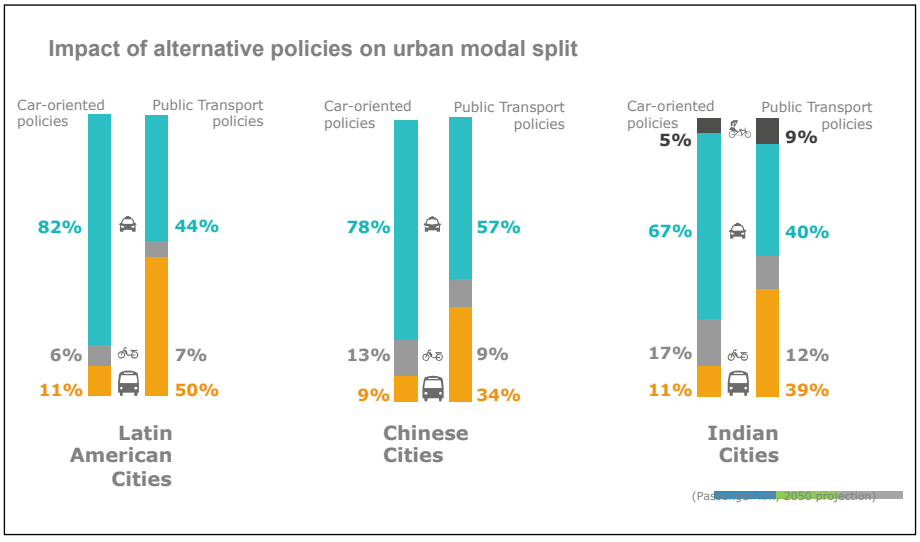
At the same time, the flows of goods around the globe will not follow the same patterns as today. The North Pacific will replace the North Atlantic as the busiest trade route, for example. And intra-Asian trade as well as intra-African trade will grow very strongly, so much more freight will be transported across inland regions, in areas with limited infrastructure. Unless significant investment is made in railways in those areas, transport will be made by road there, and so drive up emissions.

What needs to be done to ensure that transport is a force for social inclusion?

Good mobility is one of the outcomes of an efficient transport system, but it's not an end in itself. The true vocation of transport is to provide citizens with access – access to things that make their lives easier, better, more productive, more worthwhile. On the other hand, in the non-transport arena there needs to be more awareness of the critical role of transport as key enabler. To provide access to education, for instance, you need schools, the core infrastructure. But often the decision on the location of a new school takes into consideration land requirements for the school's educational program, but pays less attention to how its teachers, support staff and especially the children will be able to get there.

Access is not only an issue in poor underdeveloped countries. ITF recently did a study for the government of Finland on providing reasonable access to services in remote and sparsely populated regions. The study triggered a debate among Finnish parliamentarians whether a revision of their definition of public transport was needed. Ultimately, transport is one of the great facilitators – and at the same time a largely underrated facilitator – for the success and cohesion of our societies.

Today's large-scale urbanization goes hand in hand with growing demand for individual mobility. Will we see an unstoppable increase in car traffic?



Urban policy choices scenarios

Graph: ITF

Estimates say that with growing incomes in emerging economies, 3 billion people will join the middle class in the coming decades. These people are striving for the lifestyles of the developed world, and the prime expression of that is buying a car, and then another. There is a debate as to whether we have seen 'peak car' in some developed countries, because there car ownership and distances traveled seem to have stopped rising. But any 'peak car' in the West will be dwarfed by the opposite development in the emerging economies.

To this trend add the demographic trend of exploding urbanization: By 2050, 70 % of the world's population will live in cities, up from 50 % today. Populous countries like China are actively promoting urbanization. The ITF has modelled policy scenarios for urban mobility for China, India and Latin America for the coming decades. What we found is that the big cities of those regions will more than double their share of global passenger transport emissions by 2050 – from 9 % to 20 % – if transport policies remain unchanged. But the important message is: There is a policy choice. Take Latin America: If cities there switched now to long-term policies favoring public transport, and deprioritized the building of new road infrastructure, the modal share of cars in 2050 could be half of what we would see under the current policies (see *graph*).

What steps and policy actions need to be taken to make urban mobility systems fit for the future and provide good access opportunities to citizens?

First of all, recognize that the strategic goal is equitable access to jobs and services, based as much as possible on active modes such as walking and cycling. Then develop good collective transport solutions that are attractive to all population segments. The digital connectivity mentioned above is opening up great possibilities in this domain, namely shared car rides responding to real-time demand, e.g. shared taxis. It also opens up the prospect of a new paradigm in bus services that will be non-scheduled and instead respond much more efficiently to the demands of citizens, providing most of them with transfer-free trips. Policy actions in this domain must above all demolish the regulatory barriers that prevent new service patterns from emerging.

There are huge investment needs to keep transport infrastructure up to date. Are Public-Private Partnerships really a solution?

There is no hard-and-fast rule about whether a PPP is the best solution for an infrastructure investment project. Not all projects are appropriate for a PPP, such models have often been adopted for the wrong reasons, namely to get off-balance sheet financing. Demand estimates and risk assessments should always be subject to independent screening, followed by efficient allocation of risks to the public and private sides. When these requirements are not met, PPPs face a big risk of leading to disastrous results. But when they are met, and the project includes good margins for innovation in design and operational management, they may lead to very positive results.

The digital revolution in transport seems non-reversible. Connected and even self-driving cars are becoming a reality. Do you see this as an opportunity, or are the challenges predominant?

I see transport at the threshold to a new age of opportunity. There will be challenges, but I don't think we should let ourselves be governed by fear. The key to success is setting the policy parameters in ways that encourage creativity and innovation, while at the same time limiting potentially negative side-effects. Also at this new frontier, transport policy matters.

One source of problems is that innovation is happening so fast today that many new technologies are ready for deployment or already rolled out, while the regulatory environment is lagging behind and therefore fuzzy – a good example here is the recent experience with drones, or with shared rides of various kinds, for that matter.

José Viegas has been Secretary-General of the International Transport Forum at the OECD since August 2012. A Portuguese national, Viegas had a distinguished career in academia and in the private sector before joining the Forum as its chief executive. A full Professor of Transport at the Technical University of Lisbon, he served as Director of MIT-Portugal's Transport Systems focus area. As chairman of TIS.pt consultants, he advised governments and international institutions on key transport projects and policies

At the helm of the ITF, Viegas has implemented new initiatives to increase value for member countries. He has created a work stream for rapid-delivery policy analysis for countries, strengthened ITF's links with the private sector through the ITF Corporate Partnership Board and advanced the harmonisation of pan-European road freight transport. Viegas holds a PhD in Civil Engineering from the Technical University of Lisbon and undertook postgraduate studies in regional studies at the University of Karlsruhe, Germany. He speaks fluent Portuguese, English, French, Spanish, German, and Italian.

The use of digital technologies in transport is still new, and some serious safety issues have been identified. Quite recently an e-car was hacked in a few minutes, for instance. Are safety and security concerns taken seriously enough?

For every sector that is going digital, cyber attacks are a new reality. But as manufacturers and operators in transport move towards basing their offer on digitally-supported concepts, they will have to beef up their understanding of the associated risks and invest in mitigating them as far as they can. Every CEO in the transport sector should think about what would happen if the cyber terrorists that attacked Sony or TV5 Monde targeted his company.

On the safety side, of course the introduction of new technologies may cause safety issues. But on balance, digitalization of transport greatly contributes to its safety, through fine-tuned actions – think airbags, ABS, ESC – as well as by quickly identifying hazards and supporting the decisions to avoid them.

One area that is a serious concern and needs urgent reflection is data privacy. Mobility data of citizens is particularly sensitive. Merged with other data it allows new insights that can spur innovation, but it is also extremely personal and very difficult to protect. In a world of smartphones and GPS sensor technology, all you need to identify a specific person with 95% accuracy using anonymized mobility data is four co-located data points, for instance Facebook status updates, online credit card transactions or Wi-Fi log-ins. I think we all should keep an eye on this evolution. ■

Photo: Helmer

Passenger information using a sign language avatar

Individual travel assistance for passengers with special needs in public transport

Public transport, passenger information, travel assistance, information and communication technology, reduced mobility, accessibility, inclusion

Public transport operators are legally obliged to ensure equal access to transportation services. This includes equal access to information and communication related to those services. Deaf passengers mostly prefer to communicate in sign language. For this reason, the specific needs of deaf and hard-of-hearing passengers still are not adequately addressed – despite the tremendous efforts public transport operators have put in providing accessible communication services to their passengers. This article describes a novel approach to passenger information in sign language based on the automatic translation of natural (written) language text into sign language. This includes the use of a sign language avatar to display the information to deaf and hard-of-hearing passengers.

Authors: Lars Schnieder, Georg Tschare

Public transport operators provide real-time passenger information via electronic information systems in order to keep passengers up to date about the current status of the public transport system [1]. Information provided to the passengers may include predictions about arrival and departure times at stations, as well as information about the nature and causes of disruptions [2]. The passenger information system may be used both physically within a transportation hub as well as remotely via mobile devices used by the passengers. In the design of such passenger information systems (PIS), public transport operators are legally obliged to consider the special needs of persons with disabilities. For example the UN Convention on the Rights of Persons with Disabilities oblige all ratifying countries to ensure that persons with disabilities have the opportunity to live independently and participate fully in all aspects of life. This includes that persons with disabilities should have equal access to public transportation systems as well as all information and communication related to the use of trans-

portation services [3]. In the design of PIS this means that all information provided should be made available to the users by addressing two perceptional modes in parallel. This can be achieved, for example, by combining both tactile and audible elements to convey information to blind passengers. However, as deaf people mostly prefer to communicate in sign language the needs of the deaf and hard-of-hearing currently are not adequately addressed in the design of PIS. The project aim4it (accessible and inclusive mobility for all with individual travel assistance) develops a solution to make passenger information accessible for deaf and hard-of-hearing passengers.

Distribution of incident and disruption information to deaf and hard-of-hearing passengers

With the use of mobility apps and communication via journey planning platforms, passengers perform their initial route planning based on time-table data. During operations the initial route will be updated based on available information about timetable deviations or changes in the status of the network infrastructure (real-time data). Real-time data also includes incidents and disruption information due to their mostly short-term nature. Conventional approaches to making this incident and disruption information available to deaf and hard-of-hearing persons are not suited to the special requirements of passenger information in public transportation.

One possibility to provide audible passenger information to hard-of-hearing passengers is the use of *assistive listening technology*. With this technology a physical cable loop is placed in a station area in public transport systems. The cable generates a magnetic field throughout the looped station area that can be picked up by a hearing aid or Cochlear Implant (CI) processors. This approach allows the sound source of interest (e.g. public address system messages) to be transmitted to the hearing-impaired listener clearly and free of distracting noise in the environment [4]. However this technology is only suited for individuals with reduced ranges of hearing, but not for deaf passengers. In addition to this, providing full coverage with assistive listening technology in all stations and vehicles is not economically feasible given the tight budgets of public transport operators.

An alternative way of providing passenger information to the deaf and hard-of-hearing is to make all audible information routinely accessible visually by the use of *captioning*. With captioning the text version of speech is usually displayed at the bottom of a video screen. Captions are considered useful by people whose hearing has been damaged after they had learned how to speak (so called late-deafened). Furthermore, also hearing persons who are viewing content in a noisy environment benefit from captions. In contrast to this, people born deaf mostly prefer to communicate in sign language. Sign language has a grammatical structure that is completely different from that of spoken language. The written form of their national language is usually the second language learned by deaf people. As the written form of a spoken language is highly abstract and as deaf people have never ever heard the language spoken, they have a hard time learning the written form. For this reason most of them have low reading skills [5, 6]. A passenger information system that is easy to understand and accepted by the community of the deaf and hard-of-hearing should therefore provide both captioning (for hard-of-hearing and late-deafened persons as well as for hearing passengers – in line with the "design for all" concept) and information in sign language (for deaf people).

Sign language is the only possibility to provide information in a barrier-free and understandable manner for deaf people. Translation of spoken or written information into sign language can be achieved either by *human interpreters* (signers) or *sign language avatars*. The signer hears the voices of the spoken text or reads the text and translates the message into sign language. A video camera captures the translation, which can then be displayed to the deaf users. With the use of a signer, sign language can be used on TV or video. The signer usually appears at the bottom of the screen, with the main content being shown full size or slightly shrunk to free space in the bottom corner. However, this approach is expensive and time-consuming and therefore not feasible when it comes to addressing the need for real-time passenger information. Furthermore, given the great variety of reasons of disruptions of public transport operations as well as associated impacts, it is not possible to pre-record messages for all circumstances in order to have them displayed immediately when this particular situation occurs.

Integration of incident messages in sign language in the travel assistance application

With the increased availability of smart phones, passengers can use routing applications to send queries about possible routes between their start point and their final destination to Intermodal Transport Information Systems (ITIS). Especially for disabled persons, conventional routing applications are complemented by additional features that are required to give them unobstructed access to the public transport network. Once passengers have started their trip, the route they have decided to use will be monitored so that they can get updates on all incidents relevant to their individual trip. Besides transmission of incidents, this service also includes the calculation of a new route for the passenger once the initially chosen route becomes impractical (e.g. due to service irregularities). Making incident information accessible to deaf and hard-of-hearing passengers follows three steps:

Capturing incident information: With the incident capturing system (ICS), information about irregularities in the public transport network are typically captured by the staff in the operations control center. Subsequently public transport operators publish messages in their network via different media (including mobility apps). In order to adapt this process to the special case of passenger information for deaf and hard-of-hearing passengers, a new tool chain is introduced in the background systems of the public transport operators. In order to ease subsequent translation of written text to sign language, translation-oriented authoring is applied in the ICS. This means that the user can configure structured incident messages with less complex syntax and a controlled vocabulary. This not only facilitates the subsequent automatic translation process, but also makes understanding the text messages easier for all other (hearing) passengers.

Translation of incident information: Once the structured incident message is available, a video featuring a sign language avatar will be automatically created and stored in a database. The sign language avatar is able to display all elements of sign language that convey the meaning of the incident message. This includes the simultaneous combination of hand movements as well as the orientation and movements of hands, arms and the entire body. In parallel, facial expressions can be displayed to convey further meaning (e.g. emotions). *Figure 1* shows an example of an incident message in sign language developed for the public transport operator of the city of Vienna (Austria). Currently all incident messages are translated into Austrian Sign Language (Österreichische Gebärdensprache, ÖGS). In order not to exclude hard-of-hearing and late-deafened passengers, captioning is added to the incident information displayed in sign language.

Distribution of incident information: The Intermodal Transport Information System

Figure 1: Example of an incident message of Wiener Linien using a sign language avatar combined with captioning

(ITIS) identifies the passengers in need of the information and uses a push service to distribute the relevant message to the smart phone of any deaf or hard-of-hearing passenger. Once the passengers have been advised of a service disruption along their route, they can click on a link and see the incident message presented by a digital avatar. The avatar can convey the content of the incident notification by simultaneously combining hand shapes, orientation and movement of the hands, arms or body as well as facial expressions to fluidly express the speaker's thoughts.

As new standards of Internet protocol-based communication with the passengers' smart phones allow for bidirectional communication, a flow of information towards the passenger can be considered [7]. Also feedback possibilities for the traveler can be included [8]. Using the travel assistance application to gather passenger feedback allows public transport operators to continuously improve the service quality perceived by the passenger.

Conclusion and outlook

The project aim4it builds on interfaces using IP-based communication for passenger information in public transport as standardized by the Association of German Public Transport Companies (VDV, Verband Deutscher Verkehrsunternehmen). By using IP-based web services, passenger information can be provided via different channels, with their personal device being the most individual and convenient channel for the customers.

The project aim4it develops additional functions and services, which have not been part of the initial standardization project. Furthermore, prototypical operation of the new passenger information system for deaf and hard-of-hearing passengers in the test fields Vienna (Austria) and Karlsruhe (Germany) will help to gain valuable practical experience, which will be fed back into the standardization process. The aim4it interface descriptions agreed on within the project consortium will result in work item proposals for subsequent standardization performed by VDV. The use of existing standards along with their amendment makes sure that the project results can be easily transferred to other cities. Current work is directed towards the adaptation of the digital avatar to other sign languages.

Future work in machine-based translation of incident information aims at the transfer of the sign language avatar to other national sign languages. Every country has its own sign language, which significantly differs from other variants. In the future, Signtime GmbH intends to extend the current approach of information display in Austrian Sign Language to the display of German Sign Language (Deutsche Gebärdensprache, DGS). ■

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Lars Schnieder, Dr.-Ing.
Head of the Department for Intermodality and Public Transport, German Aerospace Center, Institute of Transportation Systems, Braunschweig (DE)
lars.schnieder@dlr.de

Georg Tschare, Mag. Dr.
CEO Signtime GmbH, Vienna (AT)
georg.tschare@signtime.tv

New Towns and transportation

New Town Hashtgerd in the Karaj/Tehran agglomeration — Integrated urban and transportation planning for GHG emission reduction in the Young Cities project

Population growth, metropolitan areas, transportation network

One of the strategies for solving the problems of population growth is building New Towns. These New Towns should firstly discharge the cities with large agglomerations. A secondary goal is the restructuring and decentralization of the population in the metropolitan areas. Based on this, New Towns will be planned and built in Iran. The Iranian leading partners are the Building and Housing Research Center (BHRC) and the New Towns Development Corporation (NTDC). The main objective of the Young Cities project is to find out whether the development of New Towns is a reasonable strategy to slow down the population growth in urban agglomerations.

Author: Wulf-Holger Arndt

The largest of the thirty planned New Towns in Iran is Hashtgerd, situated 65 km northwest of the megacity of Tehran and 30 km west of the megacity of Karaj (*figure 1*). The Tehran region is the economic, political, and cultural center of Iran and home to close to 13.8 million residents – 20 % of the Iranian population [PopulationData.net 2013]. The region holds 70 % of Iran's economic and financial powers [Fanni 2006].

The research project outlines the development of the planned New Town Hashtgerd in the Tehran/Karaj agglomeration and implements research results in the form of pilot projects within the New Town. At Technische Universität Berlin, the Departments of City and Regional Planning, Architecture, Civil Engineering and Transportation Planning are involved in this project.

The New Town of Hashtgerd, located to the south of the Alborz Mountain Range next to the Tehran Qazvin Highway, was initially intended to accommodate 500,000 people. The massive shortfall in reaching the New Town's population goals – combined with the necessity to adapt to recent demographic, social and economic changes in the Tehran/Karaj region – led to a revised comprehensive plan for 2005 onwards, which also extended the targeted final population number to 660,000 [Fathejalali/Khodabakhsh/Pakzad 2012]. In 2013, the number of inhabitants had reached 30,000. The distribution of the settlement areas was elaborated on the basis of the theory of central places and with the goal of ensuring the optimal provision of central services and goods.

The transportation network as originally planned was intended to serve only the needs of motorized individual transport (*figure 2*). Although the revised comprehensive plan briefly describes the planned extension of the Tehran metro to Hashtgerd and mentions the need for a public bus system, the main emphasis lies on the optimal distribution of motorized traffic entering and leaving the city through one of the big gates of the Tehran-Qazvin highway. Inside the city, the planned and already partly constructed main arteries in north-south and east-west direction form a rectangular pattern. The foreseen facilities for slow modes and environment-friendly means of transport – such as walking and cycling – only meet minimum standards.

Growing traffic and increasing traffic-based GHG emissions

In many developing countries with their rapidly increasing motorization rates the main coping strategy for the emerging problems is to expand the street infrastructure. Today, Iranian cities are facing similar problems: In 1997, already 20 % of all GHG emissions stemmed from Tehran's urban transport sector [PLS Ramboll Management 2003]. Furthermore, between 1996 and 2002, the number of vehicle kilometers traveled in congested traffic rose from about 21 % to 27 % [World Bank 2010].

The previous master plan for New Town Hashtgerd also prioritized car traffic. The results of a car-oriented policy are reflected in Iran's petrol consumption balance (see

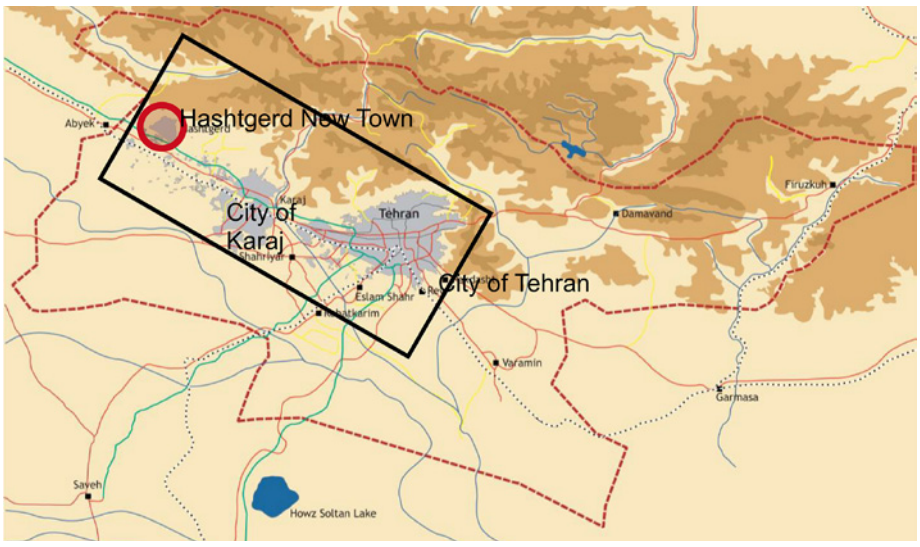


Figure 1: Tehran/Karaj urban growth center

Source: Fathejalali/Khodabakhsh/Pakzad 2012: 24

figure 3). The share of transport in petrol consumption kept rising steadily, and in 2005 accounted for over 50 % of the total petrol products consumed.

Traffic strategies

In line with the strategy aimed at reducing traffic-related CO_2 emissions, a mixed-use approach was developed as the main element of an integrated urban transportation concept for Hashtgerd. Thus there is a project dimension aimed at elaborating an integrated transport concept for a 35-ha pilot area (Shahre Javan). The guiding principle for this is to consider the interrelations between spatial structure and traffic demand using innovative transport simulation software such as VISEVA/VISUM. The project was the first to use an enhanced version of the model, developed by partners at Technische Universität Dresden (TU Dresden), for the optimization of a traffic-reduced spatial structure.

A high-density and low-rise concept was designed for the realization of the mixed-use approach (see *figure 4*). The gross population density in Iran's towns is about 100 to 110 persons per ha. The Iranian New Towns aim for a higher average gross density of about 150 persons per ha. Hashtgerd New Town meets this target with a gross population density of 147.98 persons per ha. The gross population density for the pilot area (Shahre Javan Community) is more than 200 persons per ha. More intense land use promotes effective public transport and more efficient energy supply infrastructure. However, a purely quantitative approach is not satisfactory since it does not shed light on the living situations of the inhabitants or on the quality and attractiveness of the urban layout and the public realm.

This compact and mixed-used urban layout is a precondition for reducing traffic and fostering (eco-friendly) mobility. The main approach focuses on a shift of mobility routines and the support of environment-friendly means of transport, through the creation of a modern, efficient public transport network, the provision of information on alternative ways of mobility, and different measures that limit the attractiveness of conventional, motorized individual traffic. The special situation of Hashtgerd as a New Town is a chance to strongly influence the transport behavior of the new inhabitants and promote the shift towards sustainability.

Key elements of the transport concept are:

- support of the mixed land use approach through adequate mobility systems
- accessibility (social and area-related)
- integration of all transport means in urban and transport planning
- support of environment-friendly means of transport (slow modes, public transport)
- filtered permeability of spaces and co-equality of transport modes regarding their environmental impact (traffic management)
- a flexible and adaptable transport and mobility planning approach
- prevention of extraneous traffic from moving through residential areas
- efforts aimed at increasing traffic safety
- participation of all stakeholders in the planning process
- attention paid to disaster management

In pursuit of these goals and sub-goals, the transport strategy of the Shahre Javan Community pilot project focuses on reducing travel distances and initiating a beneficial shift in both transportation routines and vehicle choices. In order to achieve this, "push" and "pull" strategies are combined with hard and soft policy measures. *Figure 5* shows a choice of possible measures.

On the city-wide level, an integrated public transport system (concept) is envisaged for Hashtgerd as a major framework. Its main task is to organize the hierarchically structured public transport system, consisting of light rail transit (LRT) or bus rapid transit (BRT), city bus lines as well as a neighborhood bus (midibus or minibus) sys-

Figure 2: New Town Hashtgerd — Photos: Arndt

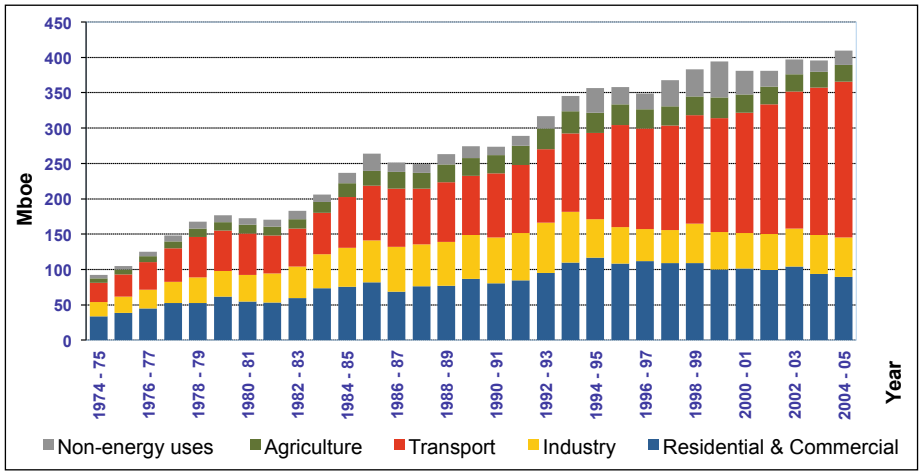


Figure 3: Consumption of petroleum products by sector, Iran 1974 to 2005
Source: Ministry of Energy Iran, Energy Planning Department, 2008

Figure 4: Urban layout of the 35-ha pilot area (Shahre Javan) and small-scale mixed-use areas in the neighborhoods — Source: YoungCities project

tem. The often underestimated soft policies (e.g. information packages, campaigns) should provide consumers with adequate information about the public transport system, which also serves the city of Old Hashtgerd.

Following the Young Cities project set-up, the key target of the public transport approach is to support energy-efficient and CO_2-reducing mobility routines. Furthermore, the plan allows for an appropriate and easily accessible public transport system that will enable also small social groups to participate in local and regional social activities. The third aim is the spatial, horizontal integration of the 35-ha pilot area as well as the settlements of Old Hashtgerd and Hoseynabad into the regional public transport network.

The approach consists of four major action clusters formed by hard and soft policies and push and pull measures. The soft policies constitute a kind of mobility management, with the aim of informing and supporting the regional population about environment-friendly ways of mobility and the public transport system itself.

