PSIroads/MDS

Intelligent approaches to smart mobility

An overview of innovative traffic management and smart city solutions

Winner of the German Mobility Award 2017

ollo 2017

preisträger deutscher mobilitätspreis

PSI

Megatrend Smart City

European cities are facing huge challenges

"Smart City" and all things related are a key issue of the public discussion. This brochure provides you with an outlook for cooperative mobility and offers approaches and measures for accomplishing feasible objectives.

Learn about

Please do not hesitate to contact me with questions.
I hope you enjoy reading this paper.

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Is individual mobility a dead end road?

Individual commuting constitutes one of the biggest urban challenges. Cars have a share of 80% of means of passenger transport in Europe [1]. In 2015 only 9% of the population ride buses and only 8% ride trains. Traffic jams in 123 European cities could generate about Euro 208 bn costs within the next 10 years. [2]

CO_2 and NOx – every day more poison?

The consequences of road traffic are disastrous for both the environment and human beings. Despite an overall downward trend of greenhouse gas emissions, the CO_2 emissions in the EU have increased dramatically by 26% since 1990 [3] and continue to rise further. For example, in Germany the carbon emissions from combustion engines increased by a total of 5.4 mn tons in 2016 [4].

Diesel engines additionally emit nitrogen oxides (NOx) which are one of the main factors of particular matter pollution in inner cities. According to the EU, 40% of NOx emissions are caused by traffic, 80% of which are emitted by Diesel engines. In particular, 67% of these are emitted by Diesel passenger cars [5].

According to the EU commission, every year 400,000 people in Europe die prematurely due to high levels of air pollution. Since 2003 NOx caused the death of about 70,000 people [6]. Therefore the EU authority requires its member states to develop air pollution control measures in order to reduce the air pollution.

Cities are now facing severe penalties

The EU commission has identified 130 cities in Europe which repeatedly and significantly exceed air pollution limits. Environmental organizations have begun to force communities to take action. The Deutsche Umwelthilfe (DUH) has filed a request with the Administrative Court in Munich for enforcement of a non-appealable "clean air" judgment handed down in 2012 against the Bavarian government. This judgment requires implementation of steps for compliance with air quality limits. The DUH has also filed enforcement requests against the Bavarian and Hessian Environment Ministries due to air quality limit violations. Non-appealable judgments have been handed down but the ministries do not comply.

Facts

The consumption of land and resources, the noise, and the emission of pollutants in cities must be reduced in order to achieve the goals of environment, health, and climates policies and to meet the needs of indiviual citizens.

Currently, the situation in the cities is far from an ideal and healthy way of live with short commutes, green spaces, healthy air, nearby shopping, and not least, climate-friendly alternatives like electric public transportation, car sharing, and rental bikes.

Politics are forcing action

The sense of urgency in politics is increasing as traffic bans are looming. The German government has provided Euro 1 bn for the "Emergency Clean Air Program 2017-2020". Euro 350 mn are designated for electrification of transport such as conversion of Diesel bus fleets. Euro 150 mn will be spent on exhaust technology upgrades for Diesel busses and the digitization of traffic will be supported with up to Euro 500 mn. (Source: ZEIT ONLINE).

Digization of traffic in Europe

The smart mobility is not regulated uniformly in Europe. Most countries have their own clean air programs. In addition, there are European programs like "Horizon 2020" and the European Structural and Investment Fonds (ESI Fonds) for funding of urban mobility projects. The cities should make use of these opportunities for numerous reasons including the health of their citizens. The required technologies are already becoming available.

