

7TH EDITION, 2018

ROADS AND BRIDGES IN BAVARIA



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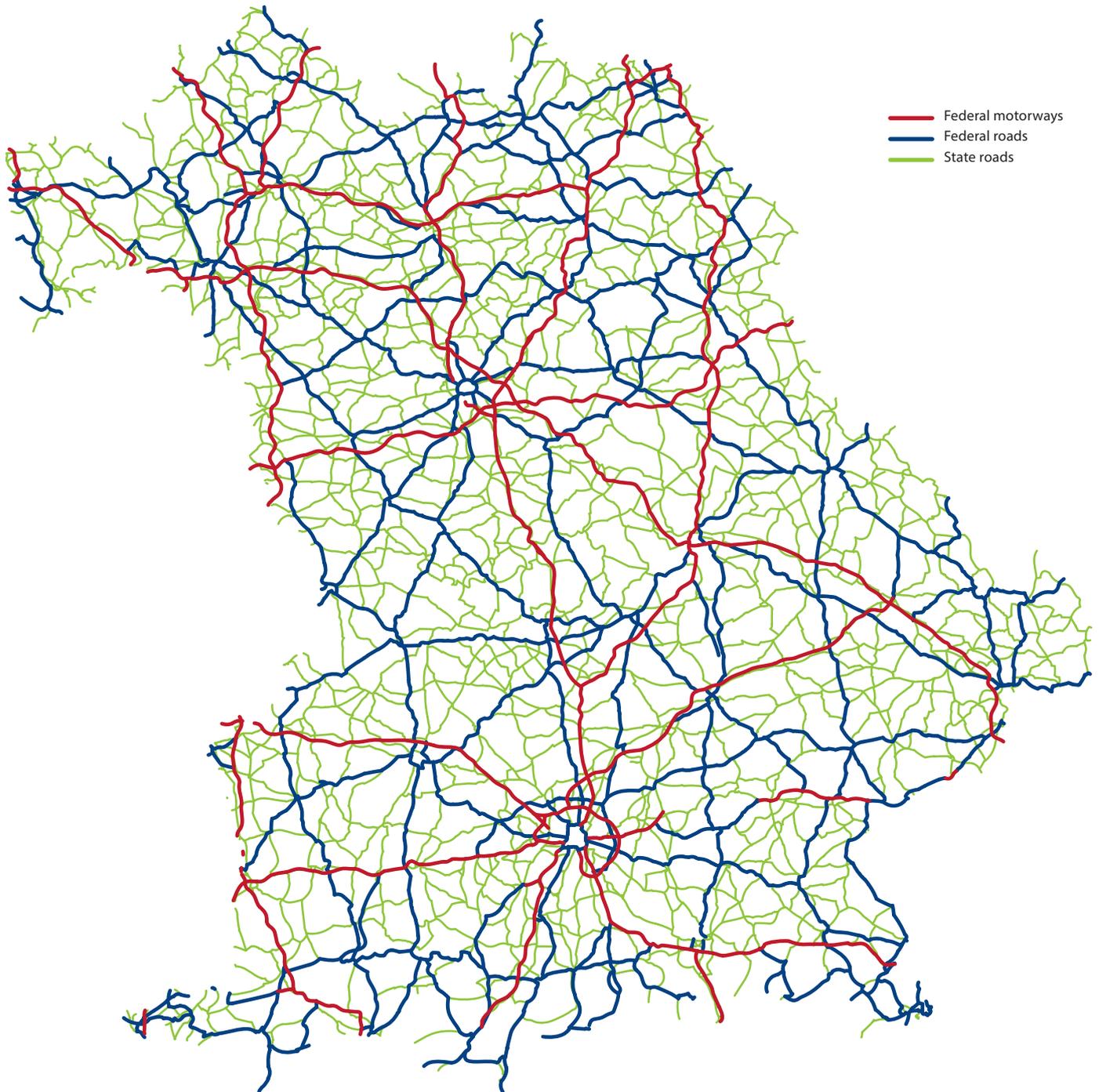
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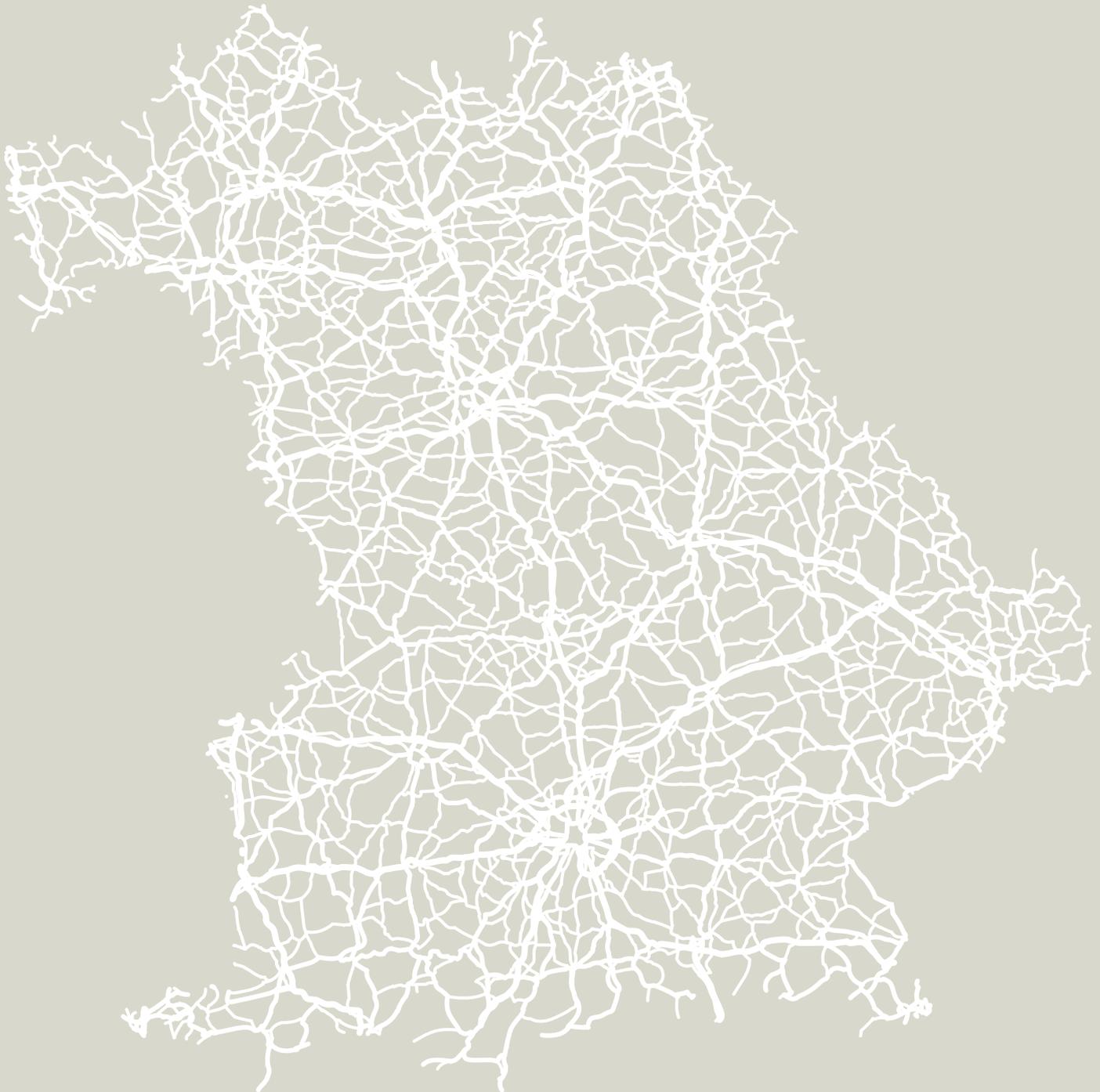
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7TH EDITION, 2018