In contrast, hard policies form the physical basis of eco-mobility encouragement, such as the development of attractive public transport, footpath and bicycle systems. In this part of the strategy, pedestrians, cyclists and shared transport are prioritized, while motorized traffic is of secondary importance. Basic functions and accessibility are maintained for service, delivery and rescue purposes, as well as for limited individual motorized traffic. The reduction of car traffic will be achieved by limiting the number of available parking lots. For the pilot area, a parking lot factor of 0.2 is planned.

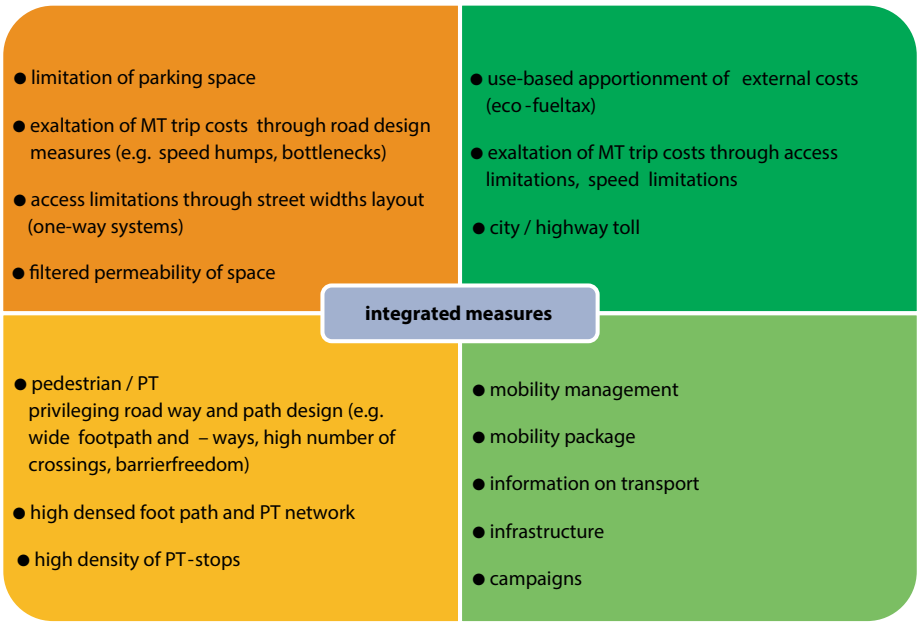


Figure 5: Possible instruments for implementing the strategy's guiding principle (hard policies on the left, soft policies on the right push measures above, pull measures below)

Source: Arndt 2011: 122

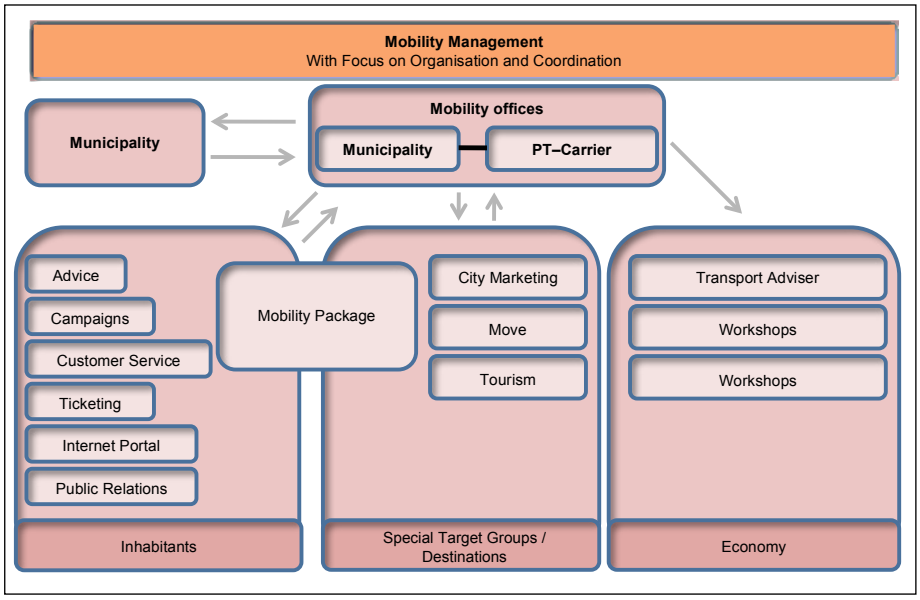


Figure 6: Mobility management concept for Hashtgerd New Town

Source: Arndt, Döge

Mobility management and public transport approach

The chief target of the transportation concept is to establish energy-efficient and CO_2-reducing mobility routines that will enable all social groups to participate. The concept's purpose is to reach these targets through a mix of "push" and "pull" strategies based on hard and soft policies to force the shift of transport routines and vehicle choice in the intended direction. The core element of soft "pull" measures is a form of mobility management and contains measures such as information and communication management, organizing services and coordinating activities of different partners. This management system aims to influence the travel choice, destination and location decisions of inhabitants, companies and other groups, for instance tourists. It provides information to these target groups and receives feedback from the traffic users, which flows back into the planning system. Its aims are firstly to coordinate all of the authorities and efforts regarding environmental mobility – for example, reduction of transport distances, and the use of footpaths, bicycles and public transport. Secondly, it informs the regional population about environment-friendly ways of mobility and supports the establishment of sustainable mobility routines (see *figure 6*).

The suitable time for a mind shift and for building new mobility routines is during the change of residence. In that phase of (a person's) reorientation, a special element of the mobility management – the mobility package for new inhabitants – will provide information and guidance about environment-friendly mobility (eco-mobility) and give incentives to use public transport (PT) and make a change in lifestyle.

Since individuals develop their future mobility routines during a short reorientation phase after the move to a new location (relocating), instruments intended to push this process towards eco-mobility are included in the transport concept. The mobility management primarily focuses on the change in mobility routines, since new residents will largely originate from Greater Tehran or other urban agglomerations that rely heavily on individual motorized trans-

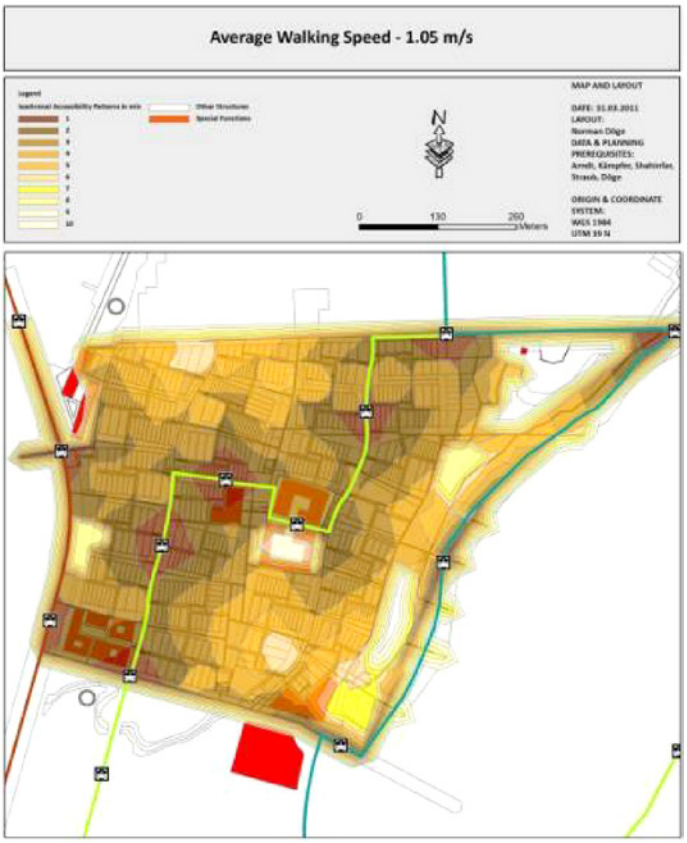


Figure 7: Accessibility patterns of public transport stops in the Shahre Javan Community

Red: Tram (LRT)/ BRT
Green: City Bus
Blue: Local Bus

Source: Arndt, Döge 2013: 165

	Cars	Public Transport	Others	All
Besançon				
Parking lot guaranteed	90%	6%	4%	100%
Parking lot not guaranteed	46%	29%	25%	100%
Grenoble				
Parking lot guaranteed	94%	3%	3%	100%
Parking lot not guaranteed	53%	29%	18%	100%
Toulouse				
Parking lot guaranteed	99%	1%	0%	100%
Parking lot not guaranteed	41%	24%	35%	100%
Bern				
Parking lot guaranteed	95%	3%	2%	100%
Parking lot not guaranteed	13%	55%	32%	100%
Geneva				
Parking lot guaranteed	93%	3%	4%	100%
Parking lot not guaranteed	36%	25%	39%	100%

Table 1: Impacts of parking provision

Source: Mezghani 2006

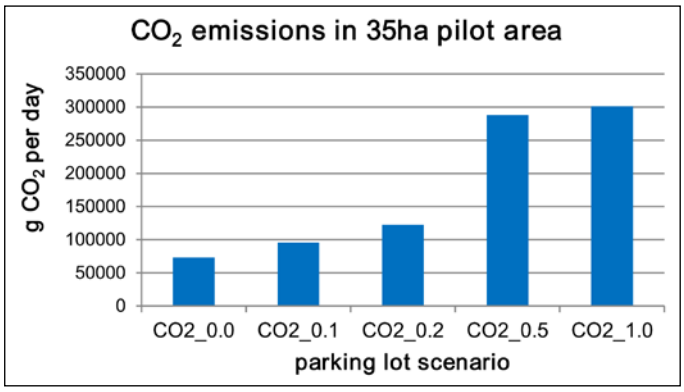


Figure 8: CO_2 emissions related to parking lot factor. 0 = no parking lots; 0.1 = number of parking lots equals 10% of the population, etc.

Graphic: Arndt

port. Soft policy measures are one part of the strategy to support this shift of mobility routines towards more eco-mobility. The key instrument in this strategy is a "mobility package" for new residents intended to make targeted use of the change of residence and the associated reorientation and 'reset' of their habitual choice of transport mode. This instrument aims to promote sustainable transport routines by helping with PT orientation and recommending destinations at short travel distances. The package includes information, services and incentives – for instance, a test ticket for the public transport system – needed for a modal shift away from individual motorized transport.

The hard policies establish the preliminary design of the public transport system. With the ultimate target being further optimization, a first approach was drafted and integrated into the transportation model. The draft follows certain criteria:

- high capacities on the main arteries from north to south
- additional city-wide 'feeder' bus system on arteries from east to west
- small buses connecting local neighborhoods
- throughout the city, the nearest PT stop should never be more than 300 m away
- integration of a common taxi system
- high-capacity connection to the railway station and the planned metro station, providing a fast commuter connection to Tehran
- integration of Old Hashtgerd and the industrial belt to the north of it
- incremental expandability

The result was a preliminary approach representing the maximum version, which will be further optimized using the results of the transportation model (*figure 7*). This first approach consists of the following public transport offers:

1. Tram (LRT)/BRT, capacity: 2,000 – 30,000 passengers/h, catchment area: < 300 m
2. City Bus, capacity: 1,000 – 4,000 passengers/h, catchment area: 250 m – 300 m
3. Local Bus, midibus/minibus, catchment area: < 250 m

The integration of these three services in a public transport network combines high accessibility in the neighborhood with low distances to the residential area and a high system speed.

Compared to bus service, light-rail transit is inflexible (separate rail network), but

produces less CO_2, consumes less energy, has lower lifecycle costs and higher capacity. For these reasons, the bus rapid transit on separate lanes is the first high-capacity option and can be developed in response to growing demand from public transportation users. It can subsequently be substituted by light rail systems using the same lanes.

Parking concept with reduced parking lot factor

The provision of parking lots has a strong impact on the modal split. A high availability of parking space located closed to the dwellings supports high car use. *Table 1* shows an example of this interrelation between public transport share and parking lot supply. The demand for public transport is higher if parking lots are not guaranteed.

The Iranian guidelines for New Towns specify one parking lot per dwelling in housing areas as a minimum. This would create an oversupply of parking lots and strong support for car use. The motorization rate in Hashtgerd New Town in 2027 will reach 125 cars per 1,000 inhabitants [Paykadeh 2011]. Based on a four-person household, this leads to 50 % household car owners and a parking lot factor of 0.5 parking lots per dwelling.

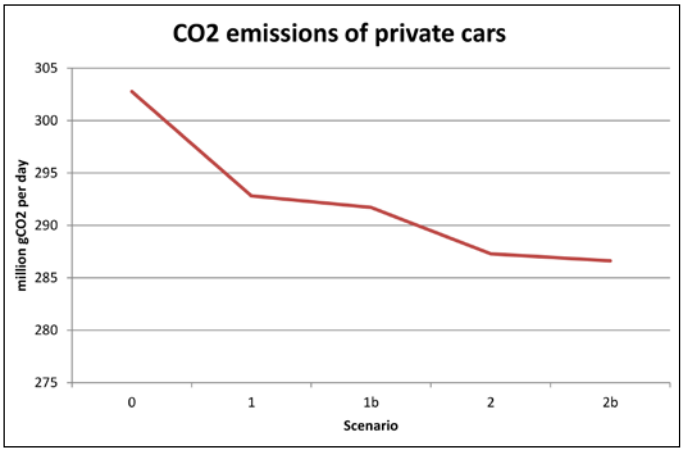
To promote public transport use and CO_2 reduction, a decrease in car ownership is needed, and the goal should be 20% household car owners. This would also support the modal split in the comprehensive plan for Hashtgerd New Town. Thus, a parking lot factor of 0.2 is an initial parameter of the transport concept for the 35-ha pilot area in Hashtgerd New Town. *Figure 8* compares the CO_2 emissions impact of different parking lot factors. It shows the steep decrease of CO_2 emission through the reduction from 1.0 to 0.2 of the parking lot factor.

A conventional parking lot demand with factor 1.0 parking lots per dwelling in the Hashtgerd 35-ha pilot area would lead to extensive parking provision, despite a compact urban form. The parking lots would cover all wetlands alongside the access roads and some parts of the residential building areas. All of these aspects show that a maximum parking lot factor should not be higher than 0.2 parking lots per dwelling.

Transportation model using VISEVA+/VISUM software

In cooperation with TU Dresden, an advanced version of the VISEVA transport model was used to calculate a traffic-optimized settlement structure for the first time as a secondary output (VISEVA+). The results were used for the further spatial development of Hashtgerd New Town with the aim of minimizing traffic. The integration of so-called paratransit services – for example, different taxis types – was a special adaptation of the model for its use in Iran.

Figure 9: CO_2 balance of all scenarios in comparison



Based on three scenarios, CO_2 emissions were calculated using the traffic CO_2-emissions tool for emerging countries (TECT), which was developed in the scope of the project. The results show that an implementation of the transportation concept as designed by Young Cities could reduce CO_2 emissions by about 10% (*figure 9*).

Implementation and financing

In 2012, the comprehensive plan for the 35-ha pilot area, including the transportation concept, was approved by the responsible State Commission 5. An investor for the realization of the entire urban concept has already been found. Thus, the implementation of the transportation concept could start in 2014. In February 2014, the Tehran Urban Planning and Research Center has expressed its interest in adapting the Hashtgerd concept for two districts in Tehran.

Sustainability should be a main criterion for location choice, and should be kept in mind from the beginning of the urban and transportation planning, as the experiences in the Young Cities project show. ■

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Wulf-Holger Arndt, Dr.-Ing.
Head of research unit "Mobility and Space", Center for Technology and Society, Technische Universität Berlin, Berlin (DE)
wulf-holger.arndt@tu-berlin.de

Photo: Amt electric

Providing local presence in a European network

International cooperation and knowledge exchange on e-mobility in the municipal and regional context

Municipal e-mobility, knowledge exchange, international cooperation, information network

The municipalities in the metropolitan region Hannover-Braunschweig-Göttingen-Wolfsburg in Northern Germany as well as the City of Valladolid in Spain demonstrate exemplary commitment to promoting the use of electric vehicles. Together they are developing and testing concepts for encouraging electric mobility. For the last two years now, the responsible teams of the 'Amt electric' founded by the municipalities in the metropolitan region and of the Innovation Agency of Spain's Castile and León region have been exchanging experiences and knowledge on e-mobility. This cooperation is already showing substantial impact.

Author: Sabine Flores

The promotion of electric mobility is undeniably one of those areas that will greatly benefit from close cooperation on the European level. Isolated initiatives by individual states would weaken Europe's competitive position compared to the US and China. Municipalities and the associated public service enterprises and regional authorities have a crucial role to play in promoting e-mobility. They are responsible for public transport and make important decisions regarding traffic management in their districts; and their vehicle fleets consist of a high number of vehicles that could be replaced by vehicles using alternative drive technologies. In addition, using e-vehicles will help Europe's cities and towns to further improve their environmental footprint and quality of life. The integration of all types of e-vehicles, from e-bikes to e-busses, allows the creation of sustainable mobility concepts. Against this background, a German-Spanish cooperation initiative has been started on regional and local level.

The cooperation is driven by the *metropolitan region Hannover-Braunschweig-Göttingen-Wolfsburg* and the City of Valladolid. For several years now, both regions have been very active in promoting e-mobility. The German metropolitan region around Hannover, Braunschweig, Göttingen and Wolfsburg in Lower Saxony is one of four

regions in Germany set to encourage e-mobility to an outstanding degree in the scope of an initiative by the German Federal Government.

The cities, towns and districts in the metropolitan region with its around four million inhabitants have shown exemplary commitment by creating a special organizational unit called 'Amt electric', which is responsible for knowledge expansion and for coordinating the extensive vehicle fleet. This organization provides the municipal authorities with advice regarding the development and implementation of local and regional e-mobility programs. These programs include, for instance, measures in support of intermodal transport concepts or different carsharing schemes as well as the incorporation of e-mobility issues in urban planning.

The 'Amt electric' attaches much importance to involving the members of local political bodies. One example is the car-swap campaign 'Aktion Autotausch', allowing local politicians to use an electric car instead of their own for a period of ten days to test the suitability of e-mobility for everyday use in their district. Up to now, about 70 municipal politicians have taken up that offer – with the corresponding positive high-profile publicity. In the scope of their studies at the Municipal University of Public Administration of Lower Saxony, future higher civil servants are trained using a simulation game – "Electrify the metropolitan region. Leverage the potential of sustainable mobility" – to help raise their awareness of the importance of e-mobility.

The municipal authorities are also actively working towards a shared energy-policy objective: to be the first metropolitan region in Germany to use 100 % renewable energy for heating, mobility and electric power needs by 2050. In addition, they want to demonstrate that e-mobility can also play a key role in connecting urban and rural areas.

A central task adopted by the 'Amt electric' is the promotion of e-vehicles as part of municipal fleets. Currently, about 150 fully electric passenger cars operate in the fleets of over 80 municipalities and municipal enterprises. This also serves to assess the suitability of series-produced e-vehicles for everyday use in various local application areas.

In early 2015, the pilot test was extended to include also fully electric delivery vans and light-weight utility vehicles – for instance the models e-load up! by VW and Twizy Cargo or Kangoo Z.E. by Renault – as well as electric cargo bikes. This extension is a response to the needs specified by the different municipal entities. For its activities, the 'Amt electric' can count on financial support provided by the German Federal Ministry of Transport and Digital Infrastructure in the scope of the 'Electric-Mobility Showcase' program.

The cooperation profits from the experiences that the City of Valladolid has gathered as one of the now 60 members of the Smart Cities network in Spain (RECI). Valladolid and Burgos share responsibility for the topic of 'Urban Mobility' (electromobility and intelligent transport systems). The network shows clear parallels with the association founded by the roughly 60 municipalities in the metropolitan Hannover-Braunschweig-Göttingen-Wolfsburg region.

Local presence – in a European network

The metropolitan region and the City of Valladolid share a strong economic interest in the automotive industry. The metropolitan region is home to the headquarters of the Volkswagen Group and Volkswagen Commercial Vehicles. In addition, several automotive suppliers are based in the region. In Valladolid, on the other hand, Renault operates a factory of the e-car Twizy. As symbols of the cooperation, Valladolid's city authorities are testing a fully electric VW Rabbit (e-Golf) provided by the 'Amt electric' while the metropolitan region financially supports the use of the Renault Twizy in the metropolitan region's municipal fleets.

The municipalities of the metropolitan region and the City of Valladolid are cooperating in piloting concepts for the promotion of e-mobility. For the last two years now, the responsible teams of the 'Amt electric' and of the Innovation Agency of Spain's Castile and León region have been exchanging experiences and knowledge on e-mobility. The cooperative efforts also involve several French regions and organizations, based on a project for international cooperation and knowledge exchange with municipalities, regions and associations in France and Spain funded by the German Federal Ministry for Economic Affairs and Energy. In addition, the efforts include various activities at international trade fairs and conferences as well as the *better transport forum* of the metropolitan region.

At this year's Hannover Messe, Valladolid has been involved for the third time in the *better transport forum* to present its municipal e-mobility strategies as well as the European project 'Faro REMOURBAN' for holistic and sustainable urban renewal. In this area, Valladolid has taken over a pioneering role in introducing innovative technological solutions for mobility, energy efficiency and ICT.

Extended cooperation

Initially aimed at promoting e-mobility, the initiative has developed into an established cooperation network, which will be given a more formal structure over the coming months and extended to cover additional energy- and transport-related topics. Moreover, the existing international contacts shall be used for closer networking on the European level. A transnational competition for the visual design of the Renault Twizy will help enhance the initiative's public profile. All this makes an important contribution to redesigning e-mobility and to closer cooperation between different campaigns for the promotion of sustainable mobility in Europe. ■

Renault Twizy e-cars used in the cities of the metropolitan region
Photo: Amt electric

Sabine Flores
Managing Director, Kommunen in der Metropolregion e.V., Hannover, Germany
sabine.flores@metropolregion.de

Figure 1: Delegates at the 2MOVE2 kick-off in Stuttgart

Photo: City of Stuttgart

CIVITAS 2MOVE2 project

Putting sustainable mobility into practice in European cities

E-mobility, non-motorized mobility, public transport, information services

Increasing urban traffic and its consequences such as congestion, accidents and pollution pose a major challenge for European cities. The adverse side-effects of urban mobility are directly affecting the attractiveness and the competitive position of cities. Therefore, transport and mobility are of the highest priority for local decision makers and practitioners. Against this background, in the year 2000 the European Commission confirmed the need for action and launched the CIVITAS initiative, designed as a program "of cities for cities." In one sentence, the heart of CIVITAS is to explore "innovative solutions to the challenges posed by creating a more sustainable urban mobility culture."

Authors: Patrick Daude, Wolfgang Forderer

Knowing that every city is different and has to address the particularities of its own situation, CIVITAS helps to identify similarities and to find solutions that meet the needs of a city faced with a challenge in the field of urban mobility. This is mainly achieved through the implementation of joint projects and the organization of study visits and workshops that provide general guidance as well as technical assistance to cities.

The program also aims to support the exchange of ideas and experiences between politicians, professionals and technicians. Currently 228 cities across 34 countries exchange knowledge and develop joint projects to implement sustainable urban transport measures. The CIVITAS Forum is the main conference where cities and local authorities involved in the program meet every year in a different European city. Four member cities of the "CIVITAS Family" are part of the 2MOVE2 project, a European mobility initiative under the current CIVITAS Plus II program dealing with innovative solutions in the field of clean urban transport.

Different cities – similar realities

The 2MOVE2 consortium scores with the strong participation of four cities: The municipalities of Stuttgart (Germany, leading partner), Brno (Czech Republic), Málaga (Spain) and Tel Aviv-Yafo (Israel) are cooperating closely, relying on a solid basis of cooperation that they have built in the course of previous European programs. The cities are supported by the transport engineers of SSP Consult and the University of Stuttgart (both Germany), the public transport company of Brno (DPMB) and the Technion – Israel Institute of Technology. 2MOVE2's main objective is to achieve concrete and visible improvements in the mobility situation of the participating cities by fostering or creating energy-efficient and environment-friendly urban transport systems.

The 2MOVE2 project was launched officially in June 2013 at a kick-off meeting on the political level (see *figure 1*). Government representatives from the four cities as well as key urban mobility stakeholders discussed the challenges of the project and of urban mobility in general in the current European context. Up to now, two annual Consortium Meetings have taken place in Tel Aviv-Yafo (2014) and Málaga (2015). The next one will be held in the city of Brno in

2016. The events are aimed at strengthening the relations between the cities on the political and technical levels. Usually, they are combined with public workshops for national stakeholders involved in the respective topics.

In line with the idea of defining and implementing similar measures and initiatives in the partner cities, the 2MOVE2 partners are working on the development of a total of 23 measures. Even if the legal framework differs in the respective countries, the cities themselves face comparable situations regarding the impact of motorized traffic, the need to improve air quality, and the infrastructure for environment-friendly transport and public space. In many cases, instead of reinventing the wheel, the authorities need only to take the successful experiences from another city and adapt their actions to the specific needs of their own location. A good example for this approach is the cooperation between the cities of Málaga and Brno. Representatives of the Czech city made a study visit to Málaga to learn how this city had built up a system for the management of on-street parking using wireless sensors installed in parking places in order to inform drivers on parking availability. The discussions and site visits have provided the technicians of Brno with valuable information that will help them install an on-street parking system in selected urban streets in 2015.

The development and implementation of similar projects and initiatives in the four cities will allow the evaluation and comparison of the results and impacts, which can lead to improvements in urban mobility. In addition, the measures have been selected to allow transfer and applicability to other small and medium-sized towns, especially in Europe.

Capacity building – a requisite for anchoring sustainable mobility in the municipality

The training of municipal technicians working in the areas of mobility management and transport planning is a key issue for the CIVITAS Program in general and the 2MOVE2 project in particular. Several workshops and study visits have been organized with the aim to deepen the knowledge of municipal staff and to strengthen their capacity to plan and implement ambitious mobility measures in their cities. These events were mostly offered in conjunction with the annual Consortium Meetings, which are attended by all partners. Where possible, such trainings are organized together with the CIVITAS Secretariat and the sister project DYN@MO. The CIVITAS Forum that is taking place every year in a different European city is a platform for 2MOVE2 partners to meet and exchange knowledge and experiences with their peers from other cities. This opportunity to make personal contact and build lasting relations between the municipalities is very important because it helps to share best practices, to inform the other parties on failures and to take the right decisions.

A broad approach – from freight transport and ITS to cyclists and pedestrians

The project covers a broad range of topics. 2MOVE2 gives special emphasis to e-mobility, freight transport and ITS-based traffic management. An additional focus is the continuous alignment of the projects with the Sustainable Urban Mobility Plans (SUMPs) as well as with urban development plans.

Other important topics that are addressed in the scope of the measures are the promotion of non-motorized mobility and public transport, as well as corporate mobility management and information services for companies and citizens.

The partner cities share the view that a long-lasting effect of all activities can only be achieved if these measures are not isolated, but part of a comprehensive system combining all efforts in the fields of urban planning, environment, traffic and transport, and civil society in general. The 23 measures are complemented by awareness campaigns, workshops and educational and information events for citizens and stakeholders in order to give the project and its results a strong visibility on the local and national levels.