+ The roads to Smart City

Smart City – how to make European cities fit for the future

mobility

Everything is connected:

Energy

+ Distributed and renewable power generation
+ Modern energy management and storage solutions
+ Local intelligent use of networks and resources

Mobility

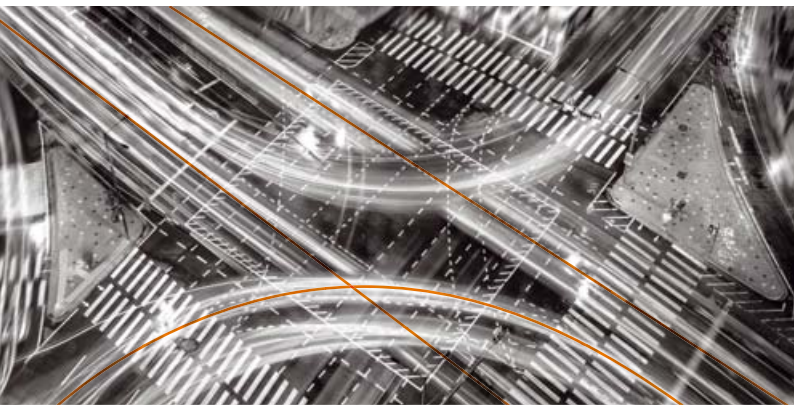
+ Car-Sharing
+ Electromobility
+ Mobility apps
+ Local public transport concepts
+ Bike rentals
+ Car parking concepts

Urban Development

+ Smart traffic guidance systems
+ Smart living

Smart City is no longer just a vision

In many places Smart City – or "City 4.0" is already being realized rapidly. Maximum interconnectivity of different technical and organizational areas and levels in cities provides the best opportunity for "smart" technological development.



ICT is the key to efficient mobility

Using new information and communication technologies (ICT) is the key for integrated urban development. ICT provides maximum realtime cooperation and connectivity of telemetry data and systems for optimal use of the road infrastructure.

Cities already implement systems for improving traffic flow and reducing traffic congestion and emissions: intelligent parking space management, interoperable ticket systems and mobility apps for user-friendly local public transport are being tested in various cities or are already operational.

The Munich transportation service is setting up 150 mobility kiosks in subway and light rail stations. The kiosks provide easy combination of environmentally friendly transport services such as car sharing and bike rentals.

The examples show that solving the urban traffic problems requires a certain amount of creativity as well as experts with a holistic understanding of the requirements who are familiar with the specific needs of the communities.

Tomorrow's perspectives are becoming reality today

Ambitious ventures are being realized in Europe today. For example, ICT systems for managing highway traffic have been implemented successfully as part of the initiative "Hesse Mobile". The systems handle construction site management, temporary release of shoulders for traffic, traffic light control, and digital traffic congestion reports. This is one of many initiatives which are progressing rapidly.

Partners from industry, research, and science are involved in the "DRIVE" project. Alongside a total of 200 km (planned total 280 km) of motorways, main roads, and country roads, a variety of innovative telematic systems are currently being tested [6]. The project is characterized by the following four development objectives:

COLLECTIVELY – Traffic management by well-known measures such as telematically controlled road signs, traffic warning via radio and Internet, etc.

COORDINATED – Traffic operators and service providers are connected in terms of organization and responsibility

COOPERATIVELY – Road users and traffic systems (road signs, traffic light systems, etc.) will be digitally connected

AUTOMATED – Functions and processes will be digitally integrated in the traffic system - automated vehicles

The cities of tomorrow are digital

What tools are available to the cities?

Intelligently connected mobility –
the digital interaction of all systems is the solution for tomorrow's traffic challenges:

+ In the future, traffic control centers and control center managers might evolve into service providers. New market places for mobility data are providing the required information and data in preprocessed form. This includes data about the current emission and weather situation as well as images provided by cameras from major traffic junctions.
+ The traffic control center communicates with data storage such as mobility clouds.
+ This cloud is exchanging data with all transport users, means of transport, and traffic infrastructure and thereby enables cooperative mobility.

The successful vision for "Smart city" mobility includes many aspects:

The digital transformation in itself
- Everything is interconnected: media, social networks, apps, traffic infrastructure, and vehicles
- Computers are becoming more powerful and allow realtime processing of large amounts of data

Requirements for digitization
- Mobility services must be widely accepted
- Measurable benefits for the general public as well as individuals
- Data protection and security must be guaranteed

Traffic management
- The digitization must not result in self-organization
- Public policies and system architectures for climate-friendly means of transport are necessary
- Cooperative and individual mobility must be harmonized

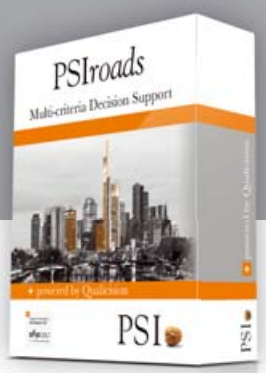
The smart city needs smart mobility

Integrated planning and connectivity are fundamental for future urban development as well as for a traffic infrastructure which is convenient for both individuals and the society as a whole. The "Internet of Things" will play a key role in the harmonization of individual and cooperative mobility.

This development may even go beyond autonomous driving.

PSIroads/MDS balances the traffic flow intelligently

powered by Qualicision



Less traffic jams and less congested roads? PSIroads/MDS powered by Qualicision turns this vision into to reality

Certainly every driver has experienced this situation: the navigation system suggests to use a certain route - but as you start to drive, it turns out that the route is already congested. The multi-criteria decision support tool PSIroads/MDS offers a smart solution for this problem. PSIroads/MDS allows the user to look a few minutes into the future and make a decision based on that future traffic situation. For this purpose, PSIroads/MDS uses the AI tool Qualicision, which has been successfully used by PSI for similar applications in other markets.

In addition to providing communities with suggestions for traffic routing, PSIroads/MDS can also help to indirectly correct past urban planning mistakes by offering the most flexible and adaptive traffic management available today.

Successful implemetations

As part of a Pre-Commercial Procurement (PCP) project subsidized by the EU, PSIroads/MDS has been implemented by the Dutch traffic authority (Rijkswaterstaat) and the British highway operator Highways England.

PSIroads/MDS

- Can be easily integrated in existing traffic control centers
- Can be easily used in daily traffic management
- Supports regional and national cooperation of different road operators
- Can be used for a variety of tasks

Optimizing traffic flow with a balanced and holistic approach

PSIroads/MDS optimizes the transport network usage so that transport users reach their individual objectives as much as possible. The system enables road operators and environmental authorities to control the traffic flow based on freely definable strategic and ecological objectives. The possible traffic control measures available for the current and anticipated traffic situation are optimized with regard to reaching these objectives.

In addition, rules for the cooperation of different road operators are defined and applied depending on the situation. This allows traffic management across resonsibility boundaries.

PSIroads/MDS App

PSIroads/MDS is available as an app on a mobile device. After creating a profile, a transport user simply selects the destination and starts the trip.

Transport users and urban destinations

The term transport user includes a variety of individuals: local and long-distance delivery drivers and commuters, motorized and unmotorized visitors and tourists, local public transport, pedestrians, cyclists, wheelchair users, etc.

The objective of these individuals is to travel from A to B as fast, directly, and congestion-free as possible while the objective of the city is avoiding emission, congestions, and traffic hazards. The challenge is the optimal combination of these objectives.

Many ways to reach a destination

In contrast to route suggestions by the car navigation system, the self-learning software PSIroads/MDS ensures that the transport users use different routes and different modes of transport (electric vehicle, bus/train, car sharing, rental bikes, etc.) as well as travel at different times to the same destination. Hence, the suggested routes to the destination are more efficient and free of congestions. As the traffic system provides useful suggestions and information to the transport users, the public acceptance and trust in its reliability increases.

PSIroads/MDS benefits for cities:

+ Strategic bypassing of traffic congestions in order to reduce hazards
+ Strategic bypassing to avoid exceeding the emission limits (NOx, particular matter, noise)
+ Strategic routing for different types of transport users like freight transport, transport of hazardous materials, electric vehicles, emergency services
+ Strategic measures in response to planned and unplanned events (football games, concerts, accidents, etc.) to avoid congestions
+ Avoiding detours through designated areas in order to protect schools and preschools, historic districts, and residential areas from diverted traffic
+ Route recommendations to reach highly frequented destinations like shopping centers, industrial zones, and commercial areas
+ Avoid stop/go traffic (set stop lights to green in certain situations) in order to prevent additional exhaust emissions
+ Reducing peak loads (e.g. speed limit in case of bridge damage)
+ Individual and situational adaptation to urban climate objectives by offering more climate-friendly alternative means of transport like car sharing, local public transport, or bike rentals to transport users

Marketing for maximal user acceptance

PSIroads/MDS flexibly adapts to citizens' needs

Transport users and citizens will accept the PSIroads/MDS system only if it benefits them. The individual objectives of transport users do not always match the objectives of cities. Even worse, urban objectives are perceived as inconvenient by drivers as they restrict them in their decision making - just think of being told to travel an alternative route that requires a detour and longer travel time in order to reduce emissions.

In order to achieve urban objectives and boost the acceptance of the system, a reward points system (similar to Payback, Miles & More, etc.) has been integrated in the PSIroads/MDS app in cooperation with the Dutch company V-tron. When users accept suggested alternate routes which contribute to a larger urban objective but pose some inconvenience, they get reward points.

Example 1:

Ms. Miller is on her way to go shopping. The quickest way to get there is going through the heavily NOx polluted city center. The app suggests a detour which bypasses this area and at the same time avoids streets with preschools, schools or hospitals. This route is forecast to take five minutes longer. But now Ms. Miller contributes to cleaner air and helps to improve the quality of urban life. The municipality rewards this behaviour with 10 points which can be redeemed for a cup of coffee at the shopping center.

Example 2:

Mr. Smith is cheering for the victorious home team in the crowded football stadium. After the final whistle the crowds are making their way to the exits. The app recommends Mr. Smith to stay 20 minutes longer in the stadium to reduce congestion of the stadium and parking lot exits and additional emissions. If Mr. Smith follows the recommendation and leaves 20 minutes later, he will get reward points. These can be redeemed during his next visit at the stadium for a free hot dog.

PSI at a glance

PSI Mines&Roads GmbH was founded in 1991 as a fully owned subsidiary of PSI Software AG, which employs around 1.650 employees. The company's largest production location is in Aschaffenburg which is situated in the heart of the Rhine-Main area; additional offices are located in Berlin, Beijing and Moscow and numerous other cities.

PSI Mines&Roads operates as two divisions. The division Roads is mainly involved in infrastructure monitoring and traffic management and offers innovative software solutions for road and smart city operators.

In the ranking published by the renowned business journal WirtschaftsWoche in December 2017, PSI is listed as one of the 30 most innovative German small and medium size companies. In June 2017 PSI won the German Mobility Award for the software solution PSIroads/MDS.

PSIroads/MDS – winner of the German Mobility Award 2017

Every year, the initiative "Deutschland – Land der Ideen" and the German Federal Ministry of Transport and Digital Infrastructure award groundbreaking best-practice projects that focus on safety. PSIroads/MDS has been awarded as flagship project for Smart Mobility.

A panel of experts of 16 jury members chaired by Dorothee Bär, member of the German parliament, selected the winners from approximately 170 entries.

The purpose of the German Mobility Award is raising public awareness for Smart Mobility solutions and digital innovations. The contest is held by the initiative "Germany - Country of Innovation" and the Federal Ministry for Transport and Digital Infrastructure.

The current situation

Municipal officials (mayors, planning departments, council members, spokespersons) are meeting with traffic experts, funding coordinators, and industry experts to initiate specific projects for intelligent traffic management systems.

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[1] http://ec.europa.eu/eurostat/en/web/products-datasets/-/TRAN_HV_PSMOD
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