Sustainable Traffic Management

Future traffic management requires data-based tools

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Environmental pollution poses challenge to local authorities

'London's toxic air is a killer'[1], declares London Mayor Sadiq Khan. This is a bold statement that is supported by a current study by the European Environment Agency (EEA)[2], which reports that 400,000 people die prematurely each year in the EU due to poor air quality.

In London, the city council has been trying to get on top of this problem for over 13 years with its congestion charge, a tax on drivers in the inner city. But to no avail.

Admittedly, the situation in Germany is not as dramatic as the sprawling metropolis of London – and, encouragingly, there has been an improvement between 2018 and 2019[3]. Nevertheless, the German Environment Agency (UBA) has reported that the annual limit of 40 g/m3 of NO2 was exceeded in 2019 at around 20 percent of Germany's measuring stations. This has significant consequences for the top 4 cities on the list: Munich, Darmstadt, Stuttgart and Limburg an der Lahn[4]. Breaches of the stipulated limits go beyond damaging their image, and lead to penalties which put a strain on the city purse. Moreover, environmental issues are increasingly seen as negative location factors for industry and residents.

The causes of this situation are clear: A mobile society with increasing transportation of goods and passengers, coupled with a clear trend towards urbanization [5],harms not only the people, but also the infrastructure and air in cities. Private households, industry and traffic each make up around a third of environmental pollution. Local authorities are responding with road closures or the identification of strict green zones which ban entry to older vehicles. This affects both Euro 1–4 cars, as well as newer diesel cars in the Euro 5 category. Sweeping measures of this kind not only aggravate residents and non-local car drivers, they also damage the local economy, as it is more difficult to transport goods or for workers to commute to these areas. Furthermore, the value of cars decreases if they aren't used in certain zones, making the car industry among those affected by the vehicle bans too.

Traffic restrictions are increasingly resulting in court cases where city officials need to justify the measures they have taken. It is therefore all the more important to have a transparent, verifiable decision-making process for environmentally focused traffic interventions.

Principles for sustainable traffic management

Blanket bans on traffic may be effective and easy to implement, but they are not always the perfect answer to the traffic and environment requirements. Here is a perfect example to prove this: In 2020, Stuttgart triggered its "Feinstaubalarm" (fine particulate matter alarm) twice over several days, including on 23 January[6].

A closer look at the situation shows that within this small green zone, which took effect in July 2020, certain areas are completely non-critical in terms of air quality, as they reach values around 0 or between 0 and 20 µg/m³, where the particulate matter limit value is 50 µg/m³. However, there are areas outside the green zone where the situation is serious, reaching 100 µg/m³ or more. Blanket traffic bans are therefore only shifting the problem elsewhere. Emissions and the associated air pollution then become an issue in the surrounding areas. The alternative to complete closures is to keep traffic coming in, but at reduced immission levels.

The best solutions for protecting the environment also take into account traffic requirements.

This means that many more stakeholders have to compromise. Responsible traffic management needs to satisfy three requirements: it must be compulsory, appropriate and effective, so that this efficiency can be proven later on. This is only possible with data-based analyses and decisions.

The **compulsory** element targets the necessity of the measures. Often, centres which need to assess the situation can only rely on partial or insufficient data. This is only supplied by a few measuring stations, such as those run by the German Environment Agency. However, in order to gain a comprehensive overview of the situation or a substantiated situation analysis, there need to be sweeping insights which extend to areas far beyond the measuring stations. Comprehensive, precise data supplied frequently and in real time is what is required. This data needs to be

assessed with the quality of each sensor in mind. Forecasts can be created based on this data. Traffic officials can then use these forecasts to move away from a reactive role and set the course by identifying and preventing possible limit-value violations in advance.

Appropriate means that only the necessary level of intervention is taken to limit traffic. Green zones cover large urban areas and completely block flows of traffic. By contrast, intelligent traffic management and speed regulation allow traffic to continue and reduce environmental pollution. Appropriate responses are the best compromise between traffic and the environment with regard to the stipulated limit values. They also significantly increase acceptance among road users.

The value of environmentally focused traffic management hinges on how **effective** it is. A lack of data has a negative impact on this. Making valid statements about the efficacy of the measures taken requires a solid data base. This makes operational decisions traceable and transparent, and not just in the event of subsequent court cases. A reliable data base and analysis therefore justifies the decisions that are then made.
In the first instance, before-and-after analyses provide in-depth insights for traffic management officials. They can find out which measures are actually effective, making them better equipped to face future challenges.

Data-based approaches light the way for future traffic management

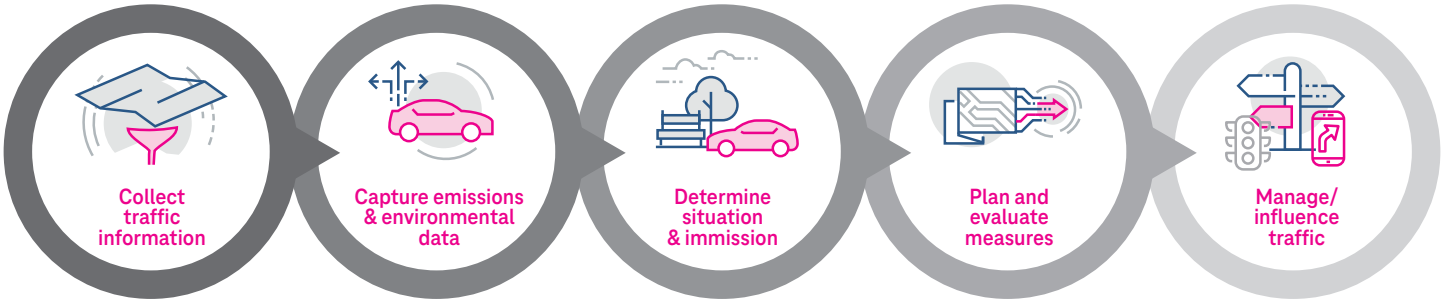
These three central requirements can be met by data-based approaches. Models of this kind produce significant benefits for all sectors. However, this has not yet trickled through to traffic management. Even large municipalities with over 100,000 residents are not yet in the ideal position for smart traffic management. There is a lack of data and tools for interpreting this data and introducing control measures – including efficient models and high-performance software. A holistic concept for sustainable, smart urban traffic management requires five components:

1. Up-to-date information about the traffic situation
2. Recorded emissions
3. Calculation of resulting immission values
4. Planning and assessment of measures
5. Implementation of the specific influencing factor/ traffic management

While environmentally friendly traffic management has thus far focused on components 1 and 5, greater 'intelligence' and efficiency are being generated in levels 2 to 4. Solutions are already available on the market which can be integrated with the existing measures and help establish smart transport management for municipalities.

Sustainable Traffic Management

Holistic solution combining best-of-breed partner assets from Bosch, Swarco and T-Systems



- Measurement of traffic and air quality situation
- Determination of traffic-related immission
- Deduction, simulation and AI-based decision-support for traffic-related measures
- Operative traffic management measures to improve air quality
- Route cause analysis, continuous expansion of knowledge base

New tools for optimized traffic management

The primary aim of traffic management is to adhere to the stipulated limit values. The most obvious control lever for this is the reduction of harmful emissions. However, emissions and (resulting) immissions don't always correlate. The weather and topography (e.g. basins) of cities, for example, have a significant impact on air quality.

Data-based approaches always take account of the specific situation within a city, enabling individual, flexible solutions for safeguarding air quality. They allow traffic to be maintained, while ensuring fewer pollutants are generated.

Dynamische Lösungen müssen statische ablösen

Collecting traffic information is a well-established process. Induction loops at traffic lights and cameras record private transport, while real-time information on public transport systems is available and runs alongside control centers. However, data on traffic flows and parking situations is only recorded selectively. These last two points in particular provide key information for assessing the current traffic situation, and help to decide whether measures are urgently required.

Annual traffic census for data collection

Annual traffic censuses are typical ways to record the volume of traffic. This sample analysis provides information about how many vehicles pass through certain streets or traffic intersections. In 2018 in Nuremberg, for example, traffic was recorded at 90 places, with a focus on the old town[7]. Over a longer period of time, this kind of traffic census provides an excellent insight into the long-term or historical development of the traffic. However, an annual sample analysis has very limited significance for everyday traffic management, especially since the traffic is generally not recorded everywhere.
A traffic census is a typical, historically established (and static) method which cannot satisfy the requirements for data-based real-time recording of the situation and a suitable response.

Thus far, only weather services are tasked with recording emissions data. Other approaches for gaining a clear picture of emissions data include on-board units, which are retrofitted to cars or, in the long term, can be fitted as standard by OEMs. Atmospheric or meteorological satellite data, as well as the use of apps, can further supplement the data.

Recording the actual immissions has so far been based on the data from the few measuring stations of the German Environment Agency. Other IoT-based sensor systems used in combination with simulation models help to capture a more precise picture of actual emission levels and the associated immissions. These models are only complete if satellite or weather forecast data is taken into account, as the weather can have a huge influence on the emerging situation.

Data-based tools which help traffic management officials make decisions are as yet rarely used. They start with a dashboard which displays the air quality at granular level (as well as possible violations of limit values) and end with the simulation of different measures realized. The systems calculate the effects certain measures will have over time and assess the suitability of the various control tools available.

Solutions aiding decision-making

Solution example 1: Air Quality Dashboard
An Air Quality Dashboard displays an overview of all the relevant components such as measured values, traffic volumes and the weather. An integrated AI-based development forecast (72 hours) allows suitable measures to be initiated in advance, so as to prevent limit values from being exceeded.

Solution example 2: myCity
This solution from Swarco allows traffic to be monitored and modelled in real time.
It includes the implementation of certain traffic scenarios (such as the morning and evening rush hour, the weekend, large events with different traffic light changes, speed restrictions and diversions). Workflows derive suitable measures from the analyses, and develop pre-checked decision proposals for traffic planners. Once a decision has been made, the measures can be incorporated directly into the traffic management system, for example through dynamic traffic light changes and displays on digital signs.

Active traffic management already comprises certain flexible, static tools for combating limit value violations. This includes road closures, speed restrictions and traffic information and management systems, such as display signs. Centrally managed systems of this type can be supplemented with individually used apps for optimized journeys and parking-space searches, as well as flexible traffic light controls. These flexible systems can help to maximize effectiveness for environmental quality.

Success stories of optimizing air quality

In addition to more sensors and IoT solutions, such as those from Bosch, simulation models and holistic concepts offer huge benefits for modern traffic management. The influence of apps, which are used by drivers and vehicle fleets, shouldn't be underestimated though.

The greatest advantage of these is that, when they are introduced, minimal changes or no changes at all need to be made to the existing traffic management systems. These apps are primarily used on smartphones, but could be installed in the vehicles as standard by car manufacturers in future.

Looking for a parking space with Park and Joy

Analyses[8] show that people drive almost 1.4 km when looking for a parking space in German cities – not to mention the associated exhaust emissions this generates. The Park & Joy app from T-Systems significantly increases the likelihood of finding a parking space (from 33 percent to 78 percent). If the app is supplemented by a central sensor system at the parking spaces, this likelihood increases to 96 percent. Journeys are reduced on average by 875 metres, and 62 percent fewer exhaust fumes are produced (240 g CO_2 and 231 mg NO_x per search).

Synchronizing traffic and traffic-light control

The GLOSA (Green Light Optimal Speed Advisory) app is already in use in Berlin and Braunschweig. It helps to make traffic flow more evenly and thereby reduce harmful emissions by around 10 to 15 percent. It also helps drivers to ride the 'green wave' in the city, showing the traffic-light phases and recommending suitable speeds depending on the distance from the traffic lights and their corresponding phase (red/green). GLOSA can also be used beyond this basic function to generate smartphone trajectories. The central traffic-management system provides an overview of current traffic levels, which allows the traffic lights to react to this traffic. Analyses facilitating long-term traffic planning are also possible based on the stored, anonymous movement patterns.

Controlling individual driving behavior

LCMM (Low Carbon Mobility Management) is a complete system developed for managing logistics fleets. DHL and DB Schenker, for example, use the patented system in China and Europe and have reduced harmful emissions by an average of 20 percent (saving of 468 kg CO_2 per HGV within one month). Fuel costs also went down by as much as 15 percent. This solution starts by analyzing individual driver behavior. The app helps drivers to develop a more environmentally focused driving style. A cloud backend with corresponding dashboards helps fleet operators to manage their vehicle fleets as efficiently as possible (including up-to-date positioning of each vehicle).

T-Systems – Partner of the automotive industry

T-Systems has worked together with Bosch and Swarco to develop an overall picture of sustainable, environmentally focused traffic management based on modular components. This includes all of the processes necessary for influencing real traffic, such as information collection, emissions measurement, weather data, conversion to immission levels, and the control cycle for deriving measures. This control cycle is essentially fed from the emissions situation, which can currently only be measured at a few points in the city, and of course from the current traffic situation that already shows a relatively good picture of the capacity of major traffic flows. Weather information and data from traffic infrastructure elements round off the overall picture.

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