The 2MOVE project covers activities in seven thematic categories of the CIVITAS Program:

1. Clean fuels and vehicles
2. Collective passenger transport
3. Demand management strategies
4. Mobility management
5. Car-independent lifestyles
6. Urban freight logistics
7. Transport telematics

In the last couple of years the City of Stuttgart has faced major problems with air quality in some areas of the inner city due to its basin-like topographic location and the high number of car trips. Stuttgart has 590,000 inhabitants and nearly as many jobs. Every day 400,000 cars are passing the city borders from outside. There are a limited number of main arteries for car traffic, which are congested at peak hours despite the valuable efforts of the Integrated Traffic Control Center.

The city is currently implementing a test site on a stretch of 6 km on a main artery in the city center to investigate how the reduction of stop-and-go traffic can lead to a more steady flow of traffic and if this will have a measurable impact on traffic-related emissions and air pollution. By introducing a dynamic speed limit that allows responses to rising air pollution levels caused by congestion or thermal inversion, the City of Stuttgart intends to develop an emission-based traffic control model for the inner urban area and to test and validate the model in a field trial (*figure 2*).

At the same time, the municipality will strive to mitigate any negative effects on pedestrians, public transportation and bicycle traffic (*figure 3*). Equally important, the

Figure 2: Emission-based traffic management in Stuttgart Photo: City of Stuttgart

Figure 3: Light rail in Stuttgart Photo: VVS

priority traffic network should be maintained to avoid crowding of surrounding residential areas. The measure also allows the comparison between the effectiveness of "hard" and "soft" measures: While there is a mandatory speed limit on some sections of road, there is another part of the same road where there is only a recommended speed – the benefit for car drivers who adapt their speed are green lights at the next two big intersections. The municipality expects a reduction in emissions on the test site especially during peak hours: –10 % for NOx and –15 % for PM10.

The City of Málaga, second largest city of the Andalusia Region, is also dealing with the topic of air quality using a very innovative concept. The measure consists in installing mobile sensors for air quality measurement on the top of four buses of the public transport fleet (*figures 4 and 5*). The sensors will provide reliable data on the evolution of air quality in several areas of the city that are not covered by the four fixed stations currently existing in Málaga. This measure constitutes an innovative approach since air quality measurement in cities normally involves only the use of fixed monitoring stations. The buses equipped with the sensors will follow itineraries where other demonstration measures will be implemented. This will allow to dynamically measure air quality levels and to estimate the measures' air quality improvement effect. The mobile sensors will complement the information on CO, NO_x and ozone emissions provided by fixed stations in several areas of the city (mobile measuring of PM 10 is not possible). All data is collected in the Málaga Mobility Management Center (MOVIMA). The center will assess the air quality levels before and after the development of the other measures to be carried out within the 2MOVE2 project.

Many European cities are developing strategies for the smart control of traffic. The quality of life of the citizens is negatively impacted by excessive congestion, noise and pollution. The City of Brno faces the challenge of maintaining its relatively high share of public transport and fostering

Figure 4: Mobile sensors for air quality measurement in Malaga Photo: City of Malaga

Figure 5: Malaga public transport bus equipped with mobile sensors for air quality measurement Photo: City of Malaga

the use of sustainable transport systems. In the scope of 2MOVE2, the City of Brno is planning to significantly expand its Transport Information Center along with the acquisition of new sources of telematics information, particularly by exploiting the latest technologies for data transfer to users (*figure 6*). The data acquired through telematics or other sources will be evaluated together with data from public utilities owned by the public transport company and BKOM, a company responsible for maintaining the city's streets. Exploiting this information will offer several benefits: reduction of the transport load and motorized individual traffic, promotion of parking in designated parking lots and venues. Furthermore, it will help enhance traffic safety and reduce the environmental impact of transport. This information will be available online and through a stand-alone mobile application available for download. The City of Brno will use the resources from the 2MOVE2 project to complement the data of public utilities and to create and evaluate the system used to monitor the occupancy of parking places located in paid-parking sectors.

Figure 6: Integrated Mobility Center in Brno Photo: City of Brno

Figure 7: Green arteries in Tel Aviv-Yafo Photo: City of Tel Aviv-Yafo

However, 2MOVE2 encompasses not only technical solutions. A good example for a soft measure is the "green artery project" in the city of Tel Aviv-Yafo (*figure 7*). The financial, economic and cultural center of Israel has been working on curtailing the predominance of motorized vehicles for individual transport through the creation of green arteries as a fundamental building block towards a social and sociable environment. The green arteries concept is one way of implementing the green backbone approach within the existing city street network, in line with Tel Aviv-Yafo's municipal policies, which encourage the use of non-motorized transportation in the city.

In the past, the streets of Tel Aviv-Yafo not only acted as an urban transit network, they were the heart of urban life, a place for commerce, cafés and interaction between people. Until recently, pedestrians and the life and activity they bring to the streets were increasingly pushed aside. The street space deteriorated and its function as a non-motorized environment eroded. The aim of the measure is to raise public awareness of the value of green arteries as an environment that is both a social and a sociable space, as well as part of a synergy of land use, transport planning and promotion of non-motorized transport modes. As a major component of the urban renewal policy, a green artery along the eastern part of the city (Quarter 9), linking schools, local gardens and urban parks, is being created. The measure also has a social impact due to the fact that the green artery reaches a part of the city that used to be segregated from the rest of Tel Aviv-Yafo. The green arteries include a high-quality infrastructure for cyclists and pedestrians combined with leisure facilities.

For more information on the EU project 2MOVE2 please visit the official CIVITAS website at http://www.civitas.eu/content/2move2 ■

CIVITAS 2020 2 MOVE 2
Cleaner and better transport in cities

THE CIVITAS INITIATIVE IS CO-FINANCED BY THE EUROPEAN UNION

Patrick Daude, M.A.
Project Dissemination Manager
2MOVE2, Mobility Department,
City of Stuttgart
patrick.daude@stuttgart.de

Wolfgang Forderer
Project Coordination 2MOVE2,
Head of Policy Planning, Mobility
Department, City of Stuttgart
wolfgang.forderer@stuttgart.de

Sustainable mobility made in Germany

The German Partnership for Sustainable Mobility – a promising network for sustainable solutions

A wide range of intractable problems such as polluting emissions, noise, fatal traffic accidents, resource depletion and inaccessibility of amenities are directly linked to the current transport regimes. Developing countries and emerging economies are often more affected by these negative effects than developed countries. In many cases, high transport costs and inaccessibility are hampering economic development and trade, health problems related to air pollution are on the rise, and every year around 1.3 million people die in road accidents, the vast majority of them in developing countries.

Many mobility problems faced by developing countries and emerging economies today are strongly linked to global challenges such as climate change, dwindling natural resources, demographic trends and migration. Reconciling socio-economic development with the protection of our livelihood is the greatest challenge in the 21st century.

But there is good news: Smart solutions exist. Germany has a long history of successful changes and transformations in the transport sector – including:

- establishment of comprehensive funding schemes
- re-emergence of walking and cycling as safe and viable modes of transport
- reorganization of the public transport sector
- continuous development of progressive regulations
- development of efficient propulsion systems
- integration of different modes of transport, including multimodality in logistics

Academia, businesses, civil society and associations have gathered invaluable experiences and skills in shaping these transformations.

The international exchange of ideas in the field of sustainable mobility and logistics offers a unique opportunity to help solve one of the greatest challenges of our generation.

The German Partnership for Sustainable Mobility (GPSM) is an initiative by the Federal German Ministry for Economic Cooperation and Development (BMZ) and the Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). It covers a wide range of focus areas, from smart mobility, logistics and public transport to technology and clean air.

Germany is a world leader in sustainable, innovative and efficient mobility solutions. By pooling the knowledge and expertise available in Germany, the GPSM makes a valuable contribution to the international dialogue on smart transportation and to sustainable development worldwide.

What we do: We disseminate know-how by giving international players access to German mobility and logistics expertise. We support the international dialogue on sustainable transport by organizing technical visits, themed forums and events during fairs and congresses to establish contact between decision makers, academia, business and civil society. We provide information on financing options by identifying funding methods and financing instruments.

A glance of what our partners do: Their fields of activity are outlined in the following. Get in touch!

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German Partnership for Sustainable Mobility

Sustainable Mobility – Made in Germany

More about us on:
www.german-sustainable-mobility.de

Insa Eekhoff,
Deutsche Gesellschaft für Internationale Zusammenarbeit (giz) GmbH, Transport and Mobility, Division 44 Water – Energy – Transport, Eschborn (DE)
insa.eekhoff@giz.de

DELPHI

Innovation for the Real World


Photo: Christian Mueller/Shutterstock #121403308

ECODyNIS – Milestone in navigation systems

Delphi is part of ECODyNIS, a Lower Saxony consortium that has successfully completed a research project to substantially improve the dissemination of real-time traffic data in Hanover. The project was the first to make use of inner-urban traffic-related information sent via DAB+ (Digital Audio Broadcasting) radio. For the first time, this information is now accessible to drivers in the Greater Hanover area. Partners in the ECODyNIS consortium include: Volkswagen AG, Delphi Deutschland GmbH, Elektrobit Automotive GmbH, pqm GmbH, Media Broadcast GmbH, bmt GmbH, Region and City of Hannover.

Although widely used on FM radio in Germany, the Radio Data System/Traffic Message Channel (RDS/TMC) offers limited data capacity: It is only able to address a limited number of pre-defined locations and cannot provide details on construction work or other problems in urban areas. All too often, drivers in larger cities do not become aware of problems until it is too late to plan alternative routes. The resulting "stop and go" traffic is counterproductive for emission reduction and creates a real challenge for electric vehicles with limited battery ranges.

In response to this challenge, the ECODyNIS consortium successfully monitored traffic information in the Hanover region, which was converted automatically to the TPEG format and then transferred to the DAB+ radio network with subsequent transmission on channel 5C.

"Our participation in this project provided a great opportunity to demonstrate the advantages of our flexible radio and navigation platform architecture by easily integrating software modules and services provided by our project partners into our system," said Lee Bauer, Managing Director, Delphi Infotainment and Driver Interface (IDI) Europe.

Dorina Laass,
Delphi Electronics & Safety Europe,
Nürnberg (DE)
dorina.laass@delphi.com

Partner of German Partnership for Sustainable Mobility
Sustainable Mobility – Made in Germany

nextbike

Bikesharing 4.0 – the next generation

Within the last decade bikesharing systems have become increasingly relevant for first-/last-mile connectivity within urban mobility networks. Since the launch of the first large-scale system in Lyon in 2005, bikesharing has mushroomed in more than 800 cities worldwide, making cities more sustainable. The year 2015 seems to be the turning point where 'Smart Bikes' are finally taking over.

As one of the technology leaders, nextbike GmbH based in Leipzig, Germany, is rolling out a fleet of about 4,000 Smart Bikes in cities like Cologne, Munich, Pittsburgh or West Palm Beach this spring and summer. Every Smart Bike is able to communicate directly with the Cloud servers in what is called 'machine-to-machine' (M2M) communication', making heavy infrastructure station installations redundant. Moreover, integrated GPS devices and smartcard readers compatible with MIFARE and DESFIRE offer completely new opportunities for novel bikesharing concepts within the urban mobility network. In combination with station infrastructure, a whole variety of hybrid systems is possible (see table).

With currently 25,000 bikes in more than 80 cities, nextbike is one of the world's leading suppliers and operators of bikesharing systems. As a specialized service provider with ten years of experience, we are complementing the existing urban public transport system. Thanks to its strong ability to link into existing card and payment systems, nextbike adds value in particular to cities that intend to achieve the maximum level of seamlessness and integration.

Sebastian Schlebusch,
Head of International Business Development,
Leipzig (DE)
schlebusch@nextbike.de

Partner of German Partnership for Sustainable Mobility
Sustainable Mobility – Made in Germany

3rd generation (station-based)	→	4th generation (Smart Bike)
• Bulky, heavy infrastructure	→	• 'Analog' docks, 'virtual' stations, geo-fenced service areas or 'hybrid' systems
• High upfront capital investment	→	• Cost-efficient solution
• Site planning procedures often complex	→	• Usage of existing bicycle infrastructure possible
• Return at fully occupied stations impossible	→	• Stations can never be fully occupied as Smart Bikes need not be locked to an infrastructure device
• High costs for redistribution of bikes	→	• Redistribution costs can be cut by half by focusing of empty stations only

Table: Evolution of bikesharing

PTV GROUP

the mind of movement

The mind of movement – Shaping today's and tomorrow's mobility

Our cities are becoming the control centers for the future. They pulsate with life. The urban metropolitan areas are important hubs for labor, economic growth and the application of innovation as well as gateways to an attractive life. Huge influxes of people, companies and organizations are moving to the city – for widely differing reasons.

Demand for transport is high: People and goods use a number of different means of transport, such as by bicycles, trains, cars or vans, to reach their destination. As space is limited, sharing schemes are increasingly considered the way forward: sharing the purchase costs, the means of transport and the infrastructure. New forms of travel add spice to day-to-day mobility. A wide range of options accommodate the different motives of the individual users, e.g. getting there as soon as possible, traveling on a budget, safely or in an environment-friendly way. We need livable cities and well-functioning freight transport to ensure reliable supply. Moreover, there is a high demand for multimodal, smart mobility options. For urban planners, it is not an easy job to define suitable fundamental conditions when planning sustainable transport.

As a market leader, PTV Group is committed to meeting the requirements of the future and taking an active part in shaping it in a responsible manner. To this end, the company provides advanced software solutions and consulting services for transport and logistics planning and is involved in forward-looking projects. Customers in more than 100 countries rely on PTV's solutions such as PTV Map&Guide for transport route planning, PTV Drive&Arrive for dynamic optimization of the entire transportation chain, or PTV Visum for strategic transport planning, and PTV Vissim for traffic simulation. Moreover, PTV is an active member of political, business and scientific associations as well as supranational networks. It is above all a matter of seeing mobility as a complex whole and helping to create and optimize urban logistics and passenger transport at the same time.

Vincent Kobesen,
CEO, PTV Group, Karlsruhe (DE)
vincent.kobesen@ptvgroup.com

Partner of German Partnership for Sustainable Mobility
Sustainable Mobility – Made in Germany

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teamred

Innovation consulting for tailor-made mobility solutions

The team red can rely on the expertise gained in 13 years of experience in developing market- and customer-oriented mobility solutions, such as urban transport plans, carsharing solutions, integrated mobility cards, cycling policies and bike rental systems.

With tailor-made solutions based on the client's requirements, the interdisciplinary and dedicated team of more than 50 experts at team red guarantees reliable performance, always working in close collaboration with the client. Mutual trust and long-term partnership are the fundamental business values.

The mobi-MAX product, for example, offers a mobility management solution for companies seeking to promote sustainable mobility among employees. The analysis, development and implementation of the right measures for the individual company will improve the quality of life for the employees and help the company reduce costs (www.mobi-max.eu).

The Shared Mobility team works with a view on the mobility of the future. The team develops, implements and evaluates new mobility services to meet the challenging transport planning requirements of cities, citizens and companies (www.shared-mobility.info).

Photo: Jorg Hackemann/Shutterstock #51068710

The Mobility Academy is the perfect place if you want to keep abreast of new developments in the sector. Different formats, such as workshops and Learning Journeys, offer the opportunity to share knowledge about all aspects of mobility, connecting different branches, providers and clients (www.mobility-academy.com).

Presentación Victorero-Solares, Dr.-Ing.,
International Consulting, team red
Deutschland GmbH, Berlin (DE)
presentacion.victorero-solares@team-red.net

Partner of German Partnership for Sustainable Mobility
Sustainable Mobility – Made in Germany

TCP INTERNATIONAL
TRANSPORT CONSULTING PARTNERS

NAVIGAR – Traffic control centers & routing systems

Integrated traffic control centers in cities respond to current traffic situations such as congestion, accidents or construction sites, by issuing routing recommendations to the car drivers via dynamic signposts and traffic light systems along the roads. Unfortunately, private navigation software does not yet take these public strategies into account, since the public and private systems are not linked to each other. As a consequence, the preferred routes of the private navigation systems often

counteract public traffic management strategies.

NAVIGAR is a new technical solution conceptualized by TCP International and currently tested in the City of Stuttgart. It is designed to bridge the gap between public traffic control centers and private navigation software, enabling onboard and mobile navigation software to account for all messages and strategies issued by the control centers. Public traffic measures will be transferred to the navigation software via standardized interfaces using DATEX-II format. The private navigation systems then incorporate this information in their calculation routine and adapt the routing accordingly.

A live link between public and private navigation will ensure sustainable traffic routing through the city, helping to reduce congestion and contributing to cleaner air, better usage of street capacity, enhanced traffic safety and thus to more livable cities.

TCP International supports cities in creating the necessary preconditions for the introduction of such systems. This is just one example of TCP International portfolio to cities in Germany, Europe and worldwide in creating the necessary preconditions for the introduction of sustainable mobility solutions.

Carsten Schürmann, Dr.-Ing.
Director Planning, TCP International, Stuttgart (DE)
cs@tcp-international.de

Angelika Zwicky, Dipl.-Volksw.
Director Strategy, TCP International, Stuttgart (DE)
az@tcp-international.de

Partner of German Partnership for Sustainable Mobility
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Photo: Jung

Fewer cars, more mobility

Can carsharing work in China?

Mass motorization, urban traffic, air pollution, parking management

In response to China's rapidly increasing vehicle population, the first carsharing operators are entering the Chinese market to complement the range of alternatives to car ownership. From the emergence of such services in 2009 until today, more than 330,000 people signed up for a carsharing membership in China – equivalent to almost one third of the total number of carsharing members in Germany, one of the world's largest carsharing markets. Considering that carsharing in China is still in an embryonic stage, its dynamic development indicates potential for further growth. Nevertheless, public and political awareness of carsharing is low, and uncertainties related to the feasibility of large-scale applications remain.

Author: Alexander Jung

Although China became the world's largest automobile market in 2009, its level of motorization is still comparatively low. With about 69 private passenger cars per 1,000 citizens, there is a significant disparity in car ownership between China and developed countries such as Germany (588 cars per 1,000 citizens) and the USA (786 cars per 1,000 citizens) [1]. Rising car ownership in China is very much an urban phenomenon, concentrated mostly in Chinese megacities and metropolitan regions. While here, the expansion of the automotive market has been a major driving force for the economy, serious climate and environmental concerns have cast a shadow on this development. Severe air pollution, inefficient land use, tremendous congestion levels, increasing parking demand and road accidents are among the negative effects of the unprecedented growth over recent decades.

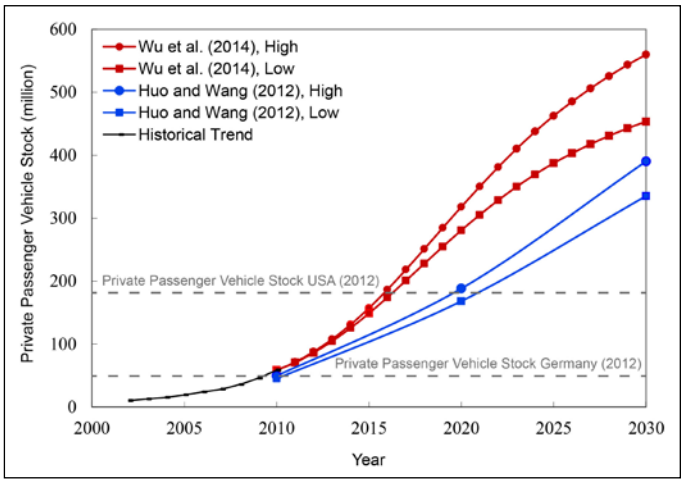

Figure 1: Private passenger vehicles in China: Historic data and projection until 2030
Source: Wu et al, 2014

Mass motorization in China: no end in sight

China's level of urbanization is expected to rise from the current 53.7 % to 60 % in 2020 [2]. Paired with continued economic growth

and increasing per-capita income, urban mass motorization is unlikely to halt anytime soon. Recent projections of the School of Environmental Studies at Tsinghua University, one of China's leading academic institutions, forecast a four- to six-fold increase in the number of private passenger vehicles by 2030 (*figure 1*). This would add between 250 and 450 million cars to the already clogged streets in Chinese cities.

The expected effects of continued mass motorization are daunting and exacerbate the pressure on Chinese city planners and political decision makers to provide livable urban environments. Consequently, various Chinese megacities have already introduced restrictions on private car ownership, such as driving ban days and license plate limitations. Nevertheless, additional demand-based strategies are necessary to persuade urban residents to adopt more sustainable transport modes, and to slow down or ideally prevent a further rise in private car ownership in the mid- and long-term.

Carsharing – booming throughout Europe and North America, but largely unknown in China – could tie in with China's already existing urban transport policies and complement a broader strategy aimed at mitigating the rapidly increasing motorization in cities. The integration of carsharing in urban transport can help reduce private car ownership, while meeting the demand for individual mobility. Moreover, carsharing users tend to shift their mobility behavior towards public and non-motorized transport modes, which contributes to a reduction of vehicle kilometers traveled (VKT). Experience in Europe suggests that each carsharing vehicle will replace four to ten private vehicles, and carsharing users usually reduce their VKT by 28 % to 45 % [3].

China's carsharing market in numbers: absolutely impressive, relatively small scale

While carsharing is gaining more and more international attention, the availability of carsharing in China is still limited and its impact on urban transport is barely quantifiable. Among a total of eight station-based carsharing companies in 2015, Yi Dian Zuche is currently the largest Chinese carsharing service. In 2009, the company pioneered carsharing in China with ten shared cars and five stations in Beijing. Since then, Yi Dian Zuche has expanded its service to nine other Chinese cities, offering a total of 1,000 vehicles to almost 280,000 registered members. As of April 2015, the overall size of the Chinese carsharing market is about 336,000 members, who share 4,915 vehicles at 1,018 stations in 13 cities (table 1). Compared to the size of the European or North American carsharing market, these are certainly impressive numbers, but in relation to the populous Chinese cities, the services are still operating on a small scale. Nevertheless, the momentum of Chinese carsharing activities in recent years does not only spark the interest of domestic companies. Besides two corporate carsharing pilot projects initiated by Daimler and Volkswagen,

Service	Operator	Founding year	Business model	Vehicles	Stations	Members	Cities	Website
Yi Dian Zuche (EduoAuto)	EduoAuto (Beijing) Technology Co., Ltd	2009	Station-based carsharing	1000	769	278419	Beijing Changsha Chengdu Chongqing Hangzhou Nanjing Shenzhen Shijiazhuang Suzhou Wuhan	www.yidianzc.com
China Car Clubs	Hangzhou Cherry Intelligence Co. Ltd.	2010	Station-based carsharing	200 (incl. 50 EV)	78	38000	Hangzhou (Membership cooperation with Green Go in Beijing)	www.ccclubs.com
car2share	Daimler Greater China Ltd.	2013	Station-based corporate carsharing	90	3	Membership limited to pilot partners during initial phase.	Guangzhou Shenzhen	www.car2share.daihing.com
VRent	Volkswagen New Mobility Services Investment Co., Ltd	2013	Station-based corporate carsharing	25	5	Membership limited to pilot partners during initial phase.	Beijing	www.vrent.cn
Wei Gong Jiao	Zhejiang Kandi Electric Vehicles Co., Ltd. (Joint Venture of Zhejiang Geely Holding Group and Kandi Technologies Group)	2013	Station-based carsharing	~2500 (estimated, EV only)	34	n.d.	Hangzhou	No website available. Booking only via WeChat.
EVCARD	New Energy Vehicles Operating Services Co., Ltd.	2013	Station-based carsharing	300 (EV only)	53	3000	Shanghai	www.evcardchina.com
Green Go	Beijing Heng Yu New Energy Car Rental Co. Ltd. (Joint Venture between BAIC New Energy Co., Ltd. and Foxconn Technology Group)	2014	Station-based carsharing	700 (EV only)	26	15000	Beijing (Membership cooperation with China Car Clubs in Hangzhou)	www.green-go.cn
GX Zuche	Car-sharing Rental Co., Ltd.	2014	Station-based carsharing	100 (incl. 10 EV)	50	2000	Yantai	www.gx-zuche.com

Table 1: Overview of carsharing services in China

Source: Data collected from carsharing operators, April 2015

the German mobility provider moovel announced early this year to bring its free-floating carsharing service car2go to China. Moovel and the Chongqing Municipal Government agreed on launching car2go in the central Chinese megacity by the end of 2015. Chongqing will be the first Chinese city and the first city in Asia to include free-floating carsharing in its urban transport system.

Since carsharing is still not a common mobility service in China, numerous questions arise, especially related to the necessity of adapting the service to specific Chinese market requirements. In this respect, the current public and academic discussion often revolves around cultural barriers or competing transport modes, for instance inexpensive taxis, as market barriers for carsharing in China. However, those questions concern more the growth potential of the mobility service than its actual feasibility. From the perspective of Chinese operators, more pragmatic concerns regarding the implementation of the service are relevant. "At present, we are facing parking as a major challenge for further expansion. Taking Beijing as an example, parking accounts for a large proportion of our operating costs. In addition, parking demand is high and the availability of parking in key locations is limited," says Liu Wenjie, CEO of Yi Dian Zuche. "For this reason, we are hoping to receive support from the government in terms of exclusive parking lots for carsharing in public areas."

Parking is a key challenge for carsharing operators around the world. In China, unclear parking responsibilities as well as poor parking management can hamper the development of the mobility service. While parking has often been neglected in China, the first cities, for instance Beijing and Shenzhen, are currently introducing on-street parking management strategies, which might contribute to the feasibility of carsharing. The introduction of comprehensive pricing schemes could shift demand towards off-street parking and open up highly valuable public on-street parking spaces for carsharing. Moreover, free-floating carsharing in particular could tremendously benefit from the consolidation of parking authorities, as the operators depend on finding an agreement with cities on how to pay for the usage of public parking spaces.

Figure 2: While the electric cars resemble a popular German two-seater, Wei Gong Jiao has revolutionized the design of carsharing stations. Photo: Jung

The Hangzhou-based carsharing company Wei Gong Jiao benefits from the tense parking situation by turning the related problems into a smart business opportunity. Against the common practice of Chinese carsharing operators to set up stations on private parking spaces in underground car parks, Wei Gong Jiao makes its fleet available in fully-automated parking towers (*figure 2*). Distributed across the whole city area, these innovative carsharing stations strongly contribute to the service's convenience and visibility. But Wei Gong Jiao does not only see an opportunity for carsharing in the high parking demand. The operator's carsharing fleet consists exclusively of electric vehicles (EV), leveraging another promising driver for carsharing in China: electro-mobility.

Carsharing does not need electric vehicles, but electric vehicles might need carsharing

China's continuously growing traffic volume does not only cause environmental concerns, but also increases the pressure to address China's strong dependence on oil imports. Against this background, electro-mobility has been singled out as a key technology to achieve sustainable mobility. Purchase subsidies of up to 120,000 CNY (~17,000 EUR), privileged license plate availability and exception from driving bans are exemplary governmental incentives to meet the ambitious target of five million electric vehicles in China by 2020. However, as private EV ownership comes with technical limitations in terms of range and charging, as well as with a certain price tag even after subsidies, there is still a large gap between the announced and the actual number of EVs. Tony Lai, General Manager of the Hangzhou-based carsharing service China Car Clubs, sees great potential for carsharing in the slow development of the EV market. "For our carsharing service China Car Clubs, increasing the awareness of carsharing among local authorities is part of our overall development strategy. We are highly confident that especially our future plan to integrate more electric vehicles in our carsharing fleet will help to generate a higher level of awareness and support from the government."

The integration of electric vehicles could prove to be a valuable opportunity for carsharing operators to receive policy support beyond existing EV promotion in exchange for their contribution to major governmental objectives. On the one hand e-carsharing can encourage the diffusion of electro-mobility by facilitating low-cost access to electric vehicles and eliminating the mobility limitations private EV owners have to face. On the other hand, electro-mobility alone will not solve transport-related issues, such as congestion and space consumption, caused by high private car ownership. Yet e-carsharing can help to reduce demand for private vehicles and – depending on the energy source – provide access to low-carbon mobility at the same time.

Access beats ownership: carsharing can complement sustainable urban transport

Recognizing the challenge of rapid motorization, China is committed to limiting the climate and environmental impact of transport not only by promoting electro-mobility, but also by implementing other low-carbon transport policies. In addition to extensive investments in public transport infrastructure, various Chinese cities have adopted transport demand management strategies to discourage the use of private cars and to promote walking, cycling and public transport. Combined with an increasing number of cities with restrictions and strict regulations on car use and ownership, the range of pressing problems in the urban transport sector might be another essential market driver for carsharing. Especially in cities such as Beijing, where cars are partially restricted, but bikesharing, taxis, buses and subway – all accessible with one ticket – provide seamless multi- and intermodal mobility, the integration and promotion of large-scale carsharing services would be the next step towards a sustainable urban transport system. "As a new transport mode, carsharing plays a prominent role in relieving urban traffic congestion, reducing energy consumption and environmental pollution, as well as effectively enhancing the attractiveness of public transport. China is in an important phase of rapid urbanization, and carsharing can provide a comple-

REQUESTED IN BRIEF

Three questions to Michael Glotz-Richter, Head of Sustainable Mobility of the City of Bremen

Michael Glotz-Richter is one of the carsharing pioneers in Germany and regularly invited by the Sino-German Cooperation Project on Electro-Mobility and Climate Protection[1] to advise Chinese ministries and cities on carsharing as a contribution to sustainable urban transport in China.

Mr. Glotz-Richter, you have been focusing on carsharing for more than 20 years. How do you assess the current situation of carsharing in China?

"Since my first invitation to China in 2008, many things have changed. By now, the first privately owned companies are offering carsharing services. They have recognized the huge potential of this market. The interest in Chinese cities is enormous, as the pressure to act is high. Cities are running out of space for driving and parking cars alike. Intelligent solutions are needed to mitigate these problems. Those who are familiar with parking demand and air quality in Beijing, know that carsharing can have a bright future in China."

Do you think the Chinese government will promote carsharing?

"I think it is a very positive signal that the Ministry of Transport (MoT) has recently and for the first time ever put carsharing on the agenda of a three-day transport training with 250 decision makers from all over China. MoT invited me to speak about carsharing and sustainable mobility. Back in 2013, GIZ organized a study tour on carsharing concepts in Germany and the Netherlands with representatives from MoT. This indicates the increasing importance of sustainable urban transport concepts for MoT, including carsharing systems."

Photo: Jung

Is it possible to compare the momentum of Germany's pioneer phase 20 years ago with the current situation in China?

"A comparison is only possible to a limited extent. The opportunities in China are much better nowadays. When we started the concept in Germany, people used to smile at carsharing, mistaking it for a social experiment. Today, Germany alone counts more than 1,000,000 carsharing users. Back then, technologies such as the internet and smartphones, which make carsharing so convenient nowadays, did not yet exist. Nor did we have the market experience that we have today. If a city wants to introduce carsharing now, it can simply use a proven set of tools and start right away. Carsharing is a question of political will. And it requires a good private provider."

[1] The Sino-German Cooperation Project on Electro-Mobility and Climate Protection is funded through the International Climate Initiative of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in China.

mentary tool for solving the urban traffic problem," says Wang Hao, Deputy Director of the Road Transport Department at the Research Institute of Highways, a think tank under the Chinese Ministry of Transport. "Governmental efforts to promote carsharing and carsharing-related benefits can shift the mobility behavior of urban residents towards carsharing and public transport. The Government should endorse low-carbon travel and make people understand and use carsharing."

But even if private car ownership retains its current high status in China, it will become increasingly difficult and inconvenient to own and use a private vehicle in densely populated urban areas. Restrictive policies, parking demand and traffic congestion as major downsides of hyper-motorization are counteracting the benefits of owning a car. Facing the projected increase in private car ownership until 2030, it does not seem irrational to imagine a scenario that will take the already existing restrictions and regulations on private car ownership in major Chinese cities one step further. City centers with environmental zones open only to shared vehicles, electric vehicles, taxis as well as public and non-motorized transport might be one of the mid- to long-term consequences of continuous growth. This would be a major game-changer in the discussion about the feasibility of carsharing in China and a good reason to stop talking about culture-related obstacles to sharing cars. ■

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Alexander Jung
Project Manager Sustainable Transport in China, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Beijing (CN)
alexander.jung@giz.de

All photos: GIZ

MoveWindhoek – Sustainable urban transport in Namibia

Challenges and solutions for an African flagship project in urban transport development

Sustainable transport, urban transport, middle-income country, Africa, public transport, Namibia

Moving Windhoek's transport system to a sustainable, affordable, accessible, attractive and efficient transport system focusing on public and non-motorized transport is the aim of a coalition of the Government of the Republic of Namibia, represented by the Ministry of Works and Transport and the Ministry of Urban and Rural Development[1], the City of Windhoek and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. In the scope of the joint project, a Sustainable Urban Transport Master Plan[2] has been developed that will enable decision makers in the transport sector to implement measures according to a long-term vision for sustainable transport through public participation.

Authors: Gregor Schmorl, Michael Engelskirchen

Across the world, cities and urban areas are facing increasing environmental, social and economic challenges caused by inefficient urban transport systems. This results in reduced accessibility and affordability for the urban poor, traffic congestion, increasing cost and space for streets and parking facilities, traffic accidents, high consumer costs, high pollution and energy dependence, plus inadequate mobility for non-drivers.

Initial transport situation in Windhoek

Obviously Windhoek is no exception, though on a smaller scale compared to other capital cities. Car-oriented transport planning with inadequate consideration of non-motorized and public transport has become a key challenge for sustainable development in Windhoek and other Namibian cities.

Namibia's capital is growing at the fast pace of approximately 4.3 % per annum, mostly in informal and unplanned settlements along city borders. Within the next twenty years Windhoek will have to cater

for the mobility needs of over 800,000 residents. Hence it is now the moment to set the right course for sustainable urban transport development. Making suitable land-use and transport planning decisions now will turn Windhoek into a lead example of sustainable development in Africa and ensure that the mobility needs of current and future generations are met.

Population growth is not the only issue, as more and more citizens will have the desire and the financial opportunity to purchase their own cars. Accordingly, it is estimated that if no major alterations in traffic management are introduced, traffic congestion in Windhoek will be six times more severe by the year 2030.

However, despite all efforts, large parts of the population will still be unable to afford their own car in 2030 and will have to rely on public transport by bus or taxi. The current public transport situation with its limited bus network and high prices for taxis excludes many citizens from participating in the economic, social and cultural public spheres of Windhoek. The urban poor currently spend up to 25% of their income on their mobility needs, or are even forced to walk long distances to reach their work place or school, which exposes them to severe safety and security risks.

The current public transport system is mostly shaped by the policies set down in the 1995 White Paper, which favored private provision of public transport. This is why taxis clearly dominate the market for urban public transport, leaving only a marginal role for municipal public transportation (*figure 1*). The system can best be described as a school-bus system picking up domestic and factory workers in low-income areas in the morning and taking them to work in industrial areas or well-off suburbs, followed by the reverse process in the evening.

The main problems in public transport are a lack of full-day bus service, a lack of interchanges connecting different routes within the city, an aging bus fleet that comes not even close to meeting peak-hour demand, as well as poor route planning resulting in irregular service.

Moreover, Namibia's capital is in urgent need of more efficient and integrated transport and land-use planning. Current technical and financial restrictions do not allow for state-of-the-art transport planning and implementation.

Planning

The City of Windhoek and the Ministry of Works and Transport decided to change course in urban transport planning with the assistance of the German Federal Ministry for Economic Cooperation and Development, represented by its implementing agency Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. The said institutions have been cooperating in the development of the "Sustainable Urban Transport Master Plan for Windhoek including Rehoboth, Okahandja and Hosea Kutako International Airport (SUTMP)". The Master Plan will ensure an accessible, efficient, safe and affordable transport system for Windhoek and is also intended as a blueprint for the whole of Namibia and the development of similar plans in other urban and rural areas.

This Master Plan has produced a clear and realistic vision for the development of a sustainable urban transport system for the next 20 years, and generated strategies and policies to help make that vision a reality. For the Master Plan, scenario techniques were used in order to determine appropriate measures. Transport scenarios were calculated based on different land-use concepts. The two main scenarios developed, the 'Business As Usual 2032' and the 'Sustainable Transport Scenario 2032', served as the basis for deriving different bundles of interventions. The plan recognized that not only public transport, but also measures aimed at non-motorized transport as well as transport demand management have to play a role in addressing the needs of different user groups.

Based on future transportation demand, land-use development and current transport management, various transport systems were discussed and their suitability for implementation in Windhoek was analyzed. After the analysis of deficiencies in the pedestrian and cycling infrastructure and the forecasted demand for non-motorized transport, areas of improvement were identified.

The entire process of drafting the SUTMP was guided by a Steering Committee consisting of the key stakeholders of the project, i.e. representatives of the Ministry of Works and Transport, the Ministry of Urban and Rural Development, the City of Windhoek, the Polytechnic of Namibia Department of Land Management, and the GIZ Transport Project in Namibia. A major achievement in this respect is that the necessity of combining land-use and transport planning is endorsed. This is unique in Sub-Saharan Africa, and when properly applied and enforced, will set benchmarks for the entire region since it helps to increase the attractiveness and efficiency of public and non-motorized transport and considerably reduce the environmental impact of transport.

"We want to develop an integrated public transport system that combines the taxi industry as feeder service and a high-quality bus system that connects all parts of the city."

Prof. Dr. **Heinrich Semar**, Team Leader, GIZ Transport Namibia

The re-design of an urban transport network leads to drastic changes in city layout and appearance, which requires extensive stakeholder consultations and public information and participation. The SUTMP was designed in a participatory and inclusive way by the different institutions, experts and citizens involved. The public was invited to contribute to the development

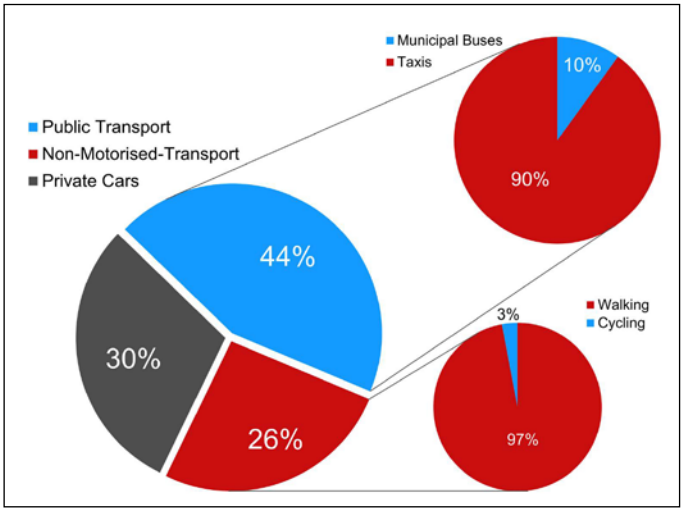

Figure 1: Modal share in Windhoek: Taxis dominate public transport, and walking is clearly the main mode of non-motorized transport.

Figure 2: Public participation was a major success factor for the project.

process in order to identify deficiencies in the current public and non-motorized transport system in the study area. This type of public participation process was a novelty. A broad mix of tools was used to sensitize the citizens to change, collect data and generate a rich fund of ideas for a new mobility strategy. The tools included for instance Social Media engagement, an online "Shared Map", and moderated public hearings (*figure 2*).

Implementation

After finalization of the SUTMP and its approval by Namibia's Government in 2014, it is time to turn the vision of an accessible, affordable and sustainable transport system into reality. As the Master Plan proposes a large number of interventions, the individual measures are being assessed separately. Therefore a variety of legislative and institutional processes, feasibility studies and social and environmental assessments are currently underway. These expert studies will enable the Government of Namibia and the City of Windhoek to plan accurately for the future needs.

The MoveWindhoek project is in the process of developing new and modified bus routes and an operational concept that will result in a cohesive bus network while integrating the taxi industry. The City of Windhoek has started to modernize and expand its bus fleet and purchased new busses. The new bus system and the new busses are scheduled to be introduced in late 2015 together with the introduction of a new fare system on the basis of the existing smart-card system. For the first time, Windhoek will then have a bus network covering large parts of the city. At a later stage, more advanced systems like Bus Rapid Transit or Light Rail are envisaged for some of the routes with the highest passenger volumes.

"Many people walk on unpaved walkways along many roads. Their trip becomes a dangerous adventure since they are forced to walk in unsafe riverbeds and to cross high-speed highways."

Erkki Nghimtina, Minister of Works and Transport (2010–2015)

The project is divided into the design of a new network (service hierarchy, development of bus routes, standard and express routes, interchanges etc.), operations (optimum modes for route volume, time points and running time, cycle and layover times, schedule development, vehicle blocking, fleet requirements etc.) and financial and staff requirements.

Developing technical specifications, drafting tender documents, developing a maintenance plan and advising the City of Windhoek on contract design is the key task of the MoveWindhoek project team for the ongoing bus procurement project. The German Federal Ministry of Economic Cooperation and Development and the City of Windhoek have jointly provided funds to increase the capacity of the current bus fleet. The procurement of these busses will go hand-in-hand with a re-branding of the bus fleet.

The City of Windhoek has started to implement non-motorized transport infrastructure in line with the SUTMP. Cycle paths and paved sidewalks have been included in scheduled roadworks projects. In order to foster the development of a non-motorized transport network, the City of Windhoek will develop a comprehensive non-motorized transport strategy based on the SUTMP's identification of a bicycle core network and gaps in pedestrian infrastructure.

As a first step, transport and land-use planning are integrated in the concept for the revitalization of Windhoek's CBD. The urban design framework takes up the planning principles of the MoveWindhoek project and has been developed in close cooperation with the respective departments of the City of Windhoek.

To address existing capacity constraints, MoveWindhoek enables various employees of Namibian institutions to attend professional training courses and develop their skills at international conferences and workshops. In this way, Windhoek will ultimately be able to introduce, operate and maintain their own transport system without the need for outside experts.

Still, the execution of the measures cannot rest on the shoulders of one single institution or person. The implementation stage, too, requires joint responsibilities on various governmental levels (national, regional and local) operating within a given legal and financial framework, and a shared approach using formalized and informal interrelations to re-create the participative approach used for developing the Master Plan.

In order to effectively accompany, guide and enable the intended sustainable transport development and to spread urban transport solutions to other regions, the Intergovernmental Sustainable Urban Transport Committee for Namibia is to be established to guide the way forward.

Conclusions

The MoveWindhoek project serves as an African example for sustainable transport in medium-sized cities (*figure 3*). Functioning as a blueprint for other projects in Namibia, the award-winning project aims to reduce transport-induced poverty and to improve traffic safety not only in Windhoek.

Project background

Windhoek's challenges in a nutshell

- Lack of reliable data
- Car-oriented transport planning
- Car as a status symbol
- Cycling is seen as an inadequate mode of transportation because of safety issues
- Bus system lacks extensive service delivery capabilities
- Integration of existing private-public transport operators, i.e. especially the taxi industry
- Institutional and individual lack of capacity and human resources
- General lack of public participation in political decision processes

MoveWindhoek project achievements so far ...

- Project partners jointly developed the Sustainable Urban Transport Master Plan in a participatory approach.
- The SUTMP was launched at the end of 2013 and approved by the Government in late 2014.
- Cycling and pedestrian infrastructure according to SUTMP is being included in upgrading projects for urban streets.
- Project received the UITP Africa Grow with Public Transport Award for Integrated Mobility at the UITP World Conference in Geneva, Switzerland on May 26, 2013, and was presented to the United Nations.
- Inspired by the planning approach in Windhoek, a Scoping Study and Master Plan for Sustainable Transport in the regions Oshana, Ohangwena, Oshikoto and Omusati was launched in October.

Further information

www.movewindhoek.com.na

Figure 3: A vision for sustainable transport in Windhoek

MoveWindhoek recently inspired the plans for a transport master plan for the northern regions of Namibia and gained international recognition when the project was presented at conferences on sustainable transport in Washington, Geneva, Munich and Johannesburg, and received the UITP Africa Grow with Public Transport Award for Integrated Mobility in May 2013.

There are different factors that have significantly contributed and still contribute to the on-going success of the project:

- Thorough analysis of the local situation and development of adapted and appropriate measures that can be operated and maintained in the long-term.
- Involvement of stakeholders and the public through different means adapted to the specific target group, such as public hearings, events, newspapers, websites and social media. The residents usually know the weak points and have good ideas.
- Securing ownership of the responsible institutions in a transparent planning process as well as by defining official structures for joint development and implementation in close cooperation with counterparts and stakeholders. This can be ensured by regular Steering Committee meetings and the approval of intermediary results by decision-making bodies such as the City Council and the Ministry Administration. This considerably increases the chances for a sustainable implementation.
- Identification and effective use of a local champion with the necessary clout and political backing. Champions are most passionate and dedicated to getting things done if they link the project to their career.
- Building healthy working relationships with counterparts on different levels by making use of good personal contacts with the responsible colleagues in different institutions to promote activities. This makes it possible to discuss and prepare decisions prior to official meetings.
- Use of different financing options on national and international level and definition of measures according to the specific focus of different financing institutions. International awareness and good communication will help in finding suitable partners.
- Support through local research institutions such as universities. This leads to in-depth scientific input for certain areas of the project, land-use in this case, and additional capacity-building on student level. ■

[1] The former Ministry of Regional and Local Government, Housing and Rural Development was renamed to "Ministry of Urban and Rural Development" in March 2015.

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Gregor Schmorl, Dipl.-Kfm.
Technical Advisor, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, GIZ Transport Namibia, Windhoek (NA)
gregor.schmorl@giz.de

Michael Engelskirchen, Dipl.-Ing., Dipl. Wirt.-Ing.
Technical Advisor, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, GIZ Transport Namibia, Windhoek (NA)
michael.engelskirchen@giz.de

Photo: City of Lörrach

Lörrach banks on electric mobility

Local public transport, e-car sharing, municipal fleet

Increasing traffic volumes represent a great challenge for the town of Lörrach. Situated in the immediate vicinity of Basel, Lörrach is subject to commuter and shopping traffic. It is thus essential to find new concepts and break new ground in terms of sustainable mobility. This is why, in early 2013, the town developed a mobility master plan setting targets and proposing measures concerning traffic policy. Taking some of the car traffic load off the town by promoting non-motorized traffic and local public transport is the top priority. As for the promotion of environment-friendly alternatives, the enhancement of electric mobility is an important part of the master plan.

Authors: Arne Lüers, Christine Wegner-Sänger, Alexander Fessler

Situated in the far southwest of Germany in the Wiese valley in the foothills of the southern Black Forest and close to the Swiss land border, Lörrach is a pulsating hub between Basel, the Alsace, the Vosges and the Black Forest. Amid this unique landscape, some 49,000 inhabitants as well as visitors of the "capital" of the Markgräflerland region find a diverse, open culture and savoir-vivre characterized by a tri-national atmosphere.

The town consistently pursues a sustainable energy policy: In 2002, Lörrach was the first German town to be awarded the Swiss Energiestadt label; in 2007, it was the first town in Baden-Württemberg to be given the European Energy Award (eea), and in 2010, Lörrach took a leap to achieving the European Energy Award Gold, which it was able to renew in 2013.

Electric vehicles in local public transport

Within a model test carried out by the State of Baden-Württemberg, an electrically driven bus was operated on an inner-city line as early as 2005 (*figure 1*). This bus had been borrowed from Genoa and featured an inductive battery charging system of the Conductix-Wampfler company in Weil am Rhein. Charging coils were installed at two stops for contact-free recharging of the bus batteries within a few minutes, thus allowing for a smaller vehicle battery. The bus was in operation for about eight months and proved that the technology is suitable in general. For instance, it was able to keep up with the normal flow of traffic. However, a larger passenger capacity would have been desirable.

Lörrach opts for e-car sharing

CO_2 emissions of e-vehicles are very low when using green electricity. In addition, electric vehicles drive extremely quietly, thus contributing significantly to the reduction of traffic noise. The use of electric cars in car sharing is ideal. It enables many citi-

zens to use this environment-friendly transport alternative without having to put up with any of the deficiencies that it still has to cope with, such as the short range. Car sharers can access conventional cars if necessary and opt for an e-car when driving short distances. Lörrach supports urban electric mobility in its "Lörrach mobilises electricity" project in cooperation with the innovation fund for climate and water protection of the regional utility, Badenova. Its partner, Stadtmobil Südbaden, procured three electric car sharing vehicles for Lörrach in 2014. They may be found at the new bicycle parking hall, among other places (*figure 2*). Charging is realized by ultra-quick charging systems developed especially for this project. They are currently throttled to 22 kW. Once the necessary tests have been completed, however, the batteries can be charged completely within 30 minutes. The vehicle will thus be available for the next user within virtually no time at all. As the town is itself a customer of Stadtmobil, these electric vehicles are also used for official trips.

"my-e-car" supplements the existing car sharing offer

Stadtmobil Südbaden and the regional utility, EnergieDienst, have kicked off yet another project.

The my-e-car GmbH joint venture has been operating a fleet of more than 30 electric car-sharing vehicles in southern Baden since December 2014. The vehicles are parked at quick-charging stations with two charging slots (*figure 3*). So, apart from my-e-cars, other (private) owners of e-vehicles can use the charging stations, paying with their credit cards. The electric power comes from the nearby run-of-river power station of Wyhlen and is therefore 100 % green electricity. The current my-e-car offer comprises four locations, with two further ones to be added in the coming months.

The headquarters of my-e-car GmbH is in Lörrach, which further enhances Lörrach's pioneering role in the field of electric mobility. The total number of charging facilities in Lörrach amounts to 11 charging stations. For a town of this size, this is a remarkable number. Lörrach thus ranks at the top in national comparison.

Electric vehicles in the municipal fleet

The town of Lörrach is also active on its own behalf. Three pedelec bikes are available for town staff to use on official trips. Moreover, Lörrach is involved in the badenova project "Practical test of e-mobility to examine the use of electrically driven vehicles in the municipal fleet". In an initial step, ten municipal vehicles, e.g. flatbed trucks, transporters and passenger cars, were equipped with data loggers for three weeks in order to record the daily distances driven. It turned out that all but one vehicle could be battery-powered, as they do not have to cover long distances. In a further step, an e-Smart was leased. It is used for official trips.

In March 2015, the town administration purchased another electric vehicle. An electrically driven flatbed truck travels the town center streets for the public cleansing service. The town administration plans to purchase further electric vehicles: Courier vehicles, for instance, and the service vehicles of the municipal executive service are particularly suitable for electric drive technology due to frequent stop-and-go traffic.

Conclusion

It is understood: The electric car is not going to solve all the problems that result from automotive traffic, especially not the huge space requirements for streets and parking lots. This is why the promotion of bicycle traffic, walking and the use of local public transport will continue. Yet, it makes sense, for reasons of climate protection, to replace automobiles using combustion engines with electric vehicles

Bicycle parking hall with e-mobility offers

The new bicycle parking hall, situated centrally at the main station, allows commuters to combine local public transport, e-car sharing and trips by bicycle in an ideal manner. The building, which was inaugurated early in 2014, provides space for more than 100 bicycles on more than 200 square meters, including ten separate stalls as well as lockers for bicycle helmets and other luggage. The solar system on the roof of this hall partly provides the facility with its own electricity. The parking hall is designed as a monitored bicycle parking lot and can be accessed via an electronic system. There are publicly accessible charging slots for e-bikes

Figure 1: Contact-free recharging e-bus.
All photos: City of Lörrach

Figure 2: The Stadtmobil e-car sharing vehicles may be found at the new bicycle parking hall.

Figure 3: The "my-e-car" joint venture supplements the existing carsharing offer

Figure 4: E-mobility day 2013 in Lörrach

in the entrance area. Apart from charging stations for the shared e-vehicles, two charging slots for private e-cars are located at the adjacent parking lot.

Bicycle parking facilities have also been installed in the town center. They are equipped with bicycle holders as well as lockers and charging slots for e-bikes. The objective is to create an attractive offer for citizens to ride their bikes into town and do their shopping.

Information offerings on the topic of e-mobility

Lörrach wants to inform the citizens regularly and comprehensively about any measures taken in the field of electric mobility. Therefore, an information platform about this future-oriented topic will be included on the town's website. Apart from an overview of public charging stations, the e-car sharing offer will be explained on this web page and information will be provided about the use of electric busses and e-vehicles in the municipal fleet.

In addition, the town also organizes public events relating to the topic of electric mobility. In the scope of the "100 years of train operation at the Wiesentalbahn" anniversary, there was an e-mobility day on September 13, 2013. Interested visitors had the opportunity to look at numerous electrically driven vehicles in the town center (*figure 4*). The models ranged from current ones through to historic vehicles. A special one was the "eforce One" electric lorry of the Swiss Feldschlösschen brewery, of which only two exist so far. Visitors were also allowed to test e-cars and e-bikes. The highlight of the day was a parade of all sorts of e-vehicles – from e-cars, e-bikes and Segways through to electric wheelchairs – through the town center of Lörrach. Watched by numerous spectators on the side of the street, the parade of 73 vehicles moved through the street silently.

This year, Lörrach will be a stage of WAVE. WAVE is the world's largest electric vehicle rally. For this event, more than 80 e-vehicle users are expected to come to Lörrach and present their vehicles for several hours. Simultaneously, the "Mobility Day" will take place in the town center. Apart from private enterprises, such as bicycle and car dealers, transport companies, car sharing providers and other parties will be represented with information booths. The town of Lörrach will provide information about its endeavors in the field of electric mobility.

Outlook

Extension of e-vehicle infrastructure

The number of charging stations will be increased continuously over the next few years. The future locations will be determined according to such criteria as accessibility and grid stability. These charging stations are to give an incentive to the citizens and visitors of Lörrach to buy and use electric vehicles. Moreover, we are investigating whether free parking spaces exclusively for e-cars can be made available near the town center and whether charging stations can be created in existing customer parking areas in cooperation with the retailers of Lörrach. Customers would really benefit from this while shopping, since they would be able to recharge their vehicles for free during this time.

Use of local public transport

The use of e-vehicles is also possible in local public transport. The town is investigating the possibilities of installing a solar shuttle bus line between the swimming pool, the town center and the Swiss border in Riehen. This would provide visitors coming from Basel with an attractive connection to our local public transport, linking it to the Basel tram network. The installation of park-and-ride spaces at the swimming pool would create a comfortable alternative for commuters and shoppers coming from the Wiese valley to driving their own cars into town. In addition to this solar shuttle bus line, the general use of electrically driven town busses is being examined. ■

Arne Lüers
Mobility Officer, Environment and Climate Protection Department, Town of Lörrach (DE)
a.lueers@loerrach.de

Christine Wegner-Sänger
Head of the eCarsharing project, Environment and Climate Protection Department, Town of Lörrach (DE)
c.wegner-saenger@loerrach.de

Alexander Fessler
Press and Public Relations Officer, Environment and Climate Protection Department, Town of Lörrach (DE)
a.fessler@loerrach.de

Standards-based Smart Traffic solution from Shared-E-Fleet

How vehicle sensor data can be captured and made available for improved traffic analysis, environmental monitoring and urban planning.

Traffic analysis, environmental monitoring, intelligent traffic solutions, urban planning

Vehicles today are equipped with many different sensors that enable them to have a good awareness of their surroundings. Some sensors capture vehicle-specific data, including acceleration, rounds per minute or fuel consumption. In addition to vehicle positioning, other modern sensors measure environmental data such as temperature, rain or light intensity. Typically, these sensors have a purpose related to vehicle operation, providing data for driver assistance systems, among others. The light sensor, for instance, controls headlight dipping and the rain sensor controls activation of the windshield wipers, while the acceleration sensors allow selective braking of individual wheels for enhanced vehicle stability.

Authors: Andreas Ziller, Arne Bröring

With Smart Traffic as part of the Shared-E-Fleet project, we have developed an approach that goes beyond this local use of sensor data. Our vision is that in future vehicles will serve as mobile sensor platforms contributing data securely and anonymously to a global data pool where data can be made available to various applications. This approach goes beyond existing solutions such as BMW Connected Drive or Tomtom HD Traffic, for example, by making data available to external applications too, using a standardized gateway. Vehicle sensor data can be queried via the vehicle bus, enabling this data to be read, uploaded and used for new applications. Smart Traffic can make the data from vehicle sensors available not only to the driver of the vehicle on which the sensors are mounted, but also to all other road users. Large-scale collection and analysis of sensor data from a large number of vehicles can thus enable a whole array of new applications. These are not restricted to traffic applications.

The sensors can be used, for example, to capture the automobile's local surroundings. The rain sensor tells us if it is raining; combined with the data from outside temperature sensor this information also indicates whether it may actually be snowing or if there is a risk of black ice. The acceleration sensors on the wheels provide information as to whether the road surface is in fact icy. The video cameras installed on the vehicle can be used in future to ascertain more complex interrelationships such as the condition of the road (snow, potholes).

The many sensors in vehicles will open up far-ranging opportunities for intelligent systems that go well beyond the capabilities of today's traffic management and traffic control systems. In current practice, both stationary and mobile devices are used to capture traffic data. Stationary devices mounted above or alongside the roadway are not evenly distributed, nor do they provide a reliable picture of the traffic situation. The advantage of a mobile distributed network of sensors compared to conventional dedicated sensor networks is that it does not require any fixed installations. Large numbers of vehicles and high road saturation levels create a very dense data network. Coverage is further increased by the element of mobility. On the vehicle side, this requires only a processing unit connected to the vehicle bus. Such components are already present in the vehicle for other purposes (entertainment, navigation etc.). Power supply, polling intervals and processing capacity present no problem for vehicle-based sensor systems, unlike fixed-installation sensor networks. Vehicles provide sufficient capacity for this. And wireless connectivity solves the issue of accessibility and data transmission.

Typical applications

Potential applications for such sensor data captured by vehicles are many and varied. Here we briefly outline some typical applications:

Improved traffic safety thanks to weather-dependent route planning

If data captured by the sensors for outside temperature and rain or by the windshield wiper controllers already present in automobiles today is collected and then logically combined, the resulting aggregated data can help to determine the current weather situation. This makes it possible, among other things, to infer from the fact that it is both cold and raining that there is a risk of ice on certain stretches. Using information from a large number of vehicles provides a good overall picture. Vehicles on the road can be warned of ice or can in fact altogether avoid areas at risk.

Environmental monitoring

Data provided by vehicle sensors can be used in analyses to support environmental monitoring models, for example. One potential such application is regional emission monitoring (CO_2 and particulates), using the air quality sensor in the cars' recirculation control unit for instance.

Traffic optimization
For inner city traffic management, using vehicles as additional data sources enables more precise monitoring and management of events in a city's traffic network. Motion analysis, for instance, allows the early detection of congestion.

Monitoring of the parking situation
A more ambitious target for future applications could be for vehicles to use video cameras to detect on-street parking spaces. The idea here is to use image processing to identify free parking spaces locally and only send information on the location of those free spaces to the control center. There the data will be processed and evaluated using a probability model and can then be made available to various applications. Of course, this procedure is not really precise as free parking spaces may quickly be occupied again. But if the purpose is simply to get a quick overview, potentially promising locations could be highlighted in a map view of the navigation system, allowing the driver to narrow down the search for a parking space.

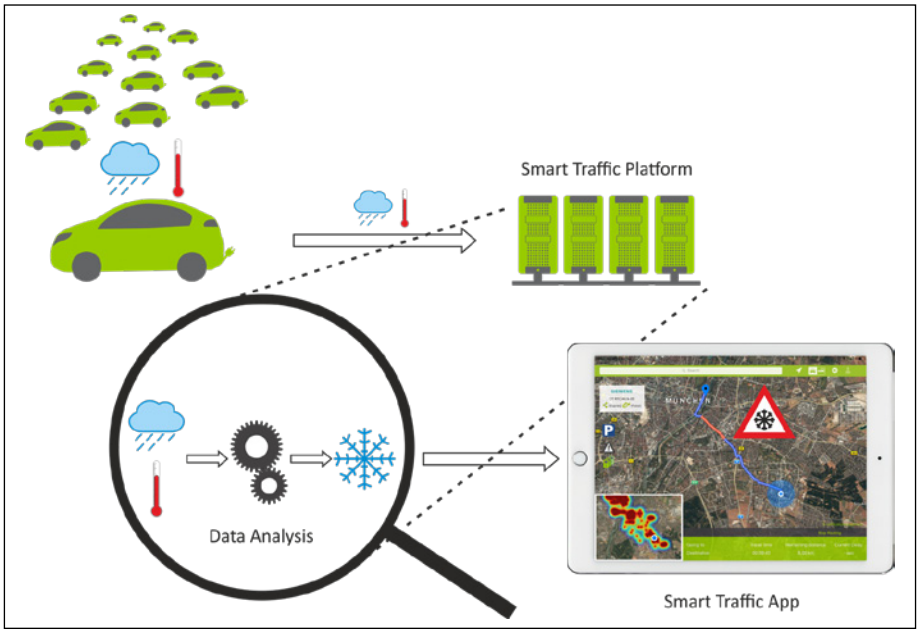

Figure 1: Basic principle of processing car data in order to enable Smart Traffic Services

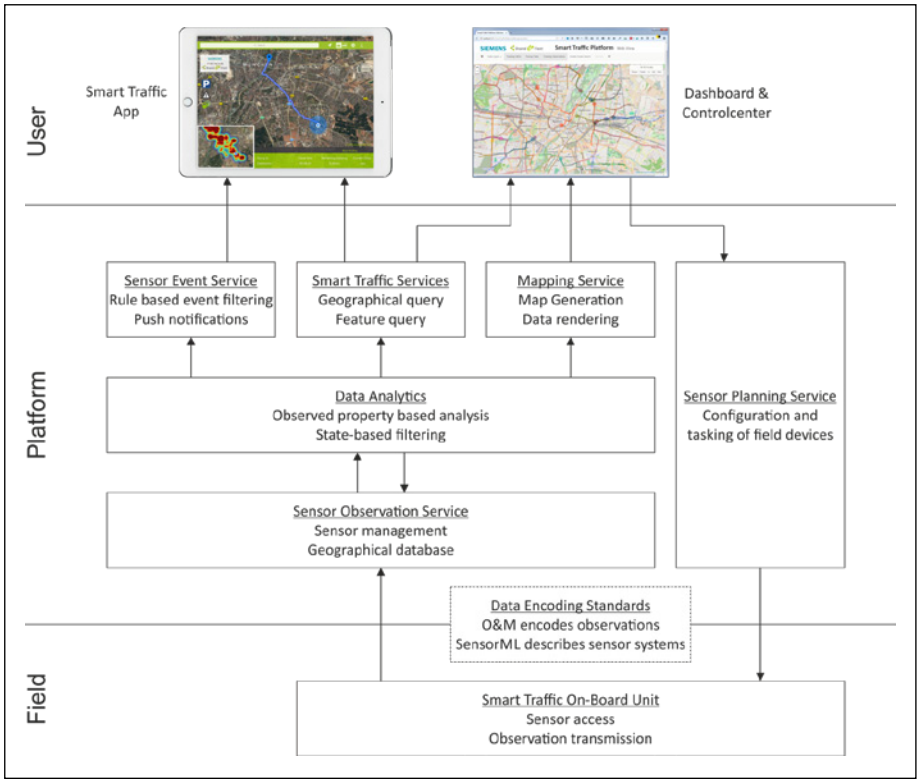

Figure 2: System setup of the Smart Traffic System including platform, on-board unit and user apps

System design

To enable the added-value services and applications described above, we have developed an innovative Smart Traffic tool in the scope of the Shared-E-Fleet consortium project. The basic principle of the provision of Smart Traffic Services for user apps is shown in *figure 1*.

The Smart Traffic On-Board Unit is an embedded Linux system that is used in the vehicle to read and then forward a range of sensor data to the Smart Traffic System. The Smart Traffic platform uses Webservices to collect the data and then make it available to other users.

Smart Traffic Services provide standardized interfaces and protocols to make the data available in an interoperable format. This facilitates interaction with other services. For example, the data provided is used by the route query system developed in Shared-E-Fleet to support route selection. This allows drivers to avoid routes with a high volume of traffic or hazardous weather conditions such as ice on the road. In the background, the registration and search process for these value-added services is supported by the Marketplace. This is where providers can make their services available to other users. Services are described using a specific vocabulary while appropriate quality dimensions (pricing, accuracy, reputation) permit comparability.

An important aspect of Smart Traffic Services is their compliance with internationally accepted standards. They follow the proven standards of the Sensor Web Enablement (SWE) initiative [1] issued by the Open Geospatial Consortium[1] (OGC). The three main web service types are:
(1) the Sensor Observation Service,
(2) the Sensor Event Service and
(3) the Sensor Planning Service.
These services are shown in the architecture overview (see *figure 2*). The data captured by the Smart Traffic On-Board Unit is uploaded to the Sensor Observation Service [2]. From there, these resources can be searched in standardized formats, including the application of thematic, temporal and spatial filters. The Observations & Measurements Standard [3] is used for sensor data, and the SensorML Standard [4] for metadata. The raw sensor data is further processed by the Data Analytics component. A mapping service allows to visualize the data in maps. The Smart Traffic Service makes it

available for client applications. To inform users about events, sensor data is regularly processed and forwarded to the Sensor Event Service. In addition, the Sensor Planning Service [5] allows remote configuration of the Smart Traffic On-Board Unit.

The sensor data aggregated by the Smart Traffic platform is the dynamic basis of the route query system (not shown in *figure 2*), which is responsible for calculating routes (or route options). As well as considering static costs (e.g. distance), it adapts dynamically to the current conditions in the traffic network. Trajectory analysis is used to generate and refine statistical prediction models (e.g. energy consumption). It is also desirable that real-time data (e.g. traffic flow) is factored directly into routing queries.

Via Smart Traffic applications running on a smartphone or a tablet PC, the traveling user can access the services delivered by the Smart Traffic platform and thus benefit indirectly from the data collected previously. The user interface to the Smart Traffic platform is provided by the Smart Traffic App, a smartphone application for iOS (*figure 3*). The app offers a navigation solution that relies on Smart Traffic Services. In the event of an incident, the app is notified and calculates a new route using the Shared E-Fleet route query system (see *figure 4*).

Conclusions and outlook

The solutions described here make it possible to expand existing traffic monitoring and control mechanisms. The core idea of the approach presented here is the large-scale collection of the different data that the sensors deployed in modern vehicles capture already today. This approach can give rise to a large number of novel services and applications. New applications in turn will lead to more intelligent traffic monitoring and control, for example, or can be used for environmental monitoring or to improve traffic planning. In future, the growing number of assistance systems will lead to a further increase in the number of sensors deployed in vehicles. This will allow the continuous development of new applications and the generation of added value for the Smart Traffic approach described here. ■

[1] http://opengeospatial.org

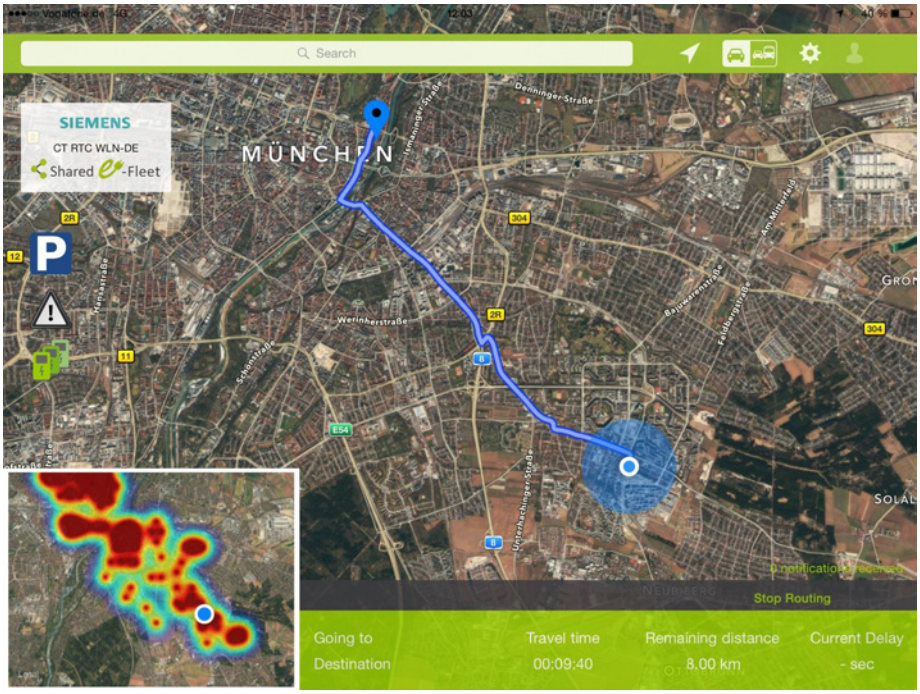

Figure 3: Screenshot of the Smart Traffic App

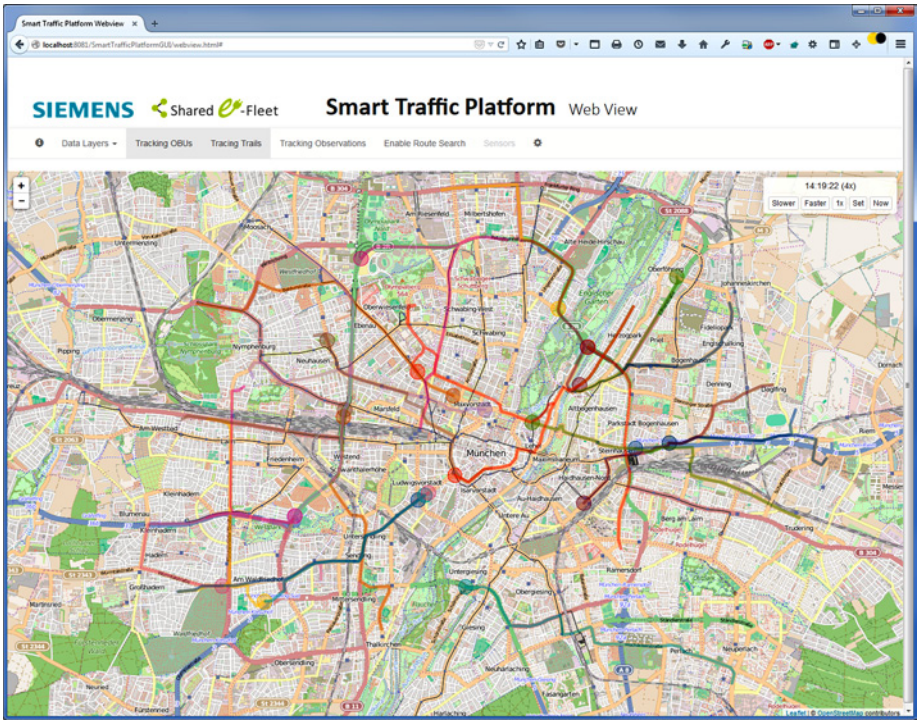

Figure 4: Screenshot of Smart Traffic Web View

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Andreas Ziller
Siemens AG, Munich (DE)
andreas.ziller@siemens.com

Arne Bröring, Dr.
Siemens AG, Munich (DE)
arne.broering@siemens.com

Aerial ropeways for urban mass transportation

Gondola lift, cableway, cable cars, traffic noise reduction, electric mobility, city traffic, local transport

The CO_2 problem, dwindling crude oil reserves, dramatically rising air pollution and increasingly congested roads should be enough reasons to adopt new paths in mass transportation. Individual traffic using electric cars offers no real solution. But what about rethinking urban transportation and considering the deployment of urban gondola lifts, where a gondola for up to 10 passengers arrives every 10 seconds and leaves the station just seconds later. – A plea for urban ropeways.

Author: Günther Ecker

The strong trend towards re-inventing cable-car systems for commuter mass transportation and for everyday use was triggered by Alfredo J. Brillembourg and Hubert Klumpner in Caracas (Venezuela): In the scope of their "Urban Think Tank Project", the two architects proposed to open the Caracas hills slums with better transportation systems. The project was delayed and, while there were some small-scale earlier applications, it was only in 2004 that the Metrocablé de Medellín (Colombia) opened as the first urban gondola lift for everyday traffic.

Cable car systems are cheaper to build and operate than trams or subways. It is said that the first cable car line of the Metrocablé de Medellín paid for itself within a year [1] – thanks to more than seven million passengers in the first year and the sale of emission-trade certificates. This is the reason why, these days, so many new cable car lines are scheduled to be built in South America: three in Rio de Janeiro, five in Colombia, five new cable car lines in Bolivia's seat of government La Paz. The rapid payback turns urban cable car lines into a profitable investment business, almost a "license to print money".

Especially in developing countries, where urban and transport planning was neglected for a long time and newly arriving rural migrants used to build their shelters in the wasteland on the outskirts of cities, there is a lack of good roads and streets. People mostly use winding walking paths. In the megacities of developing countries, slums and favelas dominate the urban area, "wild construction" is gradually covering slopes, and this substandard housing is accessible only by footpaths and/or stairs made from concrete slabs. The chief means of "public" transport are taxis, and the abundance of minibuses further slows down traffic in the typically narrow streets, leading to extended travel times.

Main benefits of using cable car systems for public transport

Because of the favorably low capital investment needed for aerial ropeways, the available investment sums can pay for a transport system that covers a much larger urban area than with subways or trams (*figure 1*, data from [2]).

If people have to walk or bike no further than 350 meters (half the diagonal of a 500 x 500 m square) to reach local transport, they do not need to know the timetable, but can enter the next gondola without waiting and reach any destination in the city in a short time. At night it is not necessary to run empty gondolas. If needed, users simply start a gondola parked in the station. 20 hours a day, 7 days a week, passengers can travel to the city center and back, to work, to educational institutions, to shopping venues, to the sports center and so on. The gondolas are also a safe way for people to travel home after dinner or a visit to the club – without fearing to be stopped for an alcohol test. In addition, this environment-friendly transport system contributes substantially to reducing traffic noise as well as CO_2-, NO_x-, and particulate matter emissions.

Fast realization

As the cable car line operates "in the air", its construction requires neither expensive acquisition of land, nor house demolitions, nor months of road works. A cable car line is quickly designed and deployed, the erection of pillars is done without significant disruption to businesses or interference with the daily lives of the resident population (see *figure 2*).

The fully automated operation has a favorable effect on operating costs. Low investment and low operating costs (even on Sundays) either make for faster amortization or can be used to keep ticket prices low. More expensive transportation systems lead to expensive fares, but on balance public transport should be cheaper for the users than transport by car.

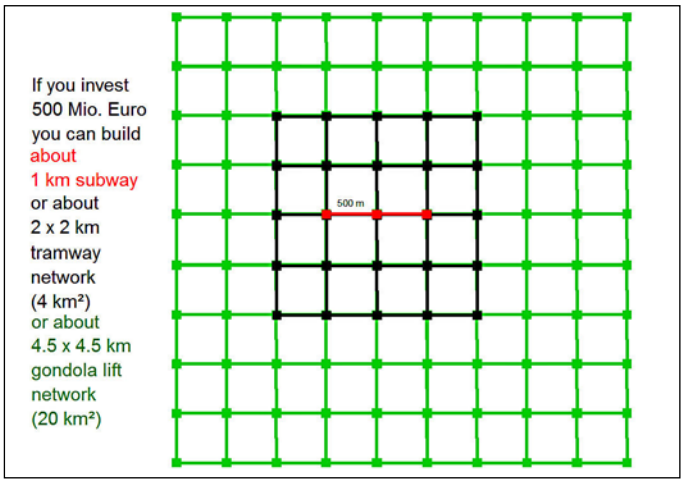

Figure 1: Comparison of subway, tramway and ropeway investment costs
Source: Ecker, data [2]

To compete with the transport capacity of a gondola lift (3,600 passengers per hour and direction), a tramway with seats and standing room for a total of 290 passengers would have to run at intervals of about five minutes; for an articulated large-capacity bus with 145 seats and standing places the interval would be two and a half minutes. To assure service at these time intervals for a ten kilometer double-track tramway line with 20 km/h maximum speed (average speed for short distances) you need about twelve vehicles; with large-capacity buses about 25 vehicles and drivers would be required. A comparable fully automated gondola lift system needs just five people to operate – if the entry and exit points are monitored by cameras, as it is usual in subway systems (based on data from [2]).

Figure 2: Construction without significant disruption of daily routine in La Paz, Bolivia
Photo: Marlene Ecker

Energy efficiency

On mountain-to-valley lines, the system is particularly effective. The weight of the gondolas traveling downhill and uphill balances out, so that only little energy for moving and braking is required. Modern tramways can feed braking energy back into the grid, but only at a loss. Also in level sections of the line, cable cars can be operated economically, because the same energy-saving balancing principle allows lowering the gondolas to pedestrian level and later raising them again with only minimum energy requirements. As the gondolas carry neither motor nor brake systems, kinetic energy is saved. Cable cars can be powered by electricity from renewable energy sources, they operate very quietly and emit neither noxious gases nor particulates.

For cable cars to be an attractive means of transport also for level sections, they need only to be faster than pedestrians or than cars in congested streets or on detours, which can be guaranteed most of the time. Cable cars are not much slower than subways or tramways. Railways undoubtedly achieve higher top speeds, but they cannot reach maximum velocity on short stretches between stations. What is more, cable cars need not drive detours like tramways or buses. Since the relevant criterion is overall travel time for passengers from their starting point to their destination, lower maximum speed is not a problem.

Easy and quick crossing of hills, canyons, rivers, parks, gardens, historic town quarters (*figure 3*) and parking areas, and no need to cut tracks through agricultural land or pedestrian zones – these are as many arguments in favor of cable car lines. The establishment of a line along an existing road or street simplifies the approval process and facilitates any rescue operations – modern urban cable cars are even equipped with spare engines to bring passengers safely to the next station in case of an emergency.

Urban cable cars – different from touristic cable cars

Touristic cable cars are stopped during storms and lightning (and are equipped with extra earthing conductors), which does not present a problem, because in such bad weather, no one likes to go skiing or hiking anyway. In urban contexts, authorities try to avoid interrupting transport service for weather reasons because this will disrupt urban life. This is why a city must choose the most suitable cable car system for the prevailing weather conditions, namely storm frequency. Gondolas on a monocable haul rope can move safely in crosswinds with a speed of up to about 60 km/h (37 mph). Cable cars traveling on wheels on one or two ropes are safe in crosswinds of up to 100 km/h (62 mph), but this technology is more expensive. Just like high-voltage power lines, urban cableways should also be equipped with an earthing cable. While the passengers in the gondolas are safe when lightning strikes a cable, a lightning strike in the stations might paralyze crucial systems.

In more than a century of operation and continuous evolution, cable car technology has proven to be the safest means of transport overall, based on the number of passengers carried. Accidents are excluded since there is no point of contact with other transport means.

Modern gondolas are equipped with WLAN devices, loudspeakers, lighting, heating and ventilation, and in some cases even surveillance cameras. Crime is rare because criminals have little chance to escape. In the stations platform screen

Figure 3: Ropeway crossing old urban quarter of Funchal, Madeira
Photo: Günther Ecker

doors ensure safe passenger entrance and exit: The platform doors open only when a gondola is in the station, so nobody can accidentally step in front of arriving gondolas.

The cabins are well ventilated so that the windows can remain closed and nobody can throw out waste or burning cigarette butts. Blinds with horizontal slats, partially opaque window glass or other structural measures can be used to keep visitors from looking into the gardens and backyards that the gondolas are traveling over.

Every cable car must be checked and serviced at regular intervals. About one week per year the gondolas are not available for transportation. This revision can be done in

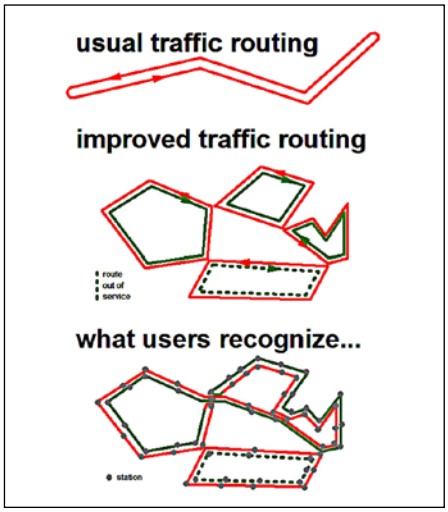

Figure 4: Effects of a combination of several ropeway lines
Draft: Ecker

Figure 5: Barrier-free access
Photo: Günther Ecker

the main holiday period. Another possibility is to build circular lines with separate drives for each direction. Then one direction can be taken out of service for revision purposes (or to save energy at low-traffic times) while the other line allows passengers to reach every station. If one drive is damaged, it can be coupled with the other one. Likewise, in an emergency, one line can be used to rescue passengers stuck on the other line. In systems consisting of several lines crossing each other, two or four drives can be centrally installed in the same building as the control center (*figure 4*).

In overcrowded informal slums, the lack of roads is one of the reasons for above-average violence and crime levels. In Medellín (and later in Caracas and Rio) the cable car stations in the favelas were equipped to house police stations and public facilities (libraries, health centers and rooms with free internet access) in addition, ensuring that now more police officers are on the spot [3].

BACKGROUND INFORMATION

Language confusion

"Urban ropeways" is the technical term in the English language spoken in the (former) Commonwealth States, Japan and Southeast Asia. "Urban cable cars" or "urban aerial lifts" mean the same in the English variety used in Europe. "Cable propelled transit" is the term used in Canada and the United States where "cable car" refers only to cable-propelled streetcars on rails. In French the technology is called "télécabine urbaine", "télépherique urbain" or "transport urbain par câble". The Spanish term is "teleférico urbano" while the Germans call the system "Urbane Seilbahn".

Ropeways with fixed or detachable vehicles are "gondola lifts", "télécabine" (French), "telecabina" (Spanish), "Gondelbahn" (German).

Ropeways with one or two "cabins" (not gondolas) that commute between station 1 and station 2 are called "reversible ropeway" (Europe), "aerial tram(way)" or "jig-back ropeway" (both Northern America), "téléphérique" (French), "teleférico" (Spanish) and "Pendelbahn" (German).

Barrier-free and easy access, even for freight transport

Gondolas offer barrier-free, easy access for people with wheelchairs, prams, bicycles, roller skates, luggage carts or hand trucks because there are no thresholds or steps, and the gap between the vehicle and the platform edge is very small (*figure 5*). Entering is no problem for young children, invalids or disabled persons. Depending on the system the gondola moves through the station at crawling speed (slower than an escalator) or stops completely. In larger gondolas, bicycles can be transported easily. In addition, cable cars are suitable for transporting goods, either in separate gondolas, or in combination gondolas with folding seats for passengers, or in two-tier cabins.

A few – solvable - problems

In cableway construction, curves are a problem. The sophisticated technology is suitable for straight lines only, in curves gondolas have to drive on rails. As gondolas drive on rails in stations anyway, stations should be built where curves are required. The "CURVO-System" (Conveyor & Ropeway Services, India) promises improved operation in curves, but there is probably higher load and more wear on the ropes.

The optimum length for cable car rides as mass transportation is a maximum of about seven kilometers (4.3 miles), for longer distances faster transportation systems are better. The reason: The number of stops and the resulting braking and reacceleration procedures are a crucial factor in overall travel time. Urban cable car lines recently built in South America and Ankara (Turkey) have intermediate stops. In practice, the sections are structurally separated, so that the passengers need to transfer by foot from one line to the other within the stations. Continuous lines with intermediate stops or passing gondolas are of course feasible.

Although some technical innovations would be necessary for the construction of entire networks – e.g. to enable passing intermediate stations without stopping, crossing stations, or modular stations built for subsequent extension – all customer requests from gondola heating to roofless gondolas can be met by the cable car manufacturers.

Intervals between gondolas can of course be longer than 10 seconds, for instance at night. It is desirable that, before starting their trip, users should inform the system how far they intend to go. This will enable more targeted control of traffic flow, for instance by inserting additional gondolas on high-usage sections. Gondolas could also be parked at every intermediate station so that at night the rope will run empty and gondolas will only latch on on demand.

Although ropeways can be constructed and operated at quite low costs, they will face resistance in cities with extensive public transportation systems. But in towns or cities where efficient public transport is lacking and traffic jams are an every day phenomenon, cable cars would be an effective way to reduce car dependency and promote the switch from cars to public transport.

Seven days a week, 20 hours a day, cable car lines are an inexpensive and profitable mass transport system and in many respects the only true alternative to the car: "Go to the stop, get on without waiting time, start immediately and arrive on time", could be the new motto for public transportation. ■

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Günther Ecker
Chairman abcde-institute.org,
Wels (AT)
info@abcde-institute.org

Urban ropeways

Less journey time and more travelling comfort while reducing environmental stress and traffic jams

In densly built up cities ropeways can be a smart solution to take on urban transport tasks. Ropeway projects are implemented rapidly, efficiently and cost-effectively even in small or difficultly accessible places. LEITNER ropeways carries out two projects in Mexico and Turkey.

Mexico's first urban ropeways in the northern district of Ecatepec de Morelos. Photo: LEITNER ropeways

Ropeways from the city of Bursa to Uludağ Mountain range in Turkey. Photo: Oğulcan Yener

The agglomeration of Mexico City, with around 22 million inhabitants, is one of the largest and fastest growing metropolitan areas in the world. Because the infrastructure has not grown at the same pace as the population, there is a desire in the Mexican capital for alternative, space-saving traffic concepts. LEITNER ropeways is now constructing Mexico's first urban ropeways in the northern district of Ecatepec de Morelos.

The first urban ropeway project in Mexico

Two gondola lifts are running independently of one another and they are connected at one station where passengers can change lines. On the two stretches, which will be 2,900 and 1,800 meters long respectively, there will be a total of seven stops. The 10-passenger cabins will be overcoming a height difference of 55 and 62 meters. Up to 3,000 people an hour will be transported, for which the ropeways will be in operation 17 hours a day.

The unique drive system called LEITNER DirectDrive, which functions without a gearbox, offers significant advantages compared to other types of drives. It minimizes the ropeway's down-time because of low wear and tear and a low risk of breakdown, which is a particularly important criterion for any kind of local public transport.

For the inhabitants and visitors, this connection will mean a considerably easier and improved quality of life. While they have, until now, needed a good 45 minutes to cover this stretch they can finish the journey comfortably in just under 20 minutes. The ropeways will be directly connected to the public transport system.

A spectacular major project in Turkey

The Uludağ Mountain range in the northwest of Turkey is a popular vacation destination. In summer it attracts visitors to the national park, while in winter it is home to one of Turkey's largest ski resorts. Until a few months ago, the trip from the city of Bursa was a laborious affair, relying on a 50-year-old ropeway followed by a bus or taxi ride. The city of Bursa commissioned LEITNER ropeways to install the longest monocable gondola lift in the world, which has now made the journey considerably faster and more comfortable. Now guests are transported from Bursa to their final destination within 22 minutes, on a ropeway boasting 139 cabins and 44 support towers. The valley station of the GD8 ropeway is located at 395 meters, while the top station is at almost 1,800 meters. Instead of traveling 35 kilometers by road, the gondola ropeway covers just nine kilometers and offers panoramic views.

Just a few months after the first two sections opened, the new ropeway was already proving a huge success. From 7 June 2014 to the end of the year it carried around 520,000 passengers. Equally satisfied with the project is Ilker Cumbul, CEO of Bursa Teleferik A.Ş. "The new ropeway now offers a fast, comfortable and environmentally friendly connection up to Uludağ." ■

MORE INFORMATION

LEITNER ropeways

LEITNER AG / SpA
Brennerstrasse 34 | Via Brennero, 34
39049 Sterzing / Vipiteno (I)
Tel. +39 0472 722 111
Fax +39 0472 724 111
info@leitner-ropeways.com
www.leitner-ropeways.com

Sensors upside down – Managing parking with a twist

Siemens tests overhead radar detection to monitor parking spaces and bring smartness to the city

On-street parking management, parking sensors, radar detection, Smart City, intelligent street lights

A growing number of cars faces a limited number of parking spaces: the noise and emissions generated by the increasing amount of cars searching for parking spaces make this tendency noticeable in many city centers. This demonstrates the need for extensive parking management systems. Parking management solutions based on intelligent sensor networks can increase efficiency, and additionally equip a city with the infrastructure that is required for other Smart City applications.

Authors: Julia Hetz, Marcus Zwick

Most drivers are familiar with the problem caused by the shortage of city center parking spaces – searching for parking is frustrating and costly and once a driver has found a suitable parking space, he would rather not give it up.

However, the shortage of urban parking spaces is not just a problem for the drivers themselves: Drivers searching for parking account for around one third of inner-city traffic, and they create traffic jams, noise and emissions. This also results in a stop-and-go effect which further negatively impacts the environment as well as levels of traffic.

Public parking also plays an important role for municipal authorities that goes beyond the problem of drivers searching for a parking space. The availability and prices of parking have an influence on the modes of transport chosen by city dwellers and visitors. Therefore parking management is a determining factor for the achievement of traffic and environmental objectives.

Parking management and planning – the importance for cities

Public parking can generate additional revenue for the city and make it more attractive to businesses and residents: Businesses benefit from nearby parking for their customers, and resident and underground parking spaces improve the appeal of a residential area. In order for the parking area provided to be able to stand up to comparison with an alternative use, e.g. one which is more lucrative or improves the cityscape, it is essential for the area to be optimally utilized and for costs to at least be covered.

Initial solutions have only partly resolved the problem

In recent years, a diverse range of innovative solutions has been developed with the aim of reducing the time spent and the number of vehicles searching for a parking space. Online parking encyclopedias provide information on the locations and prices of car parks and registered parking spaces worldwide, and peer-to-peer applications enable private individuals to post information online regarding rented parking spaces or parking spaces that have just become available for drivers searching for parking. Concepts such as using vehicle-integrated sensors or floating car data to make predictions regarding parking availability and incorporating these into driver assistance systems and navigation apps are currently being tested.

However, these solutions alone have not provided cities with the parking planning and management support that is required in the long term. Availability predictions based on unique information collected are often incorrect due to changes in the cityscape that can occur on a daily basis. Real-time parking navigation can help drivers search for parking spaces at their destination, but it cannot create free spaces where there aren't any. And even businesses with private parking spaces cannot provide enough additional parking to resolve the original problem caused by the shortage of parking.

Parking management systems based on infrastructure sensor technology offer a broad range of options

As a result, current pilot projects are focusing increasingly on parking management systems with sensors built into the infrastructure for continuously determining the occupation status of parking spaces. Data

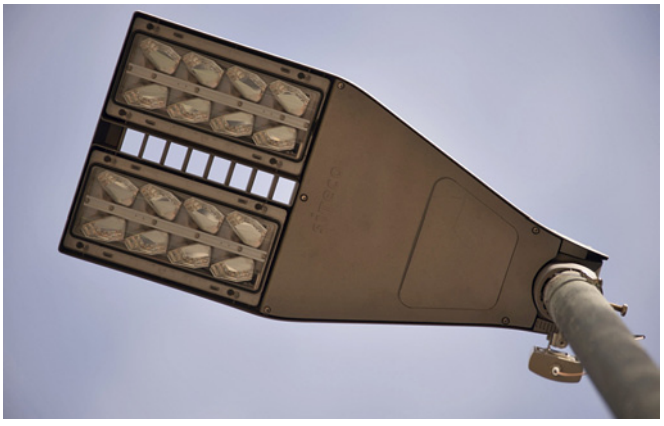

Figure 1: Overhead radar sensors that can invisibly be integrated in street light heads are the solution's core. All figures: Siemens

collected is used to guide drivers to vacant parking spaces but is also evaluated for the purpose of controlling and monitoring supply and demand in respect to city center parking. At present this data is predominantly being gathered through the use of infra-red or magnetic field sensors in the ground.

Siemens also regards this approach as a promising solution and is currently developing an integrated smart parking system, which stands out from existing systems, mainly due to its innovative sensors.

The core of the solution is a sensor network based on overhead radar sensors (*figure 1*), which reports the occupation status of parking areas and neighboring areas to a parking control center (*figure 2*).

Figure 2: The Siemens integrated smart parking system reports the occupation status of parking areas and neighboring areas to a parking control center.

End user applications such as navigation apps or multimodal route planners can call up real-time and statistical data from the parking control center and distribute the data to road users via smartphones, tablets or navigation systems, thus optimizing route planning or the search for parking spaces (*figure 3*). The intuitive central software detects recurring parking space situations at certain times. Therefore the navigation to free parking spaces can take calculated predictions into account, and the navigation system can reroute the driver to an area with currently a higher availability of parking spaces long before the driver even starts to look for an actual parking space. This reduces the demand for parking on the one hand – with people switching to alternative modes of transport in view of the predicted shortage of parking spaces at their destination (*figure 4*) – and it distributes vehicles more effectively on the other. Information can also be conveyed to drivers via traffic guidance signs.

At the same time, information on parking violations, e.g. parking in bicycle lanes or on emergency access routes, can be distributed accordingly to the parking control center in order to assist monitoring personnel (*figure 5*).

For the purpose of parking management, information on the occupation of parking spaces can also be incorporated into urban planning. A high level of transparency regarding the actual use of parking spaces increases the ability of area-specific parking control and pricing (*figure 6*). This in turn allows control of parking supply and demand by, for example, restricting the maximum parking time, charging prices based on parking time in each case or having different prices for different groups of users, e.g. discounted parking for residents.

Parking violations can be detected automatically by comparing the parking space occupation data with payment information relating to the associated parking areas. This information can help monitoring personnel to optimize route planning and thus assists in improving the efficiency of parking management. Depending on the city's strategic intentions in each case, the same level of monitoring success can be achieved at a reduced cost, or alternatively the level of monitoring can be increased while costs remain the same. The intensity of monitoring has an impact on the payment behavior of drivers using parking spaces and is a determining factor in respect to the effectiveness of pricing and parking regulations as an instrument for controlling the demand for parking.

An RFID solution can be added to the sensor system: In the case of vehicles which have been fitted with RFID tags, user-related authorizations such as resident, disabled, electrical vehicle or shared-car parking permits can be detected automatically (*figure 7*).

If the RFID system is used as an electronic identification system at the same time, the parking management system enables the implementation of minute-based billing and cashless payment for parking. In

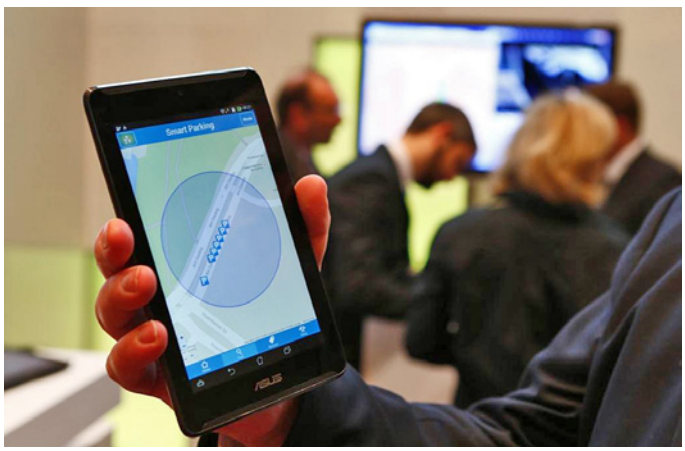

Figure 3: The parking control center distributes the occupation status to road users via smart phones, tablets or navigation systems.

Figure 4: A navigation system can use the information to suggest alternative transport options and guide drivers to park-and-ride facilites.

order to do so, the occupation of the parking space detected by the parking sensors will be compared with user information recorded by the RFID system. Billing of the amount owed is initiated automatically as soon as the vehicle leaves the car park. The conventional payment process is not affected in any way, therefore any motorists who have not signed up to the automated payment system can continue to pay using their preferred method of payment.

Synergy effects can be achieved by linking the parking control center to related systems such as a traffic management system: Information collected by parking sensors can be incorporated into strategic traffic management systems, and information on the general traffic situation can be used to fine-tune parking predictions. It is also useful to link parking data with information from public transport: By taking account of real-time public transport departure times and parking information, multimodal route planners can recommend switching to public transport at suitable locations.

Overhead radar sensors are efficient and open up a wide range of possible applications

In addition to overhead radar sensors, the Siemens system can also integrate other types of sensor and sensor technologies, enabling the system to be optimally adjusted to suit the individual requirements of a particular urban area, e.g. by using ground sensors where shading restricts the view from above.

The idea of monitoring the street mainly from above rather than below stems from the drawbacks which were discovered when taking a closer look at the previous ground sensor-based solutions offered on the market.

As overhead sensors are not only able to detect individual parking spaces, but can also monitor larger areas, the investment in the individual sensors required can be allocated over multiple parking spaces. In addition, the occupation of the parking space can also be reliably detected in the case of flexible use by vehicles of different sizes, enabling the available parking space to be fully utilized. Drivers can be sent information on free parking spaces according to the length of their vehicle.

With ground sensor-based solutions, the additional benefit of being able to monitor the areas adjacent to selected parking spaces can only be gained by installing numerous additional sensors or additional systems. In view of the costs and risks associated with parking situations which jeopardize safety – e.g. where cyclists have to deviate into the traffic in order to avoid a vehicle that is double-parked or where tramlines are blocked by vehicles negligently parked at an angle – overhead monitoring can provide clear added value.

As overhead sensors are easy to install on or in street lights, there is no need for major interventions into the infrastructure as long as a continuous power supply is available. If the introduction of a sensor-based parking management system is carried out at the same time as a retrofit to LED lighting, then there will be no additional costs for the installation of the sensors.

Sensors mounted at height are less susceptible to vandalism or accidental damage, e.g. caused by construction machinery, and will not be affected if work is carried out on the road surface.

The benefit of using radar technology compared to optical overhead systems is that objects detected cannot be identified so that the privacy rights of individual road users remain protected. Radar sensors can be easily calibrated and can therefore be installed with relatively little effort. They are also not affected by fog, rain, changing light conditions or winter weather.

Thanks to its technical and physical robustness, the Siemens system delivers reliable data and distinguishes itself by its high availability.

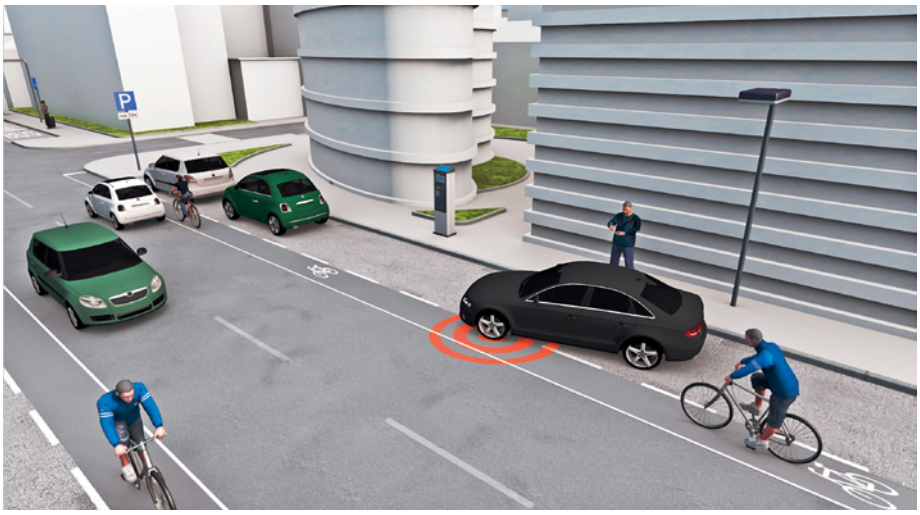

Figure 5: Parking violations can be transmitted to the parking control center in order to assist monitoring personnel.

Figure 6: The system provides cities with valuable real-time and statistic information on the use of parking areas.

From smart parking management to a smart city

By installing the described sensor network on its streets, a city will then also have the option to choose from a wide range of other Smart City applications.

In principle, an overhead radar sensor can detect not only vehicles but also other stationary and moving objects. The traffic monitoring capability of the hardware already installed can be expanded simply by making adjustments to the software. For example, the speed, size and direction of travel of bicycles and people as well as envi-

ronmental changes can be detected and utilized in traffic management, for controlling street lighting or in public transport and urban planning.

The sensors send data to the control center via a communications network, which can also open the door to other Smart City applications. Gateways and local computing capacities can be used by numerous other sensors for the purpose of processing and sending data, for example enabling environmental data to be linked to traffic management, or street lighting to be adjusted based on the weather and light conditions.

Collaboration with customers and partners turns the technical concept into a market-ready innovation

The solution developed by Siemens and designed for basic smart parking applications was first demonstrated during winter 2014/15 at the test site in Munich and is due to be launched in the public domain this summer as part of an initial pilot project.

Figure 7: With RFID tags, such as for resident parking zones, parking permits can be detected automatically.

The development is being funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety. In particular, the project takes into account the use of parking detection for monitoring parking spaces designated for electric vehicles while recharging and includes the additional integration of semi-public parking.

The innovative concept for reducing parking pressure in the city can make it easier to find a parking space. Furthermore, it can also provide support beyond the use case "parking" by helping with traffic management as well as the intelligent use of cities and their infrastructure. It focuses not only on turnover optimization for the city, but above all on the reduction of traffic and emissions together with the citizens' safety. Siemens has demonstrated the technical possibilities on offer – application and implementation in the future will mainly be shaped by cities and society. ■

Julia Hetz, MSc Marketing Innovation Manager, Siemens Mobility
julia.hetz@siemens.com

Marcus Zwick, Dipl.-Wirt.Ing. Head of Innovative Mobility Solutions, Siemens Mobility
marcus.zwick@siemens.com

Navigation of blind and visually impaired people

Smartphone-assisted navigation and crossing of signalized intersections using Car2x Communication technologies

Smartphone-assisted navigation, intra-urban mobility, handicapped persons

The mobility of the blind and visually impaired is associated with many barriers and risks. To secure crossings, signalized intersections are partially equipped with acoustic or tactile indicators. However, environmental conditions might interfere with the acoustic identification of the green time. Furthermore, information such as intersection topology, bicycle traffic or the curb structure is not accessible to visually impaired road users. Therefore, most trips are limited to trained routes. Within the research project InMoBS (intra-urban mobility support for the blind and visually impaired) a prototype of a route planning and navigation system has been developed and evaluated in an exploratory manner.

Authors: Steffen Axer, Jörg Belz, Kathrin Leske, Bernhard Friedrich, Tobias Hesse, Mark Vollrath

To identify technical and functional requirements and to meet the user needs, a requirement analysis was carried out that considered the pre- and on-trip functionality of the assistance system. In this process different techniques like in-depth interviews and video documentation of typical street crossing situations provided important implications for the engineering of a web-based route planning and mobile navigation assistance system. The collected qualitative results have been verified as effectively as possible by an online survey of 719 visually impaired and blind users. Extracts of the most important functional and technical aspects are qualitatively summarized in the following.

The functionality of a web-based pre-trip route planning tool for the given user group is basically similar to already established and well-known online routing services used by people without any visual impairment. However, to ensure content interaction that is compatible with the use of a keyboard and braille terminal, specific accessibility guidelines need to be applied [1]. Moreover, standard routing services mainly allow a shortest-path routing [2] that minimizes the total costs (i.e. geometric route distance) between two nodes of a road network. Typical underlying road network models are primarily designed for turn-by-turn vehicle navigation. In this case network topology and geometry are modelled in a very simplified manner [3]. The existence of sidewalks needed for pedestrian navigation is usually logically generalized information linked to the modeled intra-urban street. Compared to this standard approach, a routing system for blind and visually impaired users requires a much more detailed network model [4] that allows the explicit modelling and attribution of sidewalks and intersections with a high spatial resolution. As a minimum, the routing calculation needs to take parameters like accessibility and route distance into account, and the accessibility level should cover aspects like the availability of acoustic or tactile indicators at signalized intersections and the existence of pedestrian crossings. In addition, obstacles and points of interest tagged during the user's daily mobility should be incorporated in the route planning, which will allow not only the exclusion of dangerous walkways, but also the planning of the route to cover supportive waypoints. Last but not least, users desire a storing functionality that simplifies the use of regularly used routes.

When talking about the needs of on-trip assistance, blind and visually impaired test persons often reported feeling uncertain in heavily motorized, complex intra-urban intersection scenarios, especially on intersections with asymmetric geometry. Traffic noise masks potential orientation signals at intersections. Missing information about curbs or mostly lowered curbs without tactile indicators makes it very difficult to securely identify the transition line between the sidewalk and the street. Therefore complementary and seamless mobile assistance is needed to compensate for these factors and provide the users with important situational information. Apart from the abovementioned aspects, the availability of a continuous and reliable direction indicator, the current position (street name and number) and nearby POIs during the whole navigation are some of the most important requirements users brought up during the surveys. This multifaceted list of information and functionality, reported by the users, clearly emphasizes the need for a sophisticated prioritization of the information provided in order to avoid a mental overload during the navigation process.

Basic system design

Based on these requirements a system architecture composed of smartphone navigation "InMoBS mobile", web-based route planning "InMoBS home", server-sided routing and Wi-Fi-equipped traffic lights has been developed (*figure 1*). Within this architecture, a Component Server Platform (CSP) acts as a central information provider that supplies calculated routes on a high-precision digital map. The digital walkway network has been generated by processing standardized land register data from the city of Braunschweig. Three Wi-Fi-equipped traffic lights, as a part of the AIM-infrastructure [5] allowed for a unidirectional communication of real traffic signal states and timing, queried with a frequency of 1 Hz. For

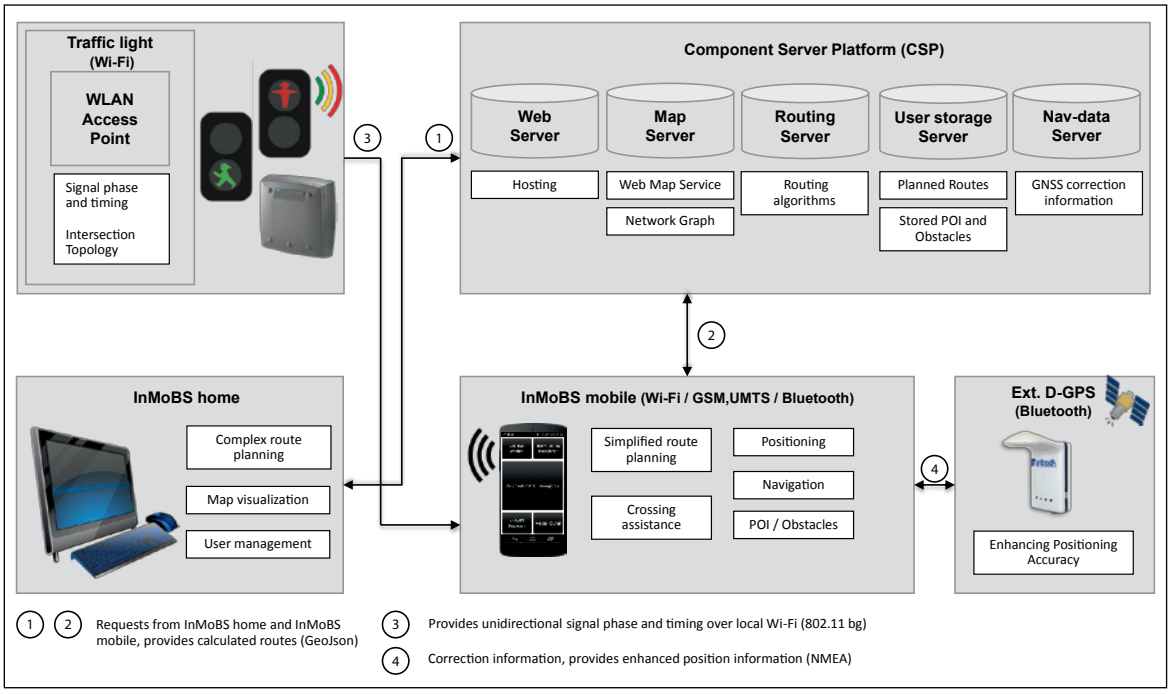

Figure 1: Basic system architecture and communication interfaces

communication purposes, a standardized protocol stack [6, 7], originally designed for 802.11 p vehicular communication, has been adapted to consumer Wi-Fi (802.11 b/g) enabled devices. To obtain more reliable and accurate position information in urban areas, a Google Nexus 5 smartphone was connected via Bluetooth to a small external differential GPS (Global Positioning System), which could be fastened on the upper arm of a test participant. In urban areas, the positioning system (Alberding A07) reached an accuracy of 1.3 - 2.2 m (1σ), depending on the surrounding environment and satellite constellation.

Smartphone application

"InMoBS Mobile" is the digital companion of the blind or visually impaired and guides the user safely to the chosen destination. In the scope of an iterative development process, blind and visually impaired participants were invited to test the app at various development stages. Their feedback was used to design the app's human machine interface (HMI). Several approaches were tested and led to the final interface, which is based on a simple layout scheme of five tiles used throughout the application (*figure 2*). The app's main menu offers the user the option to start a navigation process based on current position and desired destination (point of interest, street and house number). Furthermore, the user can select a previously defined route, stored by using the web-based route planner "InMoBS home". The route is calculated on the server, transmitted to the cell phone via mobile internet connection and handed over to the app's

Figure 2: Test participant (left) and InMoBS Mobile user interface

navigation process (see *figure 1*). The downloaded route allows the app to execute a sophisticated navigation algorithm that keeps the users on track, provides information about the surroundings and supports them in street-crossing situations.

Route guidance

The computed route represents a safe path to the destination. Deviations from this path may result in dangerous situations such as leaving the sidewalk and entering the vehicle lane. Accordingly, helping the user to remain on track is important. At any time during the navigation, "InMoBS mobile" helps the user to align the direction of movement with the help of vibration impulses, emitted by the smartphone, similar to the approach suggested by Pielot et al [8]. The impulse frequency indicates the extent of the deviation from the correct heading. The higher the deviation, the higher the impulse frequency. The actual heading is determined by using the smartphone's magnetic compass or internal GPS, whereas the desired heading can be obtained from combining the routing data with the user's current position. In addition to this

instant feedback, the app provides turning information by automatically notifying the user of upcoming curves using speech output, hence allowing the user to prepare for a direction change in advance.

Information about surroundings

Navigation in unfamiliar areas is a challenging task for the blind and visually impaired. Orientation is difficult, and unknown obstacles are a dangerous threat. To support the user in such situations the app supplies prestored information about important or interesting points and obstacles. The location and other information about these so-called 'points of interest' (POI) are part of the digital map. Public POIs, like museums, supermarkets and bus stops, are available to all users, while private POIs are only related to a single user. The app provides functionality to add private POIs and annotate them using speech input. When the navigation is started, the smartphone receives data about public and private POIs along the route. During navigation, information about a POI is provided automatically when the user approaches the POI's location. Furthermore, the user can request information about nearby POIs and POIs that are located along the remaining route. The speech output includes a description as well as the distance and bearing of the POI relative to the user's position and heading.

Crossing support

When the user approaches a crossing, crossing properties are announced automatically, for instance the type of crossing (signalized or unsignalized), the crossing distance and the availability of an acoustic or tactile indicator. The app indicates how to reach the waiting area and warns the user of crossing bicycle lanes. Acoustic information output can also be triggered manually using the accessible app interface. While standing in front of the street crossing, the haptic impulses allow the users to align their direction of movement. The Wi-Fi-equipped signalized intersections are broadcasting SPaT and TOPO messages (see *figure 1*). Based on these messages and the route information, the current signal phase of the crossing can be determined by the app. When the user has safely reached the waiting area and is ready to cross the street, the app monitors the crossing's signal state and emits an acoustic green light indicator as soon as the traffic light switches to green. No signal is given in case the user enters the waiting area within a running green time interval. In such cases, the user needs to wait for the next cycle to ensure that the maximum green time interval is available.

Entire system evaluation

Sample

The entire system was evaluated between 16 September and 23 October 2014 by a group of blind and visually impaired test persons. The realization effort for the tests and the extent of support that this specific group of users required during the test phase were relatively high. This resulted in a comparatively small sample (N = 8) and an exploratory, qualitative system assessment.

All participants (four women and four men) lived in Braunschweig. Contact was established by the Deutscher Blinden- und Sehbehindertenverband e.V., the German Federation of the Blind and Partially Sighted. All subjects had previously completed trainings in orientation and mobility. Participation was voluntary.

Five of the participants were blind (63 %) and three were visually impaired (38 %). The mean age was M = 60.0 years (Min = 44, Med = 63.0, Max = 67, SD = 8.1). 50 % (n = 4) of the participants had basic knowledge of working with tactile cards and smartphones and 63 % (n = 5) had experience with navigation apps or navigation devices. All users had basic knowledge of working with computers or laptops, as well as with tools for computers or laptops for blind and visually impaired and the Internet.

Procedure

The blind and visually impaired participants walked a 1,900 m long section of the ring road of Braunschweig twice (*figure 3*). Each subject walked the route once with the support of the navigation system (test setting) and once without navigation system (comparison setting). The participants experienced a walk in the direction of traffic on one date and a walk against the flow of traffic on the other date. The combination of the characteristics of the walking direction (with and against the flow of traffic) and the use of the navigation app (with and without) resulted in four study settings. The subjects were randomly assigned to these settings. The study design was fully balanced.

The route had different characteristics, which generally restrict the mobility behavior of blind and visually impaired persons in road traffic. There were some intersections with acoustic or tactile signal indicators and some intersections without these features. Loud traffic noise, traffic islands, bicycle lanes running in parallel to the sidewalk, different curb heights and, at one intersection, crossing tram rails further added to the difficulty of the situations.

In all study settings, the test walk started with a general explanation of the study process. Additionally, on the first date an informed consent as well as the participants' socio-demographic data were collected. In the study settings with navigation app, the examiner explained the operation of InMoBS mobile and InMoBS home to the participants. Then, the participants were given time for to practice the operation of the navigation device.

The computer for the operation of InMoBS home was equipped with tools for the blind and visually impaired (e.g. braille console). InMoBS mobile was installed on a smartphone. Through this, users were given

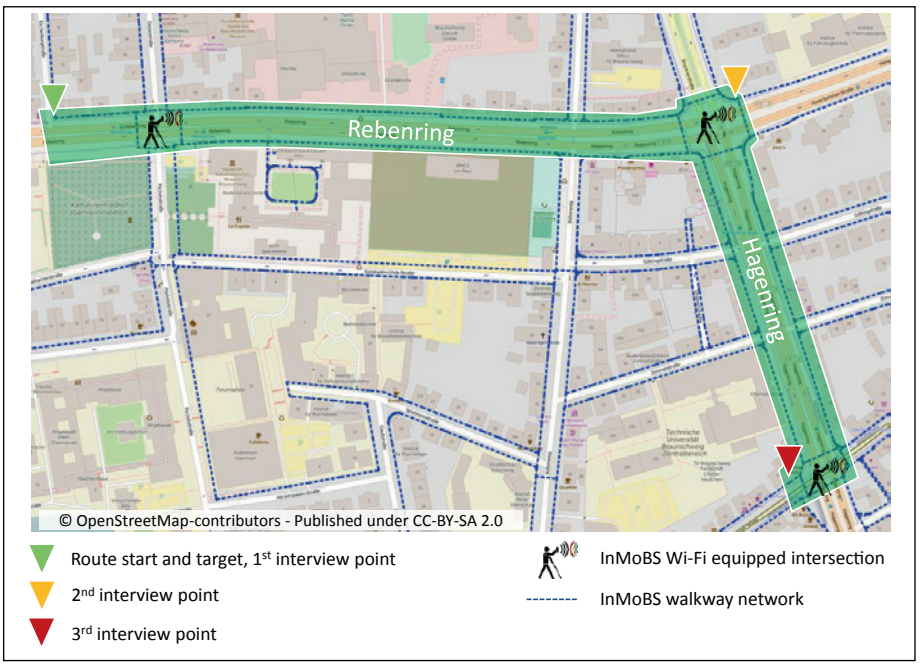

Figure 3: Overview of the InMoBS test site

acoustic and tactile information about the route and their own position. In addition, a Bluetooth speaker was used.

In the study settings with a navigation app, the users first enabled the route on InMoBS home. They then walked the route with the assistance of the navigation system. During the walk they added a POI to a position on the route. After completing the route, they were asked to rename this POI in InMoBS home. In the study settings without a navigation app, a tactile map or high-contrast map of the route was handed out to the participants. All participants were interviewed at three route points (see *figure 3*). The interviews were recorded with a voice recorder.

All participants were accompanied by at least one full-sighted research associate and at least one full-sighted student of the Technische Universität Braunschweig along the entire the route. An interview guide was developed for each study setting. The interviews included questions that could be answered on a 5-point scale of response, as well as open-ended questions. The participants were asked about their subjective experience with regard to managing the task of walking the route with and without a navigation app. The participants were also interviewed regarding general aspects of mobility. For example, one question was: "How well could you orient yourself about your position in respect to the entire route?" Participants were also asked what they thought were good and bad aspects of InMoBS mobile and InMoBS home.

Results

All participants positively evaluated the concept of the InMoBS system. The features of InMoBS mobile that provided the participants with information at intersections without acoustic or tactile signal indicators met with especial appreciation. The same was true for the announcement of bicycle lanes, as well as the option "Where am I?", which provided information about the current position on the route. The information content of the menu provided at crossings and intersections was also positively assessed. This menu offered information about traffic lights and acoustic or tactile signal indicators at the intersections, as well as the topology of the intersection and the names and number of incoming roads. Furthermore, intersection-specific information about traffic islands, tram rails, bus lanes and curbs was offered in this menu. The study participants especially liked the relatively autonomous operability and the orientation and navigation on the web page offered by InMoBS home. Almost all of the participants were able to handle the processing of tasks in InMoBS home. On the other hand, participants criticized the message delay caused by partially inaccurate positioning. Furthermore, sometimes the operation of both systems was difficult due to the lack of experience and training with the system.

Conclusion

The participants repeatedly expressed that the navigation app, with reservations regarding the localization problems, would considerably improve the quality of mobility for the blind and visually impaired. Also, the system would be suitable for providing assistance to additional groups, such as full-sighted elderly pedestrians. Thus, the next steps should be to develop the prototype further, including a larger area and the integration of public transport. ■

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Bernhard Friedrich, Univ.-Prof. Dr.-Ing.
Head of Institute, Institute of Transportation and Urban Engineering, Technische Universität Braunschweig, Braunschweig (DE)
friedrich@tu-braunschweig.de

Steffen Axer, M.Sc.
Research associate, Institute of Transportation and Urban Engineering, Technische Universität Braunschweig, Braunschweig (DE)
s.axer@tu-braunschweig.de

Mark Vollrath, Univ.-Prof. Dr. Dipl.-Psych.
Head of Department, Engineering & Traffic Psychology, Institute of Psychology, Technische Universität Braunschweig, Braunschweig (DE)
mark.vollrath@tu-braunschweig.de

Kathrin Leske, Dr. Dipl.-Psych.
Research associate, Engineering & Traffic Psychology, Institute of Psychology, Technische Universität Braunschweig, Braunschweig (DE)
k.leske@tu-braunschweig.de

Tobias Hesse, Dr.-Ing.
Team Leader Technologies for Assistance and Automation, Institute of Transportation Systems, German Aerospace Center (DLR), Braunschweig (DE)
tobias.hesse@dlr.de

Jörg Belz, Dipl.-Inf.
Mobile Devices for Assistance and Automation, Institute of Transportation Systems, German Aerospace Center (DLR), Braunschweig (DE)
joerg.belz@dlr.de

Villages on the road to the future with Smart Ecosystems

Smart rural areas, Smart Ecosystems, digital villages, demographic change

Germany has the largest and most successful economy in Europe. However, we will only be able to keep this leading role if we also maintain a strong and effective infrastructure. The towns and municipalities have a special role in this endeavor, as there are many areas in which they are the providers and operators of such infrastructure systems. This does not only include schools, swimming pools and city halls (whose condition often leaves much to be desired) – but also a suitable digital infrastructure for an elementary pillar of public service provision: transport of people and goods.

Authors: Mario Trapp, Gerald Swarat

The Internet and the ubiquitous digitalization of our lives will not go away anymore. Rather, they are rapidly expanding and increasingly shape our professional and social environments. And yes, we are indeed experiencing a digital transformation. We are experiencing how IT is becoming a crucial driver for innovations. Digital services and applications offer invaluable possibilities for improving the quality of work and life in rural areas and thus for embarking on a path where the future focus will not only be on the marketing term Smart City, but also on Smart Rural Areas. And there is good reason for this. A closer look reveals that 56 million Germans (75 %) are living in cities and towns with fewer than 100,000 inhabitants. In states with large areas and low population density such as Rhineland-Palatinate, the part of the population living in communities with fewer than seven thousand inhabitants even reaches 50 % (*figure 1*).

The two meta-trends for villages

For Germany as a whole, the forecasts regarding demographic development paint a similar picture as for other industrialized countries: fewer people overall[1], higher average age, and a more international population in the metropolises. If we leave the national level and look at the regions, we can clearly see the dramatic consequences of demographic change. Low population density and decreasing population figures are not really a surprise or new development in peripheral areas, but the simultaneous grip exerted by an aging population and the rural exodus seems to literally wrest the life from the villages. If these effects meet weak economic and social structures, as in the case of many rural regions, the demographic factor becomes an accelerator of the downward spiral. In these regions, the question then arises if and to which extent it will even possible at all to maintain a public infrastructure that does at least partial justice to the constitutional right to equal living conditions for all.

But that is not all. In addition to the demographic factor, the digital revolution is the second major trend. The challenge is to shape this trend actively and fill it with life! Digital services and applications offer invaluable possibilities for improving the quality of work and life in rural areas. However, one particular challenge – both when it comes to ensuring public services and infrastructures and establishing innovative business models – is the regions' sparse population. Compared to cities, very large areas must be covered to reach a comparatively small number of citizens. This is an enormous task, particularly for the transportation of goods and people.

Digital villages as an alternative to the city?

When faced with the choice of moving either to the countryside or to the city, every young family has to decide whether the natural environment, the animals, the open spaces, the fresh air and a carefree childhood for their children are enough to offset the concerns. Are there jobs in the countryside, respectively is the daily commute during rush hour worth it? Is it worth wasting valuable time every day in traffic jams? Is it worth for a family having a second car for the marriage partner who works part-time, picks up the daughter from the daycare center and goes shopping at a supermarket 15 km away, since the smaller, local stores have already given up? Is it worth moving to the countryside knowing that the nearest connection to the public transport system is unsatisfactory because bus service is no longer feasible due to the decreasing population?

Here, digitalization can lead to decisive progress, as our lives, our work, our education, and our spare time are increasingly determined by the Internet. Industry 4.0, Cloud Computing, Big Data, security and safety are becoming more and more intertwined and extend their reach into our immediate surroundings; new technologies are being integrated into our daily lives to an ever greater extent. The mass customization of the Fourth Industrial Revolution ensures that products and services are tailored to individual needs and usage conditions. Highly automated or even completely autonomous systems perform tasks and optimize life in every situation. Autonomy and flexibility are the guiding values that pervade society and production.

Rural solutions

So what will the technical architecture of the world of tomorrow look like? How will the special requirements of rural areas be taken into account? Quite clearly, more than a minimum basic supply must be ensured; new and flexible jobs and work models must be created; school education for children must be ensured on a high level through innovative concepts, and much more. This also involves challenges such as autonomous driving or the possibilities of sharing concepts or on-demand citizen buses that double as delivery services for goods and medication. Many visits to specialist doctors in the city could become superfluous if the local physician were to use state-of-the-art technology to consult the specialist in the

Figure 1: Networking to facilitate future development – issues and mutual dependencies

city and get a remote diagnosis. A rural scenario shows that the mobility of the future does not appear to be very far off anymore:

Mrs. Smith is working in a nearby city. The on-demand commute to her place of work using the mobility service via car-sharing, bus or share taxi is cheaper than going by car. She can book a monthly flat rate, which becomes even more affordable if she schedules her times in advance. But she also uses the slightly more expensive ad-hoc services for booking her trips. The mobility billing system is coupled with the logistics billing system, which the family uses quite often to transport packages for neighbors from a logistics cell near the gas station to the village. The best feature of the mobility service is that Mrs. Smith does not have to take the wheel anymore and can use the commute much more efficiently. Sometimes she works, sometimes she enjoys the start of the day with a cup of coffee and reads the newspaper; sometimes she coordinates her family's weekly plan or their activities. During her commute she orders fruit and cheese from a regional store and from a farm, which are then delivered at the desired time, fresh and individually, by a delivery drone owned jointly by the vendors.

This is an example of how a smart logistics system can ensure that the residents of rural areas can afford delivery of their goods, as door-to-door delivery will soon cease to be economically feasible.

Information technology will thus occupy a key role in different areas. The greatest challenge, however, will arise when systems have to collaborate across traditional industry barriers. Particularly in the countryside, economically viable solutions will only be made possible by the efficient, joint use of resources across the boundaries of established silos. This is true for the crowd transportation/logistics issues mentioned above, if, for example, packages are no longer transported only via package delivery services, but are taken along in public transport vehicles and even in private vehicles – similar to the way that digital car-sharing services have taken hitchhiking to the future as a safe and comfortable transport option. To make this a reality, a wide variety of systems must communicate with each other, from smart address labels and reading devices in the car via smartphone apps to higher-level coordination and optimization in the interaction between logistics systems and passenger transport systems offered by many different providers. This allows efficient use of the two resources 'vehicle' and 'driver' so that economically attractive business models can be developed despite the low customer density in rural areas: A shared-mobility platform coordinated via an app integrates citizen buses, private vehicles and public transport systems, calculates the best connection, and ensures that service is provided at the desired time. The result is a real-time schedule and a transport planning system all rolled in one, which allows the customers to plan their way to work.

Here, science can develop visions for the future and point to solutions, since new infrastructures and transport options need to be created in the country – through citizen buses or, in the future, also with the help of autonomous driving. IT solutions in Smart Rural Areas therefore adapt the transport ecosystem optimally and individually to the people in order to create a customized and still economically viable transport option for people and their goods.

Another important step is for the Internet to also reach the road. Vehicles are becoming interconnected with each other, but also with the smartphone, and can even be controlled in this way. Parts that need to be repaired or replaced generate an automatic alert and trigger a process aimed at the garage. The self-driving car also offers new potential in terms of organizing commutes or optimizing traffic, such as avoidance of traffic jams; and vehicle-to-vehicle networks will dramatically reduce the number of accidents. IT-based technologies already provide support today in finding a parking space and calculate the most efficient route, but autonomous driving will not only make traveling more comfortable, but can also keep sick or elderly citizens mobile. Soon cars will be communicating with each other, which will make traffic management a whole lot easier. Passengers in vehicles are already using the Internet, but in the future, the car itself will be offering services and information. The vehicles will communicate with each other and with the traffic infrastructure via sensor data and information and will trigger alerts regarding traffic jams, accidents, ice and slippery roads, or obstacles behind a curve – all in real time.

Smart Ecosystems

The basis of all this are Smart Ecosystems. Whereas smartphones and the Internet represent the tip of the iceberg of a digital society and economy, software forms the central nervous system that will combine all systems across industries and technologies in a smart collective encompassing everything from sensors and actuators to the Cloud. Smart Ecosystems are the necessary next step in the evolution and create a bridge between system classes. There is an urgent need for action with regard to the combination of application areas, for instance in the cross-domain value chains of Industry 4.0, in the

interaction between different areas of the economy (logistics, commerce, energy supply), or in the all-encompassing use of data and services in everyday life (Smart Home, eCommerce, eHealth). The term ecosystem is well known from biology, where it denotes a system that results from the interaction between organisms and their environment. A Smart Ecosystem consists of different systems that interact with each other like biological organisms in order to achieve specific goals while taking into account influences originating from their environment. Smart Ecosystems in the technical sense typically encompass both information systems and technical systems, which are interconnected with their environment in numerous ways, for example via sensors and actuators, and which interact with the people in their environment.

Consequently, the most important challenges that Smart Ecosystems have to face primarily result from mastering the complexity of the services and the heterogeneity of the systems. Furthermore, the cross-divisional, modular solutions must fulfill all requirements regarding quality, security and safety, and must create a positive user experience for interactive systems. In car-to-car communication, the speed of the data exchange obviously plays an important role. Communication between systems that were developed independently also requires the development of communication standards and rules. In addition to realizing functionality, ensuring end-to-end quality across all systems and all domains in the process chain is a central challenge.

Security versus safety

Until quite recently, safety was the primary concern in vehicles. Safety is defined under aspects of functional safety, whereas security is aimed primarily at data security from an IT perspective. Opening vehicles to the outside to enable Car2X communication makes them vulnerable to attacks. Security can then become a weak point for safety. All of a sudden, a lack of security can endanger not only our data, i.e. our digital selves, but also our physical selves. At the same time, our cars will transmit a huge amount of data about us. Who owns these data? How can we prevent misuse while still enabling new business models?

As these two areas, security and safety, are now coming together in the above described interconnected scenarios, new solutions are called for, since a security problem may now directly affect safety issues. In order to better understand these mutual effects, a lot of research and development is still needed, says Prof. Dr.-Ing. Peter Liggesmeyer, institute director of Fraunhofer IESE, "since otherwise, the whole issue of Industry 4.0 will not be safe either." Industry 4.0 concepts only work if the customers continue to feed their personal data such as shopping behavior, consumer wishes, occupation and maybe even health data into the large pool of Big Data – because these are the data that Industry 4.0 needs to mass-produce customized products.

A future in and for rural areas

The Smart Rural Areas initiative of Fraunhofer IESE demonstrates that rural areas can create and maintain very livable local conditions also in the future. The issue is participation in society in all phases of life. The provision of public infrastructure, health care, mobility, logistics and age-appropriate services must be adapted to changed social structures, must be interconnected and re-designed to make this a reality. "Ultimately," says Dr. Mario Trapp from Fraunhofer IESE, "there are a lot of things that do not need to be re-invented. Rather, the challenge is to interconnect existing systems with each other in a smart way so that added value is created." If young families and skilled employees recognize these opportunities and opt for a life in the countryside, rural areas will become attractive (again) also for small and medium-sized enterprises and factories. The downward spiral can be stopped and the region will experience a renaissance.

Figure 2: The SMART Rural Areas logo

In order to make this vision a reality, Fraunhofer IESE is developing an open platform "Smart Rural Areas", which develops future concepts for rural regions in collaboration with partners from research and industry. In this context, a so-called Living Lab is being created at the Fraunhofer Institute. As a development and evaluation platform, it will provide the necessary infrastructure for developing new ideas for innovative products for "Smart Rural Areas" and thus for demonstrating the overall potential. The Living Lab will offer companies the opportunity to test their business models for rural areas on the basis of a life-like simulation – without having to repeatedly reprogram the application for their purposes (*figure 2*).

This is how already tested good examples can be made visible, how they can have an impact and create pressure to act in order to give rural areas a future. Revitalization of the villages and collective creation of a new dynamism as a joint effort of government, public administration, business, research and citizens are crucial for a positive prognosis of our future. ■

[1] The prognosis of the Federal Office of Statistics assumes a decrease to 65-70 million by the year 2060. https://www.destatis.de/DE/Publikationen/Thematisch/Bevoelkerung/VorausberechnungBevoelkerung/Bevoelkerung-Deutschland2060Presse5124204099004.pdf?__blob=publicationFile

BACKGROUND INFORMATION

Further information can be found at

http://www.iese.fraunhofer.de/de/competencies.html

The Fraunhofer Institute for Experimental Software Engineering enjoys a worldwide reputation for its work in the area of methods and processes for industrial software and systems development based on empirical evidence. The Smart Rural Areas initiative is one the central research programs of Fraunhofer IESE. Get in touch with us and join us in actively working at the interface between research, business, politics and civil society – for the future of rural areas.

Contact:

Fraunhofer Institute for Experimental Software Engineering IESE; Fraunhofer-Platz 1, 67663 Kaiserslautern (DE) http://www.iese.fraunhofer.de/

Additional links:

Research initiative "Smart Rural Areas": http://www.iese.fraunhofer.de/de/innovation_trends/sra.html

Project "Digital Villages" in collaboration with the state of Rhineland-Palatinate:

http://www.iese.fraunhofer.de/de/innovation_trends/sra/digitale_doerfer.html

Twitter: http://www.twitter.com/SmartRuralAreas

Mario Trapp, Dr.-Ing.
Division Head Embedded Systems,
Fraunhofer Institute for Experimental Software Engineering IESE,
Kaiserslautern (DE)
mario.trapp@iese.fraunhofer.de

Gerald Swarat, M.A.
Coordinator Smart Rural Areas,
Fraunhofer Institute for Experimental Software Engineering IESE,
Kaiserslautern (DE)
gerald.swarat@iese.fraunhofer.de

Projects in a nutshell

An overview of selected mobility research projects

Reliable systems for recharging electric vehicles

The success of electric vehicle networks depends on economical vehicles – and efficient power grids. Existing power lines were not designed for the loads generated by electric vehicles: When multiple electric vehicles plug in at the same time, existing power grids quickly reach the limit of their capacity. Fraunhofer researchers have developed prototype software to show grid operators how many electric vehicles can be connected to their local grid.

"A vehicle draws up to 22 kilowatts (KW) of power. So if multiple vehicles are plugged in at the same time, current grids quickly reach their limits," says Dr. Michael Agsten from the Advanced System Technology (AST) department at the Ilmenau site of the Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB. Together with his team, Agsten has developed a software program that shows grid operators how much load their low voltage network can handle and how many charging processes can run simultaneously without hitting the limits set by statutory requirements or by the grid operator.

Each electricity substation typically supplies power to 150 or more households. Assumed that a certain proportion of households will own an electric vehicle in the future and plug the vehicle in at some point in time, then arises an inconceivably high number of charging scenarios, since it is impossible to predict which households will charge their electric vehicles at any one point in time. Every time another electric vehicle is plugged in, this increases the number of possible combinations of simultaneous charging situations distributed geographically and over time. The current processes used for testing and installation are unable to take all the local boundary conditions into account.

The researchers decided to simulate their model using the Monte Carlo method, a form of stochastic modeling. The aim is to produce a group of combinations that is as heterogeneous as possible. The number of these combinations is significantly smaller than the total number of all possible combinations. It is far quicker to analyze somewhere between 1,000 and 10,000 cases, and get a very good approximate value: In a matter of seconds the software program shows the degree of overload risk and how many electric vehicles can be charged simultaneously in a local grid. Distribution grid operators can use these figures to protect their power grids from long-term damage and sudden outages.

The prototype of the software program has already been created as part of the "Managed Charging 3.0" project sponsored by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). At the moment the IT platform is already running smoothly in the laboratory with test data. The next step will be the analysis of real distribution grids. *ebl*

Contact: Fraunhofer Application Center System Technology Ilmenau (IOSB) AST, Ilmenau (DE); www.iosb.fraunhofer.de/servlet/is/12672/

Simulator of bicycle use within cities

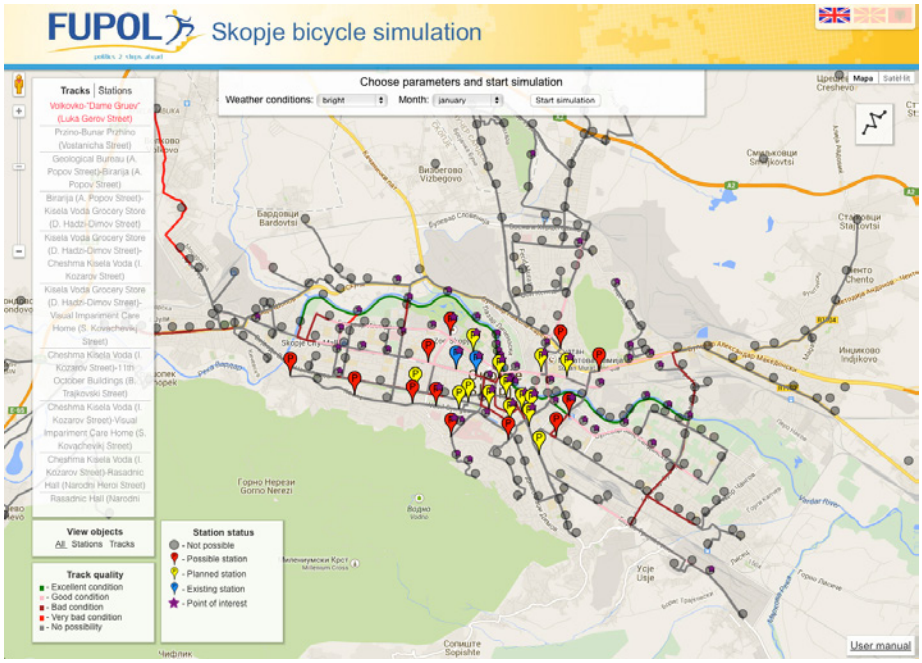
Universitat Autonoma de Barcelona researchers have developed a computer simulation model that helps city officials decide which improvements can be made to increase the number of bicycle users in the city. The model compares different actions and determines which set of measures are the most adequate according to their impact.

Initially developed for the city of Skopje, Macedonia, the model allows foreseeing results and predicting the effect that a set of actions will have on the number of bicyclists. Thanks to its application, the city of Skopje foresees an increase from the current 2.5 % to 5 %, a percentage typical of northern European cities, where bicycle transport is an established option.

Among the improvements included in the programme are the adaptation of road surfaces, the construction of new roads to cover new itineraries, the creation of bike stations and rental points, and the modification of already existing stations.

In order to calculate the impact each possible change can have, the model takes into account the characteristics of the city's inhabitants, such as their motivation to use bicycles, the lack of motivation produced after conditions do not satisfy users, and the increase in motivation when neighbors also use bicycles.

"There is a difference between those who use their bicycle even if it is raining, snowing or hot outside, and those who only use it if the road conditions are good and the weather is nice. This is the first time this type of model takes into account the percentage of each group of people according to their motivation and their preferences. This makes it easier to predict the effects of each measure with great precision", explains Roman Buil, researcher at the UAB Department of Telecommunications and Engineering Systems and creator of the model.



Given that municipal budgets are always limited, the model allows to prioritize the measures to be implemented, such as deciding how many stations or paths to create, or adapting a specific stretch of road. Based on these initial conditions, the model offers, in percentage of users, the results of a list of combinations of different actions and determines which is the best combination to reach the objective.

It is not common for politicians to use computer models when making decisions, but this model has been very well accepted in all the cities in which it is being tested. UAB researchers have created similar models to be used in very different situations, such as optimizing leisure options available on a mountain close to the city of Skopje; distributing the areas of an urban park to satisfy the preferences of a maximum number of users, in Zagreb, Croatia; determining the most adequate types of municipal facilities taking into account those living nearby (nursery schools, libraries, civic centers, parks, etc.), which is still to be implemented; as well as redistributing the industries of a large city to minimise environmental impacts, which is currently in trial mode in the Chinese city of Yantai.

The project is part of the European FUPOL project, funded by the EU's 7th Framework Programme, which develops advanced artificial intelligence tools to assist politicians in the design and implementation of social policies. *ave*

More information:
www.uab.es

Sandglasses – red and green

Researchers at the University of Granada (UGR) found that only the two mandatory phases of traffic lights, steady green and steady red, prevent unsafe pedestrian behavior and communicate a clear message. These colors in combination with an indication of the time left to cross or wait – in the form of a sandglass symbol with a countdown or what's known as a Marshalite – would be the most effective means of preventing accidents. According to the scientists neither flashing traffic lights nor the color yellow (or amber) have any effect on pedestrians.

The aim of the study conducted by scientists at UGR's "Brain Mind and Behavior" Research Center was to contribute to the design of more effective traffic signals to prevent people taking risks at traffic-light controlled crosswalks. The authors worked with a sample of 247 participants, most of whom (74.89 %) had a valid driving license. All were presented with a series of photographs of various pedestrian crosswalks controlled by traffic lights in the center of Granada.

Participants were shown different crosswalks with both real and modified traffic light regulation. They were asked to rate each situation from 1 ("Never cross in that situation") to 10 ("Always cross in that situa-

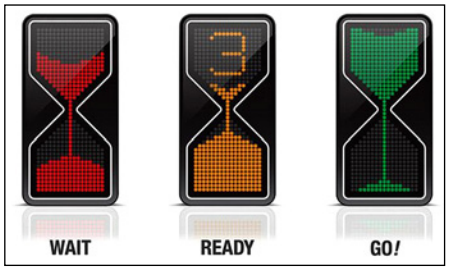
tion") as to whether or not they would cross. The types of traffic light that the researchers suggested to participants were: a steady green light, flashing green, steady yellow, flashing yellow, steady red, flashing red and lights off.

Currently, the EU has no specific, common regulations for traffic signals. For example, in Italy, as well as steady green/steady red, there is a yellow phase for pedestrians. In France, there is a flashing red phase, and in Spanish cities like Granada, a flashing green light indicates an imminent change to red.

The results revealed some curious facts. Many pedestrians do not know the meaning of the non-mandatory phases of traffic lights, yellow ore blinking lights. The researchers conclude that the options involving a flashing light and the color yellow are not effective in communicating a clear, safe message: The mandatory solutions would be the best options to avoid unsafe pedestrian behavior when crossing at controlled crosswalks.

Another type of light that they consider would be effective is called a Marshalite, which was first used in Australia in 1936; in Germany the similar Heuer-Ampel was used in the 1950s and 1960s. They had two motorized rotors that moved pointers clockwise to point to the relevant section: red, yellow or green.

The researchers suggest that the lack of common standards and the ambiguous messages about intermediate stages (steady or flashing lights) "could diminish road safety levels, contributing to the high number of accidents that occur annually in Europe at signalized junctions–equally common in



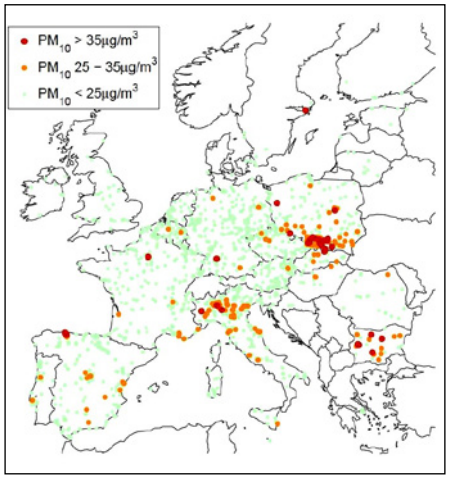
Spain, according to the Spanish Interior Ministry's Directorate-General for Traffic (DGT)". *ave*

Contact: Leandro L. Di Stasi, Brain Mind and Behavior Research Center University of Granada, Ergonomics and Cognitive Science research group (HUM687), Granada (ES); mail: distasi@ugr.es

Clearing up Europe's air pollution hotspots

Europe cannot achieve the WHO air quality guidelines without strictly controlling emissions from coal and wood burning for home heating, road traffic, and other sources such as industrial-scale factory farming, according to recent International Institute for Applied Systems Analysis (IIASA) research.

Current air quality legislation in Europe will lead to significant improvements in particulate matter pollution, but without further emission control efforts, many areas of Europe will continue to see air pollution levels above the limits set by the EU and the World Health Organization. Strict control of vehicle emissions alone will not be sufficient to achieve the limit values.



Under current legislation, air pollution hotspots will remain in Eastern Europe, southern Poland and major European cities such as Warsaw, Paris and Milan, according to a new study published in the journal Atmospheric Chemistry and Physics by researchers at the International Institute for Applied Systems Analysis (IIASA) and colleagues around Europe.

"This is the first time that we have analyzed particulate matter at individual monitoring stations across Europe, from regional background to urban streets, exactly where it's important to know if air quality limits will be met. We show the potential and the need for further emission controls to achieve safe levels of air quality – current legislation will not do the job," says IIASA researcher Gregor Kiesewetter, who led the study.

While new policies in Europe have contributed to significant decreases in air pollution over the past several decades, an estimated 80 % of Europe's population is still exposed to PM levels above WHO air quality guidelines, and a significant proportion of the region still exceeds the air quality limit values set by EU law.

Such pollution comes from a number of sources, including power plants, agriculture, domestic heating, and city traffic. IIASA's GAINS model has been used for years to provide estimates of emissions and air pollution levels to support policymakers in Europe and around the world. In particular, the model has been employed in the ongoing revision of the EU air quality legislation. The new study also uses the GAINS model, and improves the estimation of ground-level PM levels by incorporating air quality data collected on the ground at monitoring stations across Europe.

Using the improved model, the researchers explored two scenarios for how air pollution levels could develop across Europe by 2030. Assuming that current legislation is successfully implemented, average air pollution levels would decrease substantially. However, the study shows that a substantial proportion of the European population would still be exposed to PM10 concentrations exceeding EU standards in 2030, in particular in southern Poland, the Czech Republic, Slovakia, northern Italy, and Bulgaria, as well as in a number of major cities.

In a second scenario, the researchers examined what would happen if the most efficient air pollution control technologies that are currently available were implemented across Europe. In this case, they found that by 2030, 99 % of monitoring stations would see air pollution levels reduced to below EU limits. *ebl*

More information:
http://www.iiasa.ac.at/web/home/about/news/150219-EU-air.html

Mission: City of the future

An Initiative of the Federal Ministry of Education and Research

Science Year 2015

City of the Future

Science Year 2015 – City of the Future is up and running: This German national platform lays out a strategic research and innovation agenda. Science Year 2015 is devoted to the city of the future. As part of a campaign tackling the major questions around the city of the future, Fraunhofer IAO is informing city authorities, companies and individuals and helping them find the answers.

Fraunhofer IAO is addressing major aspects of the seven innovation areas a part of campaign running in parallel to the Science Year 2015 – City of the Future: Fraunhofer's Morgenstadt initiative will be on board the "MS Wissenschaft" exhibition ship, giving visitors a fun way to discover a wide range of research projects concerning the city of the future. And experts at Fraunhofer IAO and its cooperation partner, the Institute of Human Factors and Technology Management (IAT) at the University of Stuttgart, are starting a blog series about the city of the future, in which they present their insights, ideas and questions related to the following priority topics:

- Versatile city: Cities will have to be incredibly resilient and able to adapt in order to cope with the effects of climate change, shifting demographics and digitization. What are the success factors that pave the way to a "resilient" city?
- Livable city: More and more of us are living in increasingly complex urban systems. How can we embrace the idea of the city as a collaborative and social space, and how can we then design new ways of getting involved?
- Productive city: In the city of the future, production centers will be so quiet and clean that they can be located right next to residential areas. Which work practices, processes and technologies do we need to turn this vision into reality?
- Social city: Sharing is the new having. Establishing a "shareconomy" provides people and companies with new, sustainable opportunities and business models for how they use goods and resources. What do smart services look like in the city of the future, and what new living models can we expect to see?
- Moving city: More and more people and goods are on the move in our cities – leading to traffic jams, air pollution and noise. New technologies and connectivity options are making urban mobility hassle-free. What do pioneering transportation concepts look like?
- Digital city: In the Internet of Things, connectivity is not only about people, but increasingly also about machines and our environment. What specific opportunities and risks does this development pose in an urban setting?

Fraunhofer's international "Future Cities" convention will take place in Berlin on 25–26 November 2015. It will provide an overview of the latest research as well as ideas and visions for the city of the future. The event is also a chance to meet and exchange ideas with a host of national and international players from research, politics and industry connected with this topic and to collaborate in shaping the future. *ebl*

Website in German, English, Chinese:
https://www.wissenschaftsjahr-zukunftsstadt.de/uebergreifende-infos/english.html

Contact: Steffen Braun, Urban Systems Engineering, Fraunhofer IAO Stuttgart (DE),
mail: steffen.braun@iao.fraunhofer.de

Shared self-driving city cars

A fleet of self-driving shared vehicles could make 90 % of conventional cars in mid-sized cities superfluous, according to a study published by the International Transport Forum at the OECD. Even during peak hours, only one third (35 %) of the current number of cars would be needed to provide the same number of trips as today.

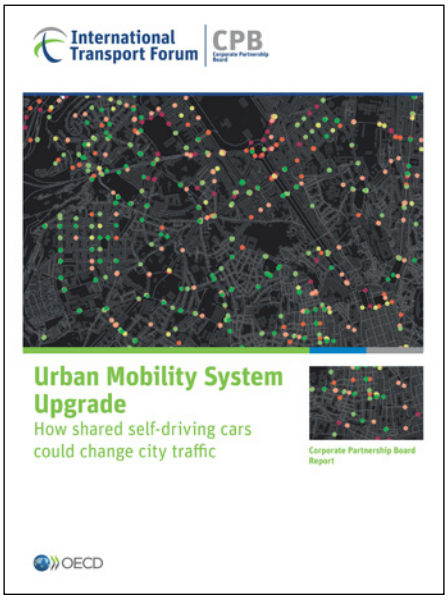
ITF researchers used actual transport data from Lisbon, Portugal, to model the impact of two concepts: "TaxiBots", self-driving vehicles shared simultaneously by several passengers (ridesharing) and "AutoVots", which pick-up and drop-off single passengers sequentially (carsharing).

The largest reduction is achieved where a fleet of TaxiBots is complemented by a subway or other high-capacity public transport. But even in the least effective scenario (AutoVots without subway), 50 % of cars would no longer be needed.

The need for on-street parking spots could be totally eliminated by the use of a fleet of shared self-driving cars in all scenarios, allowing the reallocation of 1.5 million square meters (20 %) of street space to other uses.

While the number of cars is drastically reduced, total kilometers traveled increase with such as scheme. This is due to detours traveled for pick-up/drop-off, repositioning and a shift from bus trips to shared cars. The additional travel could increase environmental impact, if the fleets used conventional engines. If electric vehicles were used instead, a TaxiBot fleet would need 2 % more vehicles to accommodate battery re-charging times and reduced travel range, though the increase would be limited to 2 %. *ebl*

The report "Urban Mobility System Upgrade – How shared self-driving cars could change city traffic" is available for free download at:
www.internationaltransportforum.org/Pub/pdf/15CPB_Self-drivingcars.pdf



Contact: Michael Kloth, ITF Head of Communications, Paris (FR), michael.kloth@oecd.org

NATRANS Arabia 2015 in Abu Dhabi

Preview: 19–21 October 2015 – NATRANS Arabia together with the 6th Middle East Rail Opportunities (MERO) Summit held at Abu Dhabi National Exhibition Center (ADNEC)

NATRANS Arabia is the region's premier B2B transport event dedicated to the Rail, Road and Maritime sectors. Highly technology focused, it plays an important role in strengthening the UAE's position as 'the' business hub for all land and maritime related products and services. Spread across four dedicated zones covering the key transport areas Rail, Road, Maritime and Intelligent Transport Systems (ITS) the exhibition is divided into three zones with specific conference streams for the transport industry:

- 6th Middle East Rail Opportunities Summit
- The Middle East Road Opportunities
- The Middle East Maritime Opportunities

The 6th MERO Summit, now part of NATRANS Arabia, is set to be the major meeting point for the rail industry in 2015. It is fully supported by the UAE Federal Transport Authority and held under the patronage of His Excellency Dr Abdullah Belhaif al Nuaimi, Minister of Public Works and Chairman of the Federal Transport Authority.

GCC rail network to connect the six Gulf states by 2018

Dr Ramiz Al Assar, World Bank resident adviser of the Gulf Cooperation Council (GCC) Secretariat General in Riyadh: "The 2,177-km-long GCC rail network, which will link all six Gulf states by rail for the first time, providing an alternative to air or sea travel for both goods and passengers in the region, will be fully operational in 2018. The designs of the nearly $200 billion network, which will run down the Gulf coast from Kuwait, through Saudi Arabia, to the UAE and Oman, with branches linking Bahrain and Qatar, will be completed by the end of this year or in the first quarter of next year. Construction on the network already in progress will be fully operational in 2018." Abu Dhabi is leading the GCC rail network with its DH 40 billion Etihad Rail project. The 1,200-km line, planned to be completed in 2018, will link major industrial zones, cities and ports in the UAE, and will eventually connect with the GCC railway.

The rail boom also raises challenges for the region, as demand is higher than ever for international experts to enter the market. The Middle East Rail Opportunities Summit will gather all of regional rail industry leaders in one place with the aim of accelerating the infrastructure requirements. ■

More information:
www.natrans-arabia.com

eCarTec Munich 2015

Preview: 20–22 October 2015 – eCarTec Munich 2015 presents pioneering Electric & Hybrid Mobility at the Munich Trade Fair Center

In October 2015, eCarTec Munich – the world's biggest B2B trade fair for electric & hybrid mobility – will be once more the industry's top international venue for electric and hybrid mobility. In the past six years, eCarTec Munich has developed into the international platform of reference for electric mobility.

With 463 international exhibitors and over 12,000 visitors from 56 countries last year, eCarTec Munich has succeeded in expanding its standing as the international trade fair for electric and hybrid mobility, organized by the MunichExpo Veranstaltungs GmbH. The wide range of topics demonstrates that electric mobility means much more than only a transfer to electric vehicles. Its successful implementation also demands infrastructure, standardized charging systems, efficient battery modules, innovative material components and sustainable mobility concepts.

With its main topics "Electric Vehicles", "Energy & Infrastructure", "Energy Storage", "Powertrain & Electronics", "Mobility Concepts" and "eBikeTec" as well as its parallel fairs MATERIALICA – Lightweight Design for New Mobility and sMove360° – Connected Car, the trade fair presents the entire range of electric and hybrid mobility. At eLiveDrive – the indoor and outdoor test track of the trade fair – visitors will get the opportunity to admire different electric vehicles or to even to enjoy driving them. The eCarTec Forum gives exhibitors the opportunity to present both their company and product innovations to an interested professional audience.

The entry to the forum is free of charge for all visitors of eCarTec Munich 2015. At the accompanying World Mobility Summit numerous high-ranking experts will talk about current trends and innovative technologies in the focus areas Electric and Hybrid Mobility, Lightweight Design, and Connected & Autonomous Driving. Another highlight at eCarTec Munich 2015 is the granting of the MATERIALICA Design + Technology Award and the eCarTec Award as Bavarian State Prize for Electric Mobility. ■

eCarTec Munich 2015 at a glance

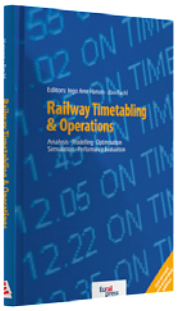
20–22 October 2015,
Munich Trade Fair Center

Main topics:
Electric Vehicles, Powertrain & Electronics, Energy & Infrastructure, Energy Storage, Mobility Concepts, eBikeTec. Indoor and outdoor test track

Parallel fairs:
MATERIALICA 2015 – Lightweight Design for New Mobility
sMove360° – Connected Car

Accompanying events:
World Mobility Summit 2015
Night of eMotion; granting MATERIALICA Design + Technology Award 2015
eCarTec Award 2015

More information: www.ecartec.com



Railway Timetabling & Operations

Ed.: *Ingo-Arne Hansen, Jörn Pachl*, 2014.
332 pages, 16.5 x 24 cm hardcover
69.00 EUR
ISBN: 978-3-7771-0462-1

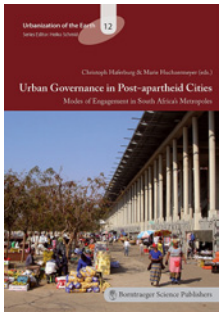
This is an updated, revised and extended edition of 'Railway Timetable & Traffic', published in 2008. It describes the state-of-the-art methods of railway timetabling and optimisation, capacity estimation, train operations analysis and modelling, simulation, rescheduling and performance assessment. The intention is to stimulate their broader application in practice and to highlight current and future research areas.

It is directed at academics, Masters and PhD students, as well as professionals from the railway industry. It will also be of interest to the public authorities that tender, monitor and perhaps fund railway service provision. The overall aim is to improve the attractiveness and efficiency of the train services that can be offered to the public.

The key to achieving a higher efficiency and quality of train operations is an awareness of the impact that the availability, reliability and robustness of the subsystems have on train processes. A deeper insight into the probability of incidents and the propagation of train delays depends on a thorough analysis of real-world railway operations and the feedback obtainable.

This leads to an optimisation of the timetable and a network-wide improvement in traffic management performance. This know-how should increase the efficiency of the railway system, making it more attractive for regular, occasional and new customers, and ensure that the railways continue to innovate. They will then be able to make the maximum contribution possible to the transport needs of the future.

More information & order:
http://www.eurailpress.de/en/buchshop/fachbuecher/produkt-single/product/railway-timetable.html



Urban Governance in Post-apartheid Cities

Modes of Engagement in South Africa's Metropoles (Urbanization of the Earth, Vol. 12)

Ed.: *Christoph Haferburg, Marie Huchzermeyer*, 2014.
1st edition, XIV, 337 pages, 36 figures, 17 tables, 17 x 24 cm hardcover,
49.90 EUR
ISBN 978-3-443-37015-2

Urban governance as a term captures the complex interaction between stakeholders or groupings influencing urban development. In South Africa, this complexity emerged with the transition from apartheid more than two decades ago. Today, governance influences priorities in a wide range of urban domains, from public transport to policing; from engagements at neighborhood level to city-wide strategies. In different configurations, urban governance shapes inner city districts and gated estates on the urban periphery.

The contributors to this volume cover urban governance in contemporary South Africa across three spheres, the state, the community and the private sector.
Part I: Urban governance in post-apartheid cities in context
Part II: City visions and urban interventions: engagements of the state
Part III: The fragile base of the city
Part IV: Private sector: gaining weight
Part V: Governing through place and space

Spatial concerns are central to many of the analyses and case studies, in which the authors highlight different modes that influence the steering of South Africa's largest cities. The range of insights provided by the authors illuminates post-apartheid tensions and urban dynamics in a way that will be of value to scholars, practitioners, decision makers, politicians and activists alike.
More information & order:
http://www.borntraeger-cramer.de/9783443370152

Stadtbahnsysteme – Light Rail Systems

Grundlagen – Technik – Betrieb – Finanzierung | Principles – Technology – Operation – Financing

Ed.: Verband Deutscher Verkehrsunternehmen (VDV), 2014.
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Published by the Association of German Transport Companies VDV with support from the Federal Ministry of Transport, prepared by former CEO Prof. Dr. Adolf Müller-Hellmann and representatives of VDV member companies as well as the tunnelling institute Stuva, this bi-lingual handbook covers practically all aspects of design and operation of light rail, be it high- or low-floor.

This book deals with a number of key elements of the transport system known as light rail, namely the basic principles underpinning the system, the technology used, its operation and its financing. It provides an insight into the current legal framework in Europe and in Germany.

The book is largely based on German practice, including a 90-page section on standards and legal requirements. The vehicle section covers all the technologies that have appeared in the pages of Metro Report since 1991, including truck and bogie types from many parts of the world. The articulations of multi-articulated cars are described, but not the different types of resilient wheel. Tram-train vehicles are also covered. A 20-page section is dedicated to the important topic of renovating light rail vehicles.

Each chapter is backed up by an extensive bibliography.

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Publishing house
DVV Media Group GmbH
P.O. Box 10 16 09, D-20010 Hamburg
Nordkanalstraße 36, D-20097 Hamburg
Phone +49 40 23714-01
Managing Director
Martin Weber
Publishing Director
Detlev K. Suchanek
Phone +49 40 23714 227 |
detlev.suchanek@dvvmedia.com

Editorial office
Managing Editor
Eberhard Buhl, M. A.
Phone +49 40 23714-223 | Fax: +49 40 23714-205
eberhard.buhl@dvvmedia.com
Revision
Ursula Ebeling (d), Dr. Barbara Gutermann (e)

Advertising
Advertising Director
Tilman Kummer
Advertising Manager
Silke Härtel (responsible)
+49 40 23714-227 | silke.härtel@dvvmedia.com
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Tim Feindt
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Your suggestions as a reader are also always welcome. Just send me an e-mail to eberhard.buhl@dvvmedia.com. I am looking forward to hearing from you.

Sincerely

Eberhard Buhl, Managing Editor

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www.it15rail.ch

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www.iavsd2015.org

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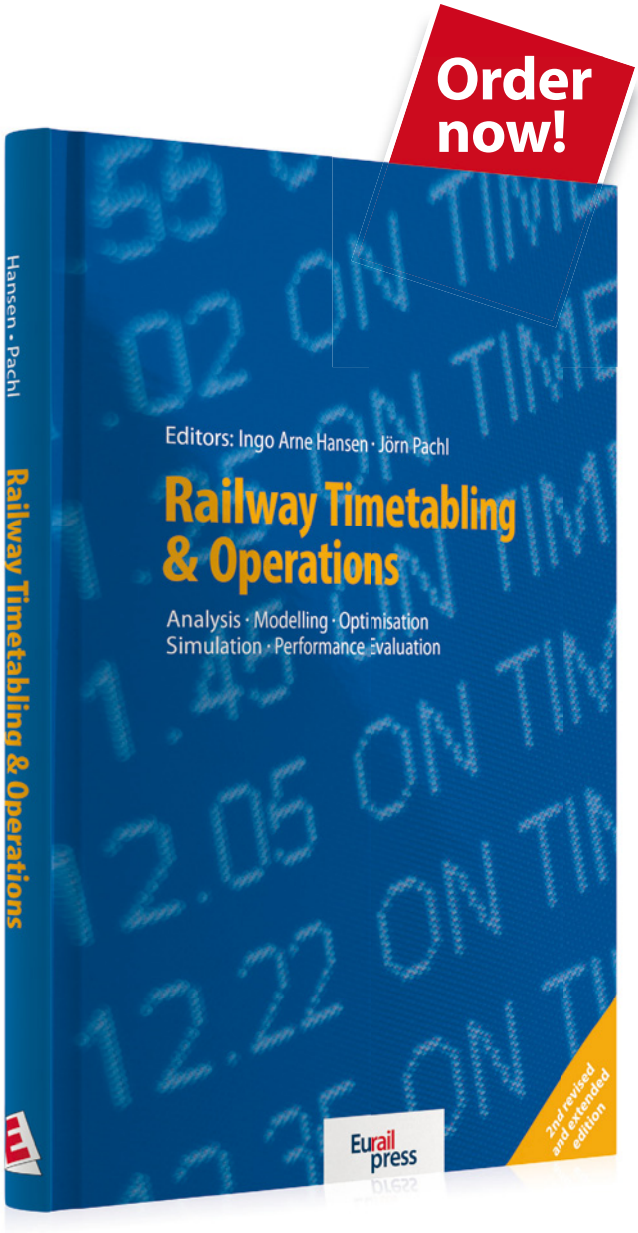

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