Traffic Management
guideline and manual to best practice
**METRASYS - Sustainable Mobility for Mega Cities**

The project METRASYS – Sustainable Mobility for Mega Cities is one of ten projects funded by the German Federal Ministry of Education and Research as part of the scientific program “Research for Sustainable Development of the Mega Cities of Tomorrow – Energy and Climate Efficient Structures in Urban Growth Centres”. With the topic of mobility and transportation in its focus, the project deals with one of the most exigent problems of current and future mega cities and metropolitan regions.

During the development and realization phase, the Transportation Studies Group of the German Aerospace Center (DLR) is the lead partner of the METRASYS project. Among the German partners are Wuppertal Institute for Climate, Environment and Energy, AS&P - Albert Speer & Partner GmbH, Fraunhofer FIRST, LUAX Software Consultancy and Freie Universität Berlin. The Research Centre for Software Engineering Technology (ASEC), the Chinese Academy of Transportation Science (CATS) Beijing, Tongji University Shanghai as well as the Chinese Academy of Science (CAS) are the Chinese project partners.

The German Federal Ministry of Education and Research (BMBF) as well as the Ministry of Science and Technology (MOST) are the funding bodies of the METRASYS project.

The main objectives of the METRASYS project are climate protection, a sustainable development of - and sustainable mobility in highly dynamic economic and urban regions.
The development of sustainable mobility concepts for already existing and future mega cities will be the main task of the project. Due to its high population growth, Hefei in the Anhui Province, China, is predicted to become one of those future mega cities. Sustainable mobility concepts will be developed for Hefei and are to be realized locally in Hefei. In close cooperation with local partners from scientific and administrative organizations, the Chinese and German project partners will develop the concepts. This procedure provides a basis for incorporating the local perception of the problems. Innovative concepts, products and services, which proof to be solid, will be transferred to other urban regions and mega cities.

Integrating the traffic management system within the overall transportation planning and transportation policy framework in Hefei is one objective of the METRASYS project. In 2009, there have been several meetings of the METRASYS team and the Hefei Institute of Planning and Design to discuss special topics of urban and transportation planning.

The METRASYS project team has been asked to develop and promote management-, transport and urban planning guidelines and manuals to best practice that accommodates Chinese urban needs and requirements and develop urban areas in Hefei accordingly.

The “Traffic Management Guideline” is intended to act as a knowledge-base and toolbox – not just for the implementation of ITS, but also as a support for making decisions on different ITS measures. The manual contains a number of tangible examples in Asia, Europe, the United States of America and Australia.

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Motivation and Targets of Traffic Management

Traffic Management is the influencing element of the traffic situation by a bundle of measures with the target of harmonising the traffic demand and the traffic supply of all transportation modes.

- Safeguarding and improvement of the citizen’s mobility
- Safeguarding and improvement of economic transactions
- Improvement of the transportation compatibility with the environment and society
- Better use of existing infrastructure / space for infrastructure is limited
- Increase of traffic safety and comfort
- Decrease of pollution
- Reduction of traffic jams
- Increase of public transport
Fields of Activity of Traffic Management

- Traffic control
- Traffic relocation
- Traffic information
- Parking management
- Rerouting management
- Management of construction sites
- Incident management
- Event management
- Freight management
- Optimization of public transport
- Modal shift management

METRASYS Traffic Management Policy toolbox

Using specific examples basic traffic management measures were identified in this “Traffic Management Guideline”, namely
- financial policy measures (road user charging, parking management)
- regulatory measures (access restriction, speed zones, HOV lanes)
- traffic information (queue warning, operator controlled free-text information, journey-time information, vehicle-activated speed limit reminders, parking and P&R information)
- management measures (traffic signal management, public transport prioritisation, variable speed limits, car- and bike sharing)

Additional essential planning and infrastructural measures are necessary
Fiscal

Road user charging

Urban road user charging involves vehicle drivers for their use of road space over a certain area and/or during a particular time period. It has two main objectives: to reduce traffic congestion/control traffic levels and (related to that) to improve environmental quality. To be achieved by the reduction of noise and pollution as well as by an enhanced streetscape and urban design. The demand for road-use can be influenced by increasing the cost of travelling by road at certain times, in certain areas and/or along certain routes.

Road user charging can help to utilise the road capacity more effectively and to increase the accessibility. The constant growth of cities leads to a higher traffic demand. As the city road network has limited capacity the increasing number of vehicles causes congestions on certain sections and/or in certain times. The road transport system can be made more efficient through road-user charging by stimulating the use of public transport and car-pooling.