ROADS AND BRIDGES IN BAVARIA



Bavarian State Ministry for Housing,
Construction and Transport



IN NOVEMBER 2018



Dr. Hans Reichhart
State Minister for Housing,
Construction and Transport



Roads are still the number one mode of transport and thus the backbone of our mobility as well as the guarantor of a prospering economy and a high quality of life in Bavaria. However, roads and bridges are more than just traffic routes: they are also witnesses to the changes in our society. Since reunification and the eastward enlargement of the EU, Bavaria has been at the centre of Europe. This has shaped the development of our road network and is still associated with major challenges in the transport sector.

Demographic changes bring about other changes too. For our ageing population, the barrier-free design of the transport network is a prerequisite for enabling people with mobility impairments to participate unimpeded in social life. Automated driving could ensure that everyone is able to stay mobile for longer. This new form of driving may become a reality much faster than we can imagine today. This is why the Bavarian State Building Administration, together with its partners, is carrying out tests of new technologies on a digital test track simulation of the A 9 motorway.

Cycling is undergoing significant change. Although the spread of electromobility is being discussed, especially in terms of passenger cars and lorries, the largest growth rates for electric bicycles are currently being recorded. These bicycles allow you to travel longer distances at higher speeds. As a result, cycling becomes increasingly attractive in everyday use, but we also need good cycle routes. Bavaria already has an excellent cycle path network. This will be continuously improved in the coming years.

The 7th edition of the book "Roads and bridges in Bavaria" illustrates the various changes in the road sector over the past 15 years. For the first time since its first appearance, the publisher is no longer the Supreme Building Authority in the Bavarian Ministry of the Interior. In fact this is now the responsibility of the newly created State Department for Housing, Construction and Transport. This department was newly created in April 2018.

The new administrative structures take account of current needs in the construction and transport sectors. This will make building in Bavaria the best way to embrace the future.

There are many roads and bridges that still need to be built. At the same time, the focus is shifting away from new construction towards expansion and preservation. However, the need for funding for infrastructure remains undiminished, as the needs-based preservation, upgrading and renewal of existing bridges and roads is essential to the accessibility of the road network. Both digitalisation and consistent strategic conservation management help to use the funds as efficiently as possible.

In developing and designing the infrastructure, we want to involve our citizens in the best possible way. A citizen-friendly involvement of the public is of the utmost importance in the planning and construction processes, because we would like as many people as possible to make use of our roads and bridges.

A handwritten signature in blue ink that reads "Hans Reichhart". The signature is fluid and cursive.

Dr. Hans Reichhart

CHANGING TIMES



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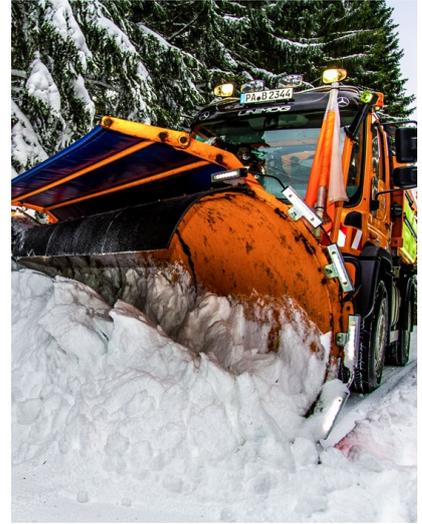
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TRADITION AND THE FUTURE

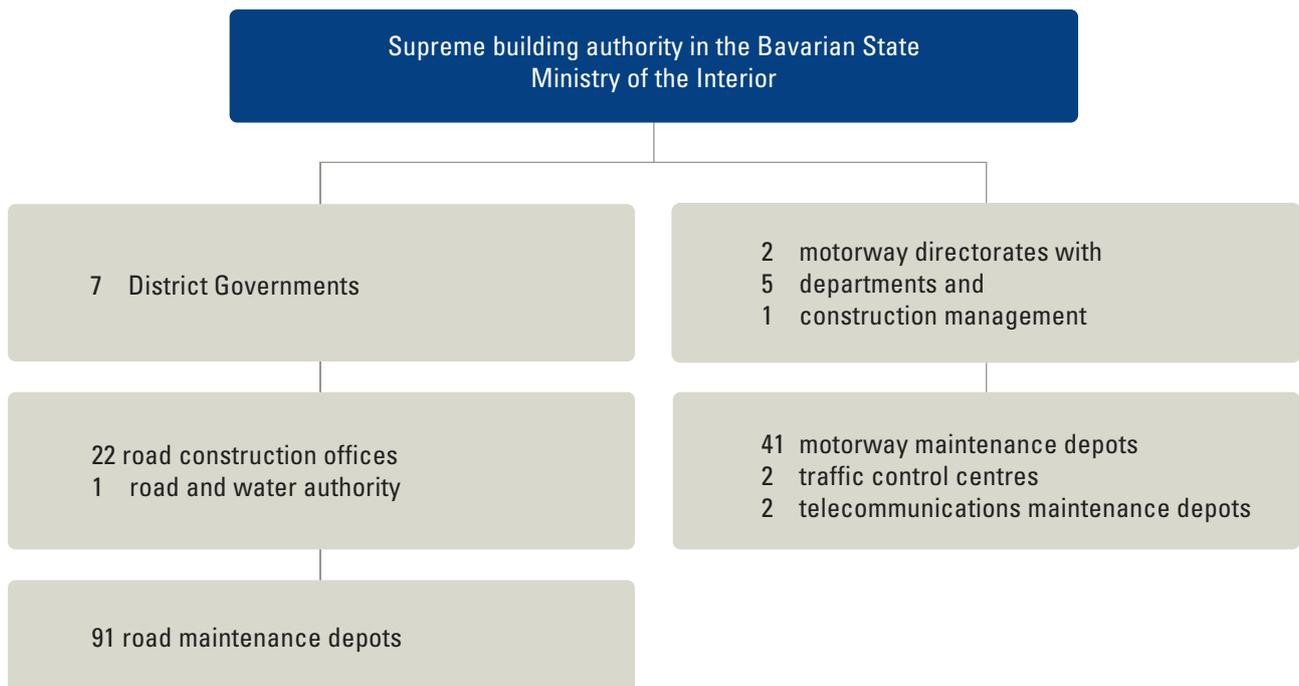
The Bavarian State Building Administration Through the Ages



Author **Josef Glashauser**

Founded by King Ludwig I in 1830, the Supreme Building Authority underwent a constant transformation over the course of its nearly 190-year history. Indeed, it was extended by 24 roads and river building authorities in the beginning of 1872 as a central body of state construction in Bavaria. The next big step followed after the end of the war in 1945 with the incorporation of the former Reich motorway authorities in the Bavarian State Building Administration. To respond to the enormous demand for construction, new road construction offices were erected in Regensburg, Bamberg and Kempten in the 1960s. With the territorial reform in 1972, the local responsibilities then fell to 22 road authorities and a road and water authority. In 1978, the motorway construction offices in Munich and Nuremberg were raised to the rank of central authorities and renamed the motorway directorates for Southern and Northern Bavaria. The new road construction offices were successively dissolved up until 1982 and incorporated into existing offices.

Organisation of the road construction administration from 1982 until 2007



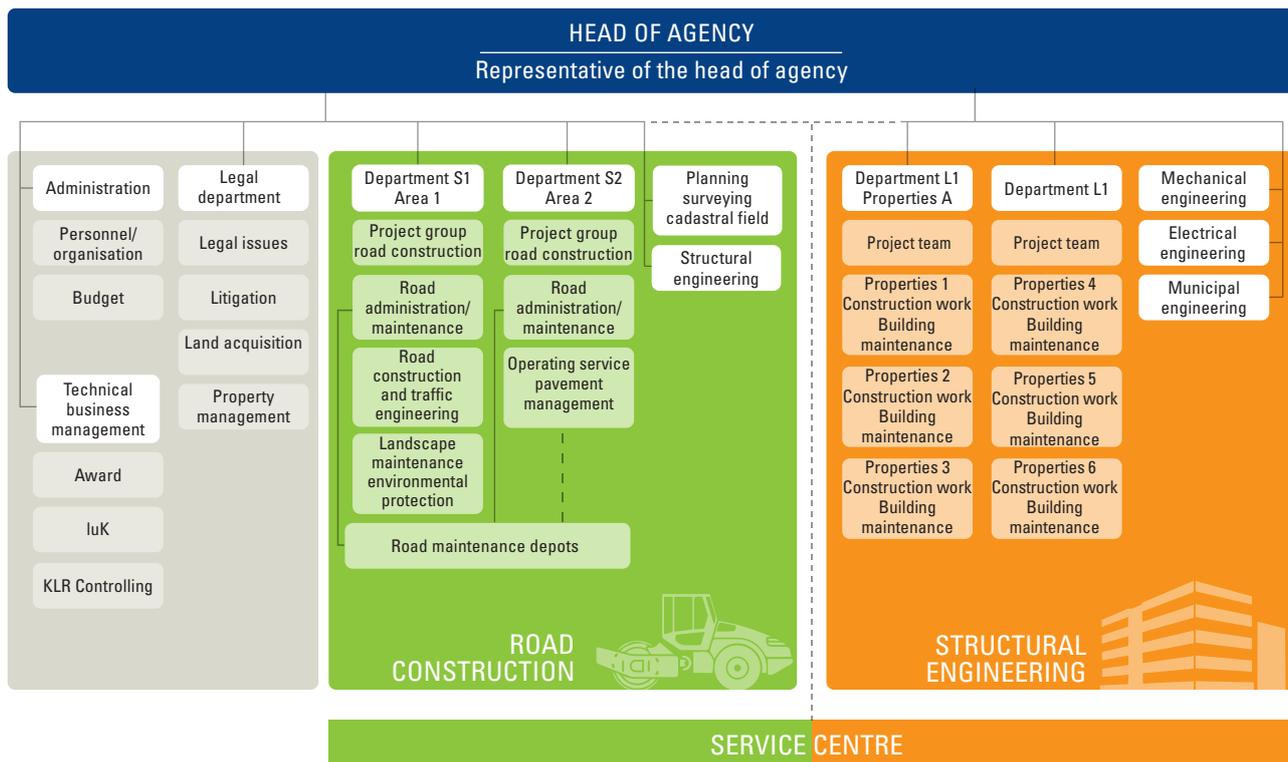
For around 25 years, road construction performed its duties – with few exceptions – within the illustrated organisational structure. It was not until it came to inspecting internal tasks and organisation as well as the "Administration 21" reform that more far-reaching changes took place.

New routes: project Administration 21

The reorganisation of the state building administration in 2007 formed a central part of Administration 21 – a comprehensive reformation project for the modernisation of administrative structures, launched in 2003, which was preceded in 1993 by a merger with the financial construction administration under the roof of the Supreme Building Authority as well as a comprehensive inspection of tasks and organisation in the road construction sector. The reformation in the field of state building management comprised the reorganisation and

design of construction offices at the lower level and the state building departments at the regional financial directorates. In response to the changing challenges and to fulfil the requirement to exhaust all rationalisation options and exploit synergy effects, a management building administration emerged from the classic state building administration. Within this organisational unit, the hitherto independent sectors of building construction and road construction could be merged to form new state building authorities, which, with a few exceptions, are equally responsible for building construction and road construction.

The focus of the targeted synergy effects was mainly in the cross-sectional areas between building construction and road construction – which is why the fields of organisation and personnel, information and communication technology and budget have since been managed in common administrative units. However, numerous other important



tasks, from the awarding of contracts to cost accounting and controlling, can now be carried out more efficiently for both sectors – an area for instance to which the sharing of future-oriented tools such as online awarding developed by building construction can contribute.

In addition, it is possible to use certain departments such as civil engineering, landscaping and surveying for road and building projects, if the units are not too large.

Reduced tasks, more efficient (personnel) structure

Another significant step in the reformation of Administration 21 was to reduce or transfer tasks within the state building administration and to increase the efficiency of the completion of the remaining tasks at the same time. Expressed in numbers, this means: on average, 70 percent of the plans are to be awarded in building construction and, in particular, in road construction. In individual cases, the percentage of contracts may even increase up to 80 percent. Self-planning, however, is to be scaled back to the necessary level, whilst always ensuring that one's own expertise is maintained to the required extent. In addition, construction work should also be carried out as PPP projects (public-private partnerships) in suitable cases. Within this context, the reformation model "Road maintenance depot 21" (Straßenmeisterei 21 - SM21)

must be mentioned, with which the road maintenance service contributed significantly to streamlining and increasing the efficiency of the state building administration. This succeeded on the one hand thanks to the enlargement of the operating units, which led to a much more efficient design of the internal organisation; on the other hand, the proportion of own staff and the inventory of own vehicles and equipment were reduced further – whilst at the same time the proportion of tenders being awarded to private entrepreneurs increased.

As a result of the previous reformation steps, the State Building Administration has been subject to continuous downsizing since 1993. In some sectors, the reduction was up to 20 percent of the workforce. Currently, there are around 8,900 employees in the state building administration.

Reorganisation of the administrative districts and locations

The reformation brought together the previously independent sectors of building construction and road construction in a total of 22 state building authorities; building construction and road construction are now operating under one roof at 19 locations. In addition, there are three purely building authorities in Munich and Erlangen-Nuremberg. The 22 state

“Competent employees at all levels are the real strength of construction management. What is more valuable than their abilities, will to perform and enthusiasm, especially in times of change?”

Josef Poxleitner, Head of the Supreme Building Authority, in 2007

« Sample organisational chart state building authority

» Responsibilities of the state building authorities with tasks in road construction



building authorities operate in 19 administrative districts, which correspond to the administrative districts of other administrative sectors, such as water management.

The state building departments of the regional finance offices in Munich and Nuremberg, which were previously responsible for the building construction tasks of the federal government, were merged in Nuremberg and, on 1 January, 2006, affiliated to the local motorway directorate for Northern Bavaria. In the meantime, it was decided over the course of the implementation of the 2015 home strategy of the state government, to make the state building directorate into an independent authority once again. Not directly affected by the Administration 21 project, however, were the two Bavarian motorway directorates; nevertheless, here too the job cuts due to budget laws had a heavy impact. In the road maintenance service, a reformation model "Motorway Agency 21" (Autobahnmeisterei 21 - AM21) was developed and implemented among the state building authorities.

Change all the way: Administration 21 in practice

In day-to-day operations, the measures of the Administration 21 project have resulted in many changes. Thus, for example, the derived concepts SM 21 and AM 21 ensure a significantly more effective and, above all, more economical road operation. The new organisational structures have proven themselves; the road operation service is modern and sustainable. In addition, the development of a "cross-departmental laboratory concept" for the Free State of Bavaria took place. This investigation also included the remaining three asphalt laboratories of the road construction administration at the road construction authorities in Weiden, Kronach and Augsburg, the operation of which was discontinued in 2007.

Another aspect of the reformation package deals with the field of grants: in the future, this should be specifically bundled with the governments in order to relieve the pressure on the public building authorities. Following the

successful completion of a pilot project in the district of Middle Franconia, the implementation of this proposal was finally decided in 2016. For this purpose, the governments in Bavaria each drew up their own personnel and organisational concepts – a necessary step, since the framework conditions on the ground are sometimes very different and can therefore only be taken into account using individual programmes. The conclusion of the reorganisation of the grant system takes place with the centralisation of all related tasks in the governments.

Well-Equipped for the Future

Some of the central road construction departments have been around for a very long time. This includes the Central Office for Traffic Safety (formerly the Central Office for Accident Evaluations). In the course of the transition to IT-based working methods, numerous new central offices have been set up in recent years – especially since many special tasks have not only become more complex over the course of time, but have also become more important overall. In technical terms, the central offices are assigned to the responsible department of the Bavarian State Ministry for Housing, Construction and Transport.

In addition, the project management system MaViS "measures for the visualisation and control of road construction projects" (Maßnahmen-Visualisierung und -Steuerung von Straßenbauvorhaben - MaViS) was developed in 2010 and 2011; it bundles the most important data of all Bavarian individual projects on federal, state and county roads. Based on the existing approximately 13,000 projects, thanks to MaViS, answers can be provided to the most diverse questions from the fields of politics and budget without much extra effort in a timely manner; the same applies to subject-specific or topic-specific evaluations. For example, MaViS has almost completely replaced project-based reporting to the Ministry with manually-filled tables. In addition, the road construction administration uses additional functions within the context of project accounting, project controlling and strategic resource planning.

Central road construction state tasks

ZSB

Central office for highway maintenance

ZIG

Central office for engineering structures and georisks

ZVM

Central traffic management

ZIT

Central office for IT management for road construction in Bavaria

ZIS

Central office for information systems

ZVS

Central office for traffic safety in road construction

➤ Overview of the central state tasks in the field of road construction

Also, the budget strategy and associated strengthening of rural areas make adjustments necessary for the Bavarian State Building Administration. For example, a new location was set up in Deggendorf for the motorway directorate for Southern Bavaria to which parts of the Regensburg department are to be relocated. At the same time, it is planned to distribute the staff of the Munich department based in Maisach to the directorate in Munich and the Kempten and Regensburg departments by 2025. In the motorway directorate for Northern Bavaria, there was a spin-off of the state regional building management, which now acts as an independent authority in Ebern – and the Deggendorf service centre of the Passau State Building Authority is to also assume the duties of the Deggendorf service centre of the Passau State Building Authority from Vilshofen.

With the transfer of responsibilities for the federal motorways on 1 January 2021 to the “Infrastructure Company Motorway” (Infrastrukturgesellschaft Autobahn - IGA) of the federation, the motorway directorates will be completely relieved by departments and motorway

directorates from the Bavarian State Building Administration and transferred into a federal administration.

However, the change and further development of the structures do not stop at the highest building authority. In March 2018, the Bavarian State Ministry for Housing, Construction and Transport was re-established. Among other things, it assumes the responsibilities of the previous Supreme Building Authority in the Bavarian Ministry of the Interior, for construction and transport. Thus, the term “Supreme Building Authority” (Oberste Baubehörde - OBB) should disappear in the medium term from linguistic usage in Bavaria.

"Think for yourself; don't let others think for you." With all the changes and adjustments that the Bavarian State Building Administration has undergone in the past, this statement by physicist Heinz Maier-Leibnitz always provided guidance. As a result, we can look to the future well-prepared and take on new challenges on our own initiative.

BETWEEN CONTINUITY AND TRANSFORMATION

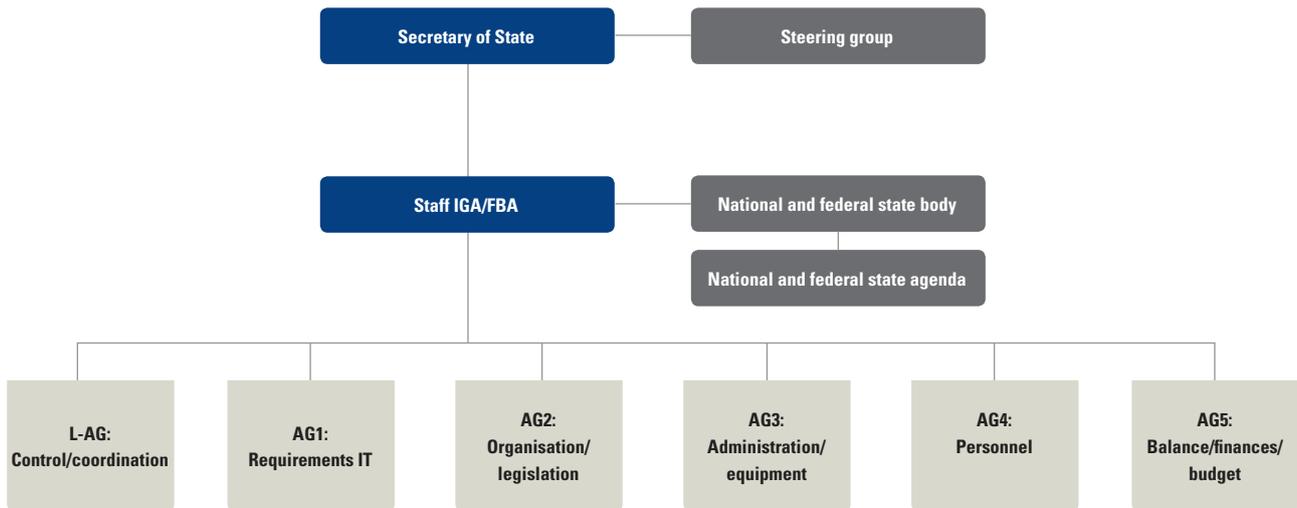
How Bavaria is reorganising responsibilities in the motorway and regional highway sector

Authors **Angela Roßmann, Wolfgang Zettl**

F For around seven decades, the federal states managed the motorways and federal highways on behalf of the federal government – and took care of the planning, construction, maintenance and operation of these traffic routes. Now the biggest reform in the history of motorways is looming. In June 2017, the Bundestag decided within the framework of the legislative package on the reorganisation of federal and state financial relations among other things to establish the "Infrastructure company for motorways and other federal highways" (IGA).

Bavaria had intensively protested in advance, but unfortunately in vain, in favour of preserving the proven and successful work of the two motorway directorates in their current form. And so from 1 January 2021, the IGA will take over the hitherto continuing order management of the countries.

Sovereign tasks, which are neither the responsibility of the "Federal Ministry of Transport and Digital Infrastructure" (Bundesministerium für Verkehr und digitale Infrastruktur - BMVI) nor are they assigned to the IGA by law, will in the future largely fall into the remit of the new "federal motorways office" (Fernstraßen-Bundesamts - FBA). As far as the management of federal highways is concerned, there will be fewer changes compared to motorways, since the proven order management can be maintained here. Although it is true that the amended Basic Law also offers the possibility of transferring the administration to the Federal Government upon request in this area, in Bavaria, the federal roads should nevertheless remain within the remit of the state building authorities. The legal framework for the IGA, the FBA and the transformation phase are specified in the Basic Law and the extensive accompanying laws.



The establishment of the IGA is in accordance with the “infrastructure company law” (Infrastrukturgesellschaftserrichtungsgesetz - InfrGG) in the legal form of a limited liability company owned by the federal government. A privatisation of the IGA as well as the infrastructure is excluded according to the legal regulations: among other things, the Basic Law enshrines the Federal Government’s inalienable and complete ownership of the network and the company. Likewise, the Basic Law prevents the direct or indirect participation of third parties in the company. This participation ban applies equally to the states.

In addition, the participation of private investors in public-private partnerships (PPPs) is excluded by constitutional law. This applies to the entire network transferred to the IGA or “essential parts” thereof. In the Accompanying Act, PPP transmission is limited to individual projects up to 100 kilometres in scope.

The expectations of several players related to the IGA of a private infrastructure company, which were decisive for the reorganisation, have changed over the course of the legislative process. The central goal of the

federal government to achieve more efficiency in the management of highways through centralisation has remained.

Great plans – great challenges

The motorway directorates for northern and southern Bavaria as well as the Bavarian State Ministry for Housing, Construction and Transport, which was newly established in the spring of 2018, are already working hard to implement the reform. Within the Federal Ministry of Transport, Building and Urban Development, an infrastructure department for a motorways staff unit (IGA staff) was established, which is responsible for the sustainable management, monitoring and implementation of the transformation. The staff unit is split up into five working groups.

For communication between the IGA staff and the states, a federal and state body and five federal/state working groups were also set up, which offer experts the opportunity for a regular exchange. Furthermore, the staff representatives, the general and major representatives of disabled persons as well as the youth and trainee

“The biggest administrative reform in this legislative period has been successfully launched. It affects around 15,000 employees throughout Germany. With it we drive the largest reform in the history of the motorway and rearrange the system completely.”

Federal Transport Minister Andreas Scheuer on the occasion of the founding of the IGA in September 2018

representations all participate in this federal and state cooperation.

The first major challenge in 2017 was the "Survey of the current situation as of 1 January 2018". The task was to fill a large number of Excel spreadsheets with data on organisation, land and real estate, equipment, projects and contracts as well as information from the IT sector. This flood of data must be updated as of 1 January 2019, and significantly amended.

The founding of IGA and FBA has a direct impact on all of the around 2,200 employees with motorway-based duties at the motorway directorates, their departments and motorway maintenance centres. In addition, the transformation process also affects employees of other authorities, such as the State Office for Finance, as a point of reference.

For this reason, guarantees on status, place of work and workstation were enshrined in the InfrGG to safeguard the personnel. For example, the IGA is subject to collective bargaining, and initial collective bargaining negotiations have already taken place in July 2018. Since the change to the IGA or the FBA is voluntary for the employees, they have the option of objecting to the transfer by virtue of §613a of the BGB, which is laid down in the InfrGG. These affected employees then remain employees of the Free State of Bavaria, and can continue to work on the motorways as part of provision or assignment.

The extent of the general willingness of employees to switch is to be shown by a message dated 1 January 2019. There

are still some uncertainties among employees at present, especially since various framework conditions – from the tariff and articles of association, through the target structures of the IGA and FBA, to personnel development concepts or official questions – have not yet been resolved. It is all the more important in this context to involve the employee representatives in accordance with their involvement and participation rights.

Overall, the transformation phase currently represents an enormous burden for the Bavarian State Building Administration. So it is a special challenge, in parallel to the current investment ramp-up and the associated creation of new building legislation to meet the sometimes high information requirements of the federal government. To make matters worse, this is exacerbated by severe deadline pressure, which is caused by the constitutionally anchored temporal cornerstones.

From an organisational point of view, the Transport Ministers' Conference in April 2018 provided a little more clarity in terms of the structuring of future structures. Accordingly, the IGA is to be represented nationwide in addition to its statutory seat in Berlin with ten regional branches and permanent or temporary field offices. Each branch has to handle between 1,000 and 1,500 kilometres of road.

Bavaria receives a total of two branches: one in Nuremberg (northern Bavaria) and one in Munich (southern Bavaria). The permanent branches of the northern Bavarian subsidiary are located in Fürth, Würzburg and Bayreuth, while the permanent branches of the southern Bavarian

Future structure of the road construction administration in Bavaria

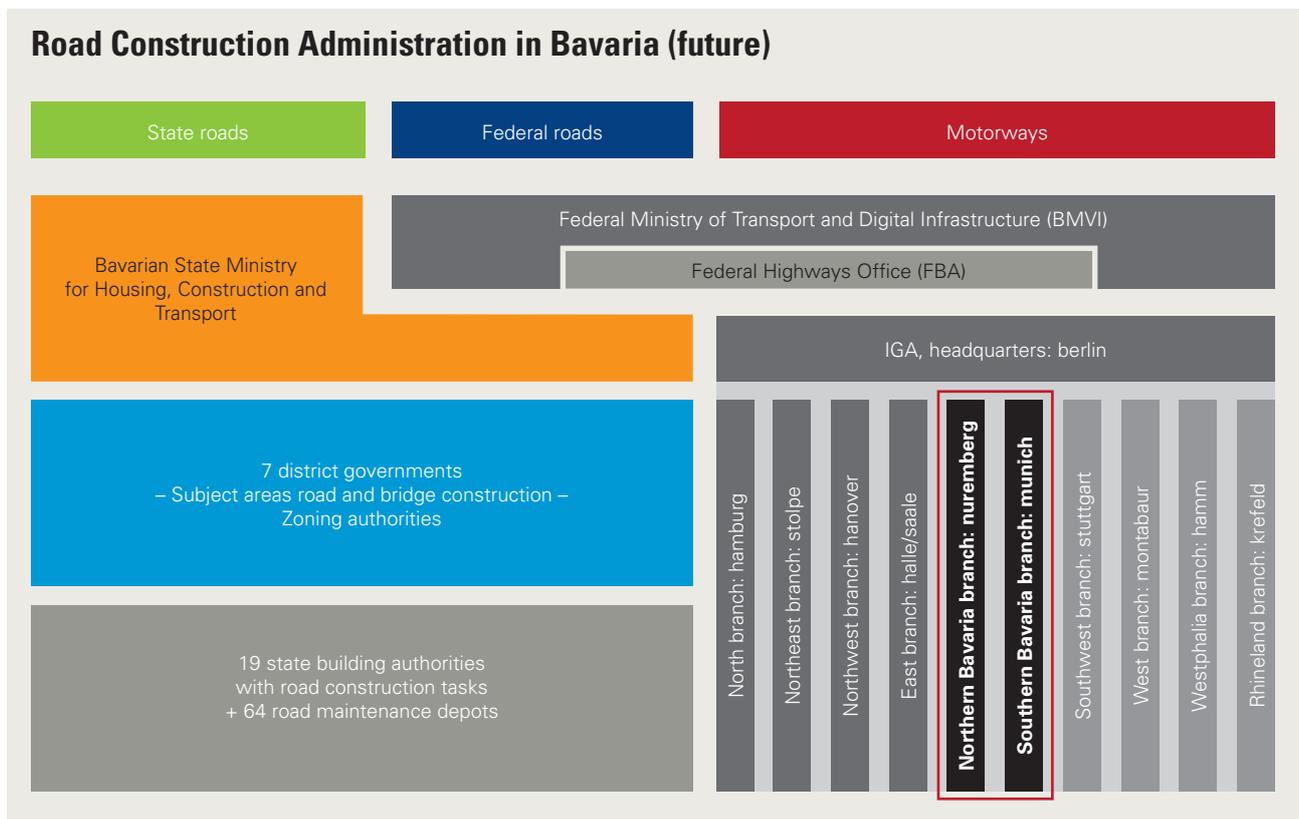
subsidiary are located in Kempten, Maisach, Regensburg and Deggendorf. The Deggendorf branch carries the additional designation "network development", which however according to the statements of the BMVI will result in no difference in the assignment of tasks. Added to this, of course, are all locations of the operational service.

The future network responsibilities in Bavaria thus essentially correspond to the previous areas of responsibility; the branches of northern and southern Bavaria will, according to the location concept, even transfer further motorway sections of other federal states, specifically the A 7 and A 96 from Baden-Württemberg as well as the A 72 from Thuringia. Thus, one of the essential Bavarian core requirements could be fulfilled by the federal location concept!

The head office of the FBA is planned for Leipzig. In addition, the new body, which is mainly responsible for governmental tasks, will be assigned additional branches: according to the current status, these are Bonn, Hanover and Giessen. The decision is still pending on the location of a fourth branch in southern Germany.

A Tight Schedule – Interim Status as at Autumn 2018

The formal founding of IGA and FBA took place on 13 September, 2018 and 1 October, 2018, respectively. However, along with the aforementioned data surveys, there are still many other hurdles to overcome on the road to transformation. In addition, a further amendment of the Basic



Law is required to ensure the constitutionality of the statutory regulations for planning approval. This change makes it possible for the responsibilities in planning determination and planning approval for federal motorways in Bavaria to remain with the Free State.

There are more to-dos relating to:

- › The formation of new forms of organisation and nationwide IT structures
- › The design of modified planning and construction processes with nationwide software and data management
- › The revision of all contractual relationships,
- › The unbundling of existing mixed directorates
- › The reorganisation of responsibilities for federal road projects which were previously supervised by the motorway directorates.

It remains to be seen how this multitude of complex tasks can be solved within the short timeframe we have until 1 January, 2021.

Of course, Bavaria will continue to actively petition the federal government to have as many Bavarian positions and requests as possible implemented, be it the establishment of a streamlined central office in Berlin or the retention of the widest possible range of responsibilities on the ground in the Free State. The overarching goal is to give the federal government a well-functioning organisation as at the key date. At the same time, as little as possible should change in the course of the transformation for the employees of the two Bavarian motorway directorates, including their departments and motorway maintenance centres.

“I am pleased that the structure of our administration for the construction of federal highways remains. Bavaria is once again a role model for the entire federal territory.”

*Minister of State Ilse Aigner at the
Minister of Transport Conference
in April 2018 in Nuremberg*



MOBILITY IN THE 21ST CENTURY

Challenge of Social Coexistence



Author **Roland Degelmann**

➤ Munich central station is one of the central connection points of the greater traffic streams of Bavaria

Ensuring mobility is one of the key social challenges in societal coexistence – and not just since the massive increase in motorised private transport. This topic has always raised questions that require far more than the expertise of transport planners: here, society in its entirety must be involved. Accordingly, in the 21st century it has to deal with central issues: what does mobility mean for humans? What options are available and what effects arise from them? How can mobility be maintained and secured without punishing future generations – and where are the limits to implementation in general? After all, mobility can only be facilitated in a sustainable way if



« Open spaces such as Ochsenfurt Old Town are central living areas for a democratic society

» To perceive mobility also means to regularly meet up with others at the destination



it is both personalised and designed to suit society in its entirety.

More than just A to B: What does the term mobility mean?

Today, mobility is often equated with traffic. If one were merely talking about this "analogy", the safeguarding of mobility would essentially involve optimising transportation – ideally individual transportation – and providing a high-performance transportation network. However, the fact that a concept of mobility understood in this way falls short is already well-known; as is the fact that it would lead to solution strategies that would not do sufficient justice to the actual problems of a mobile society. Therefore,

such approaches – even if they appear again and again in different scenarios in the future – will not be implemented.

In contrast to the concept of "motility" (Latin motio, movement), which stands for the ability to actively move, the term "mobility" (Latin mobilitas, flexibility) encompasses mobility in general. It therefore describes the basic existence of spatial, temporal, social, mental, physiological, professional or familial degrees of freedom – regardless of whether these are used actively or passively.

For humans, mobility in this connotation means the open integration into or the free exchange within society – as long as there are no external limitations such as health restrictions. Being mobile therefore means much more than being able to change one's current location.

Consequently, mobility covers, for instance in the field of social sciences, the rise in hierarchies. In addition, there are the technical possibilities afforded us by computers, smartphones etc.: thanks to them, we are able to maintain contacts over large spatial distances without physically moving anywhere ourselves by using social media. In addition, one's own mobility can also be used to allow others to benefit from the possibilities afforded by spatial movement.

The bottom line is this: if one considers the range of meaning of the concept of mobility, transportation only represents one very limited aspect of mobility. If we want to adequately answer the question of how mobility can be perceived to the fullest possible extent in the 21st century, other aspects of mobility will also have to be included in the discussion.

Here, above all, it is necessary to think beyond (improvement) approaches in traffic and traffic space design – especially for private transport – and to focus on the participation of people in social and economic processes. That is to say: how is this participation possible today – and how could it be shaped in the future? Mobility requirements will continue to increase over the next few years. In other words: we need more room to move. However, this requirement is no longer necessarily solely to be met within the context of changing one's location by means of traffic; rather, it is important to develop solutions that help to ensure that the perception of mobility in social and economic life is as positive as possible.

Mobility as a form of social participation

Those wishing to take part in social and economic life within today's predominantly existing settlement structures must regularly move back and forth between the individual areas of use. Regardless of whether this takes place by means of private or public transportation, nevertheless a great deal of time is spent on overcoming distances – which

in turn is time taken away from the actual intended uses at the respective destinations.

Although today, people repeatedly (rightly) point out that the amount of time a person spends on reaching their current living quarters, workplace or leisure location has not changed in comparison with times gone by, nevertheless this is only one side of the coin. Because although our accessible radius has increased sharply thanks to faster mobility and better (road) connections, so far no fundamental improvement in living conditions has been achieved; many even perceive their journeys between individual places to be increasingly hectic and stressful. The solution to these problems will therefore not be found in an even faster overcoming of long distances; rather, destinations must be brought closer to each other in the future, or distances must be overcome in ways other than purely by means of spatial movement.

Digitalisation as a key field

Technical progress in general and digitalisation in particular have also significantly changed the working environment in recent years. New forms of work break with traditional and proven work structures, they promote unconventional ways of providing and communicating knowledge. When work today is done primarily with mobile technical devices and online, space and time components are becoming increasingly relevant. In the long term, this also transforms internal structures of companies; in addition, the digital world of work promotes specialisation. Although access to a wide range of information sources is possible for many users, the assessment and evaluation of this information often only leads to superficial generic knowledge, as long as the topics are not addressed to sufficient depth. On this point, today's work environments do not differ from those of earlier times. The work gets more and more demanding due to the amount of available sources, even as computers increasingly take care of routine tasks.

From monologue to dialogue: mobility and communication

In addition to the topics already mentioned, advanced information and communication technology has also decisively influenced the concept of mobility in the 21st century. Even though the keywords "Internet" and "social media" only express one part of how we have changed the way in which we communicate, they are always referring to aspects of (social) mobility.

Put simply, the term social media means digital media and technologies that enable users to share and create media content individually or in communities. As a result, interaction and collaboration are becoming increasingly important and are transforming media monologues (one to many) into social-media dialogues (many to many). In addition, social media supports the democratisation of knowledge and information; by sharing content online, the user experiences a transformation from pure consumer to producer. The use of the Internet and social media means that people have much more extensive and significantly faster access to information. But not only the access to these, but above all also their interconnection as well as the discussion and further development of the gained insights facilitate a knowledge-based society, in which people can perceive their mobility in their own way. While one was formerly forced to research information on local specific issues, much of this information is generally available from any location today – the user is almost always "at the centre". You can look around a foreign city, digitally visit a museum, get information about an artist and in turn create your own data connections. Corresponding opportunities are also developing for a wide range of the working world, although certainly not for all jobs. Equally, it is important to note that these new opportunities present numerous risks and challenges related to information provision and exploitation. A key word in this context is the term media literacy. Once this has been ensured, modern communication technologies serve as a basis for perceiving and living mobility in a way

that has never been seen before. Using these opportunities in a social context for the real exchange between people and for the community is a valuable opportunity that did not exist for previous generations.

Mobility in thought

What are the consequences of these points for the perception of spatial mobility in traffic and for the provision of a transportation network? First of all, one should be aware that the restricted perception of mobility described above is largely related to external influences. But even if the latter have developed over a long period of time, they are still not set in stone.

The fact that there are often long distances to travel from home to work – such as for long-distance commuters, weekend commuters and many others besides – leads to traffic flows that cannot be coped with in many areas with our current network. For this reason, questions of necessary network expansions must be inseparably linked with the consideration of how the causes of these long journeys can be changed. On the other hand, especially in a region as large as Bavaria, which has a great variety of forms of settlement structures and mobility requirements, it is important to offer appropriately scaled transportation solutions. For example, deliberations on providing public transport in less built-up rural areas primarily via railways or large-scale bus systems are regularly misleading – just as former plans to make metropolitan areas with highly dense populations accessible by car were.

While individual and public transport in rural areas will probably continue to be based mainly on the road for a long time, priority in the conurbation areas will certainly be based on (rail-bound) public services, supported by options tailored specifically to each town. Undoubtedly, this will go hand in hand with a return to walking or cycling, with or without electric assistance; but in return, the realisation from

debates from decades gone by (such as the "car-friendly city") should have set in that ideologically influenced black and white considerations – from the unilateral priority of a single mode of transport right up to blanket 20 mph zones in towns and cities – suffocate any constructive discussion right down to its core.

In summary, it can be stated that mobility planning will have to decide more than ever in each individual case what the actual mobility requirement entails or to what degree is the transport network required and necessary in terms of spatial movement. Only on this basis can a sustainable network provision take place – also with regard to the aspects of economy and ecology.

☞ Coburg bus station – individual and public transport also requires needs-based connections outside the metropolitan areas



☞ Mobility perception is not an end in itself. Its ultimate goal is always within the context of other life contents

ROAD FUNDING

By programmes, commissions
and partnerships



« Toll bridge on a federal highway

Authors **Bernhard Wagner, Hermann Götzfried**

Road construction authorities are responsible for road funding. Regarding highways - i.e. federal motorways and federal roads - this role is assumed by the federal government. The fact, however, that federal highways are being administered by the federal states is governed by Germany's constitution (order management). The amount of financial resources for the construction, maintenance and operation of said motorways and roads is to be approved alongside the annual federal budget before the Federal Ministry of Transport and Digital Infrastructure (BMVI) distributes the funds to the individual states. This also includes revenues according to the "Federal Highway Exemption Act" (Bundesfernstraßenmautgesetz - BFStrMG). In the case of the Bavarian state roads, the Free State is the road construction authority; the funds are shown in the corresponding state budget. For district roads, in turn, the states and the independent cities are responsible – and for the municipal roads, the cities and municipalities. Deviating regulations exist for cross-town links of federal, state and district roads in larger cities, which carry public easement here.

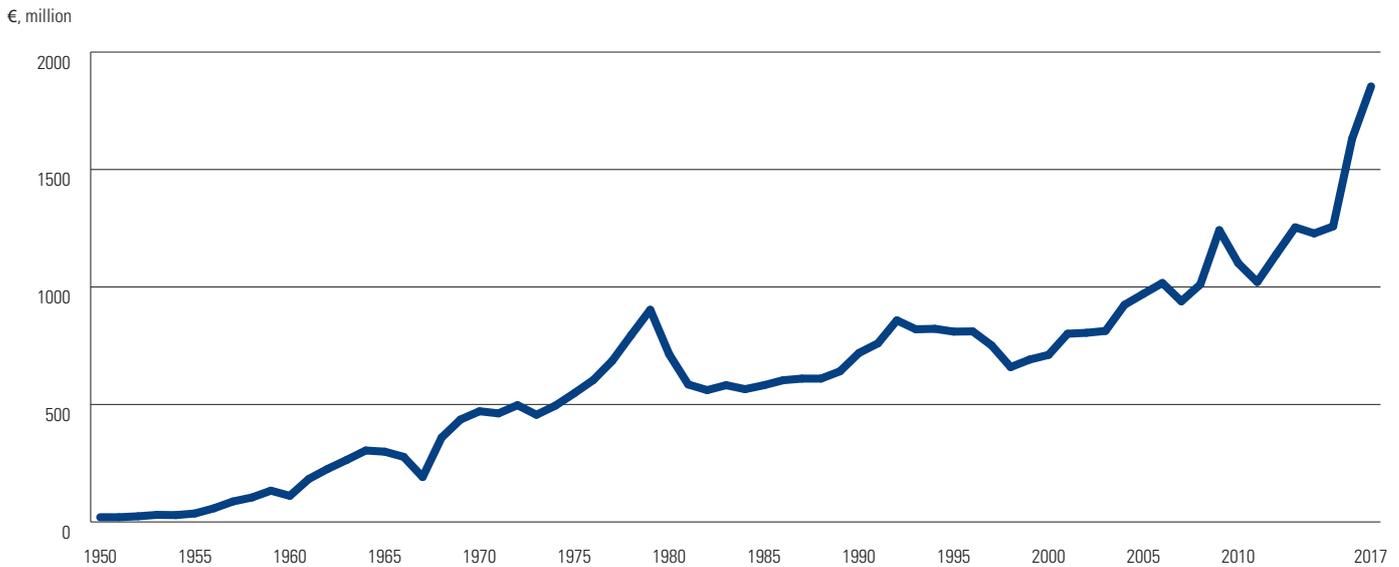