Additional important effects are e.g. noise reduction, minimization of the emissions of greenhouse gases, carbon monoxides and other particles that cause a negative environmental impact.
Example for road user charging

example from
- London
- Singapore
Parking management

Parking management includes and combines a variety of strategies that encourage more efficient use of existing parking facilities, improve the quality of service provided to parking facility users and improve parking facility design. Parking management can help to address a wide range of transportation problems and it is an important subject for the future city development. In inner city areas where parking space is limited (and often uncontrolled) vehicles tend to take over (occupy) all available public space for car parking.

Parking facilities can be managed and regulated to encourage more efficient use of parking resources in combination with more efficient inner city car trips. A reorganisation and an optimization of parking space allows the cities to redefine the land uses and to make former car parking areas available to certain higher-value uses.

A compilation of typical strategies is listed below

- Regulate based on the type of vehicles or users. E.g. during peak periods the most convenient spaces can be dedicated for service vehicles, customers, ride share vehicles, and vehicles used by disabled people.
- Limit parking duration (5-minute loading zones, 30-minutes adjacent to shop entrances, 1- or 2-hour limits for on-street parking in commercial areas) to encourage turnover and favour shorter-term users.
- Charge higher parking prices and shorter payment periods for more convenient spaces. E.g. in prime central locations charge 25 ¢ for each 15-minute period with a two-hour maximum, while at the fringe areas charge $ 2.00 for 4-hours, with no smaller time periods available.
- Prohibit on-street parking on certain routes at certain times (such as on arterials during rush hour), in order to increase the number of traffic lanes (by “opening” the parking lane for fast-moving traffic).
Example for parking management

example from - Germany
- China
Access restriction

Management strategies based upon the concept of ‘controlled access’, which entails the more or less gradual interdiction of selected urban areas to traffic.

Popular examples include the closure of inner city areas and other sensitive zones for cars without special allowances (environmental / energy efficient) or for freight vehicles above a certain weight as well as for private vehicles owned by non-residents in the restricted area.

There are different schemes of access restrictions:
• Point based (e.g. enter a small section of a city or restriction to cross a bridge).
• Cordon based: a restriction is applied for crossing a cordon, and may vary with time of day, direction of travel, vehicle type and location on the cordon. There could be a number of cordons with different rules/prices.
• Area licence based pricing: a restriction is applied for driving within an area during a period of time. The rules may vary with time and vehicle type.
• Distance or time based: restriction based upon the distance or time a vehicle travels along a congested route or in a specified area, and may vary with time, vehicle type and location.
Example for access restrictions

Example from:
- Italy
- France
- Germany
- USA
Regulatory

Speed zones / Speed limits

Speed limits are used in most countries to regulate the speed of vehicles by indicating the respective traffic signs (on a screen or platform with variable elements). Speed limits may define maximum (which may be variable), minimum or no speed limit. Speed limits are commonly set by the legislative bodies of nations or regional governments and enforced by national or regional police and/or judicial bodies.

Speed limits are used to balance the different volumes of vehicle speeds using the same road at the same time. The balance of the speed leads to an increase of road safety. Speed limits are usually set to attempt to cap road traffic speed. It is often done with an intention to improve road traffic safety and reduce the number of road traffic casualties from traffic collisions.
Example for speed zones

example from - England
 - Germany
 - Australia
 - Spain
Regulatory

High Occupancy Vehicle (HOV) lanes

HOV lanes are marked by diamond marks on the roadway. The tracks are designed either as an extra lane alongside the other or completely separated structurally. Use only for carpools is partly (not always) limited to rush hours. In other times the tracks are open to all users.

In the United States of America and Canada HOV lanes are determined to promote the formation of carpools. Only vehicles with at least two occupants are allowed to use these special lanes. Statistics show that on the HOV lanes the number of cars is limited which reduces the travel time. In addition, the speed limit can be adjusted by variable signs and it can be higher than on the non-HOV-lanes.

The definition of HOV users is variable: e.g. in California single drivers may also take advantage of HOV lanes when their vehicle falls below established emission levels and fuel consumption. This permission is documented with a clean air sticker at the car.

Improper use of these tracks (e.g. when driving with fewer occupants than required in each case) will be punished with some very high fines.
Example for High Occupancy Vehicle (HOV) lanes

Example from - USA
Traffic Information / Variable Message Signs

Queue-warning system

Queues can quickly form on roads with a great deal of traffic, such as major roads leading to and from the city during the rush hours or in other situations, e.g. during popular events. A high intensity of traffic combined with stressed motorists may result in pile-ups with serious personal injuries and major delays to traffic as a result. On such roads, the introduction of a queue-warning system can improve safety.

Queue-warning systems require a constant measurement of traffic flows. This is done by recording vehicles’ speeds at different points along the road. Queue-warnings can be linked together with journey time information.

The primary purpose of a queue-warning system is to reduce the risk of rear-end collisions, which are common accident types on urban motor ways. Motorists are warned of queues ahead and, thus, do have more time to adjust their speeds and to be prepared for a stop.

Queue-warning systems have an effect on the number or rear-end collisions and contribute to a less aggressive driving style. There has been shown, by means of floating car data, that the percentage of sudden braking (shorter than 300 m) is reduced from 75 % to 40 %; and also that the average braking distance at queues increased from 260 m to 420 m when the queue-warning system was activated.

It is important to bear in mind that variable message signs require regular maintenance for a perfect operation. Administrative responsibility and the costs of operation and maintenance should be considered from the early planning stages.
Example for queue-warning

example from - Germany
- France
- USA
- Czech Republic
- Netherlands
Traffic Information / Variable Message Signs

Operator controlled free-text information

With operator-controlled free-text information, there is an opportunity to inform road-users constantly about unforeseen traffic events by using dynamic screens. In this way, the ability to maintain freely flowing traffic is improved. In addition, a valuable road-user service that reduces stress and provides better journey-planning information is provided.

Operator controlled free-text information is primarily used for information on disruptions, queue-warnings, journey times and alternative choices of road. The system operation assumes that the road is equipped with variable message signs with free-text and systems for obtaining suitable traffic data. The text descriptions can be combined or underlined with suitable graphic symbols.

Information about distribution by means of free-text VMS is typically used on motorways and larger roads, particularly those that carry a lot of traffic and are sensitive to disruptions. Information about disruptions that cause delays longer than 5 minutes is considered useful to display. Road-users are mostly interested in the consequences of the disruption rather than the cause.

Free-text messages have a great effect on accessibility as they can provide more exact information on a disruption, recommend alternative routes and communicate journey-time information. The provision of high qualified traffic information leads to an improvement of the driver’s comfort (less stress and irritation).

Road safety is greatly dependent on speed. Changes in speed result from the messages on free-text signs and queue-warning systems. By reducing speeds over a longer section at the tail-end of queues, a positive effect on road safety can be achieved. A reduction of up to 10 % in the number of rear-end collisions has been recorded.
Example for operator controlled free-text information

every from - USA
  - Germany
  - France
Traffic Information / Variable Message Signs

Journey-time information

The recording of journey times is performed in cities in particular or in traffic systems that carry a lot of traffic in order to monitor and control the flow of traffic. The information is of interest to commuters, e.g. in relation to accidents or queue development along a road.

The communicating of information about traffic situations and current journey times assumes that there is a system for the detection and measure on data from detectors that are set out along specific routes.

Journey time information can serve several purposes. The service can provide information to road-users that can reduce their level of stress on the roads. The service can also contribute towards better accessibility as motorists can choose another route to take into account queues and incidents.

The aim of information about journey times is to create better accessibility for motorists and make traffic planning more effective for the road authority. Whether journey times on variable signs actually lead to a change in driving behaviour – and thereby improve road safety, provide better accessibility and reduce the impact on the environment – actually depends on how the system is implemented and whether there are alternative routes in the event of a traffic incident.
Example for journey-time information

- USA
- Denmark
- Singapore
- Germany
Vehicle-activated speed limit reminders

The speed of oncoming vehicles is being measured by detectors which activate a sign that informs speeding drivers of the current speed limit.

A common application for speed-reminder systems is to improve the standard of safety on roads that pass through small communities. In typical cases, the section of road is bordered by pavements and buildings on both sides. Alongside the road, there are schools and residential properties as well as unregulated pedestrian crossings at regular intervals. In addition, the view may be blocked. Unprotected road-users, such as children are exposed to risk when vehicle speeds exceed the statutory speed limits. One solution may then be to erect speed-reminder signs. These can be recognised from a distance and give road-users time to adjust their speeds.

Another application is speed reduction on sections of road that are known as accident black spots, for example, tight corners and situations with poor visibility.

Speed-reminder signs increase compliance with the regulations and reduce speeds. Studies have shown that the average speed is reduced by 10-15%.
Example for vehicle-activated speed limit reminders

example from - USA
  - Czech Republic
  - France
  - Germany
Traffic Information / Variable Message Signs

Dynamic parking information

Between 10-40 % of inner city vehicle trips are caused by drivers which are looking for available parking space.

Better information on available inner city parking options leads to a simplification of the traffic situation. The effects are a reduced number of vehicles (trips) searching for spaces, fewer queues at car parks and car parks being used more effectively. The reduced number of vehicles searching for spaces also leads to lower emissions and has a positive effect on air quality.

Dynamic parking information systems are set up so that they can calculate by detectors how many cars pass through the entrances and exits of car parks. This information is being transferred to a central system for processing. From there, the information is sent to dynamic signs that display how many empty spaces are available, or whether the car park is occupied.

Dynamic parking information can reduce the number of drivers parking on kerbs and it can also lead to greater road safety as well as to enhanced environmental conditions. The system helps to give a better orientation for non-familiar motorists.
Example for dynamic parking information

eating from - Denmark
- Germany
- China
Commuting by car has increased over the last few years and we now travel further and more frequently. This ends up in congestions of traffic and in an unfavourable impact on the environment. Measures aimed at making public transport and car-pooling easier could reduce these problems. Public transport can move people about with greater effectiveness in terms of space and energy. With Park and Ride information systems, the individual movement of car trips can be combined with the cost effectiveness and environment friendliness of public transport.

Dynamic signs are indicating real-time information concerning the present number of vacant parking spaces. They can also be used to direct motorists between various nearby car-parks and for guidance within a large car park that is divided into several sections.

Park and Ride information systems allow motorized road-users to park their vehicles and then to continue their trip by bus or train. The motorist is informed of the current traffic situation and journey times by various transport modes via dynamic information on signs. This opens the opportunity to personally decide on the best alternative.

The amount of motor traffic is reduced, which can have a positive effect on the traffic situation, e.g. through a reduction in the demand for parking spaces in the city centre.

Precondition for a successful park and ride system is the availability of sufficient parking space in combination with a powerful public transport system operating on separate lanes or on alternative routes.
Example for Park and Ride Information

e.g. England,
- Germany,
- Czech Republic.
Traffic Information / Variable Message Signs

Real-time public transport information

Real-time travel information for public transport can be communicated via information display signs close to or at bus stops and train platforms. This information may consist of the current timetable, the expected time of arrival, delays, temporary changes or route-guidance.

A prerequisite for being able to communicate information about actual departure times is that there are technical systems keeping tabs on where the vehicles are, and how they are running. These systems must be able to perform forecasts for each respective vehicle that has an estimated departure-time from the stop. The system must also ensure that this information reaches the concerned passengers.

The received information about the current traffic situation allows the passengers to act accordingly (alternative routes or modes, additional time for other activities). The passenger’s knowledge about the new traffic situation gives him the feeling of being involved and respected.

A reliable system encourages more travellers to use public transport, and as result it also contributes to a more sustainable form of travel.
Example for real-time public transport information

e.g. England - Germany - China
Traffic Information / Variable Message Signs

Driver information - navigation systems and traffic message via channel and radio

Navigation systems and traffic message via channel and radio allows the transmission of the current information about the traffic condition and the opportunity to decide to take an alternative route.

An automotive navigation system is a satellite-based navigation system developed for in-car operation. It typically uses a GPS navigation device to acquire position data in order to locate the user on a road in the unit’s map database.

The new generation of systems can not only provide precise driving directions, they can also receive and display information on traffic congestion and suggest alternate routes. These may use either TMC, which delivers coded traffic information using radio RDS, or by GPRS/3G data transmission via mobile phones.

One key type of real-time data is traffic information, which includes:

- Real-time data about free/occupied parking space;
- Nearest public transport lines and prices, to go to a destination, when there is a jam.

Other real-time data includes weather broadcasting, etc.
Example for driver information
Management Systems

Traffic signal control (independent, coordinated, adaptive)

Traffic signal control may be either independent where each intersection’s signal system works completely in isolation of other systems, or coordinated, where the traffic signals are synchronised at several intersections. The aim is to reduce the total delay and number of stops in the area that is included in the coordinated system. Coordinated signal systems can also be made adaptive, which means that the signals adapt to traffic in a more dynamic manner.

Modern traffic signal control of the adaptive type in coordinated systems provides major financial savings for society in the form of shorter journey times, fewer queues, fewer stops and fewer emissions and reduction in the number of accidents.
Example for traffic signal control (independent, coordinated, adaptive)
example from Germany
Management Systems

Public transport priority at traffic signals

The attractiveness of public transport systems depends on, amongst others, regularity, adherence to time tables and journey times. By prioritising public transport at signalised intersections, the effectiveness and thereby also the attractiveness of public transport can be increased. Traditionally, the waiting time for buses at traffic signals is not negligible – buses have to queue at signals in the same way as other vehicles (except at queue jumper line). However, with additional traffic signal techniques, it is possible to influence the accessibility of public transport at both independent and coordinated signal controlled intersections.

The main objective of prioritising public transport is to reduce the total travel time and to avoid stops at signalised intersections where possible.

Evaluations on the European market show that the journey time gains up to 15 % for bus traffic that is prioritised at traffic signals. In the optimum a reduction of up to 40 % of the delay time can be achieved. With frequent prioritisation, accessibility for cars may be affected negatively.
Example for public transport priority at traffic signals

example from - Germany
- Denmark
- Estonia
Management Systems

Variable speed limits

Variable speed limits allow the transmission of information based on the current road, traffic, and weather conditions. Variable speed limits improving safety by restricting speeds during adverse conditions.

Variable speed limits generally provide a significantly better adaption of speeds to the prevailing traffic situation than traditional speed signs. The risk of accidents is reduced and the driving behaviour becomes calmer. In the event of difficult traffic situations as well as congestions the adjustment to lower speeds is handled in a more controlled matter and the risk of sudden breaking and rear-end collisions is reduced.

A respective speed limit is indicated on the sign e.g. at bad weather conditions (slippery road, fog) or when queues form up. Speed limits may vary between 30 and 120 km/h. Road signs are only activated when critical weather conditions occur.

Regulating the traffic flow with variable speed limits leads to calmer driving, less sudden braking and a reduction in accidents of approximately 10–20%. Variable speed limits that change according to the road conditions have been shown to bring about a reduction of more than 20% in the number of people seriously injured and killed on the road. Traffic control on motorways in high-speed environments (100–130 km/h) leads to fewer blockages as a result of fewer accidents and it also has the benefit of resulting in accidents with less serious consequences.
Example for variable speed limits

e.g. Denmark
- Sweden
- Czech Republic
Management Systems

Car sharing

Car sharing is a model of car rental where people rent cars for short periods of time, often by the hour. They are attractive to customers who make only occasional use of a vehicle as well as others who would like to have occasional access to a vehicle of a different type than they use day-to-day.

Car sharing differs from traditional car rentals in the following ways:
- Car sharing is not limited by office hours
- Reservation, pickup, and return is all self-service
- Vehicles can be rented by the minute, by the hour as well as by the day
- Users are members and have been pre-approved to drive (background driving checks have been performed and a payment mechanism has been established)
- Vehicle locations are distributed throughout the service area, and often located for access by public transport
- Insurance and fuel costs (sometimes) are included in the rates.

Car sharing can also help reducing congestion and air pollution. Replacing private automobiles with shared ones directly reduces the demand for parking spaces. The fact that only a certain number of cars can be in use at any one time may reduce traffic congestion at peak times. Even more important for congestion, the strong metering of costs provides a cost incentive to drive less.

Car sharing is an alternative to owning a car where public transport, walking and cycling can be used most of the time and a car is only necessary for out-of-town trips, moving large items or on special occasions.
Example for car sharing

example from - Italy
- Germany
- USA
Management Systems

Bike sharing

Public bike sharing is a form of bike rentals, where the bikes are usually in public places or at public stations. These systems can either be placed in personal initiative of private companies or municipalities. The use of such systems provided by wheels is ideal for short distances in urban areas. In contrast to their own bike, users have no effort regarding maintenance, parking and securing of the bicycle.

Bike sharing systems are schemes in which numbers of bicycles are made available for shared use by individuals who do not own them. Publicly shared bicycles are a mobility service, mainly useful in urban environment for proximity travels.

Public bicycle can be used spontaneously - often in combination with public transport. Bike sharing is an effective instrument to shift the modal split in favour of sustainable transport modes.
Example for bike sharing

example from
- Spain
- Belgium
- China
- France
- England
- Germany
Traffic problems can’t be totally solved only through traffic management measures. Moreover, essential planning and infrastructural measures are required!
Planning / Infrastructure

Walking and cycling (e.g. walkable city)

Urban planning favours non-motorized transport. Requires linkages between infrastructure projects.
Example for walking and cycling
Planning / Infrastructure

Public transport infrastructure

Better public transport infrastructure, services and pricing will encourage modal shift.
Example for public transport infrastructure
Planning / Infrastructure

Dedicated bus lanes

Dedicated lanes for public busses in areas with high congestion. Reduction of the number of stops and a quicker arriving.
Example for dedicated bus lanes
Planning / Infrastructure

Low carbon public transport

The city favours more efficient technologies such as light rail for public transport solutions or electro buses.
Example for low carbon public transport
Planning / Infrastructure

E-Mobility

Large potential over the long term. Cost-effectiveness may be an issue. The problem is to build a new infrastructure in the cities.
Example for E-Mobility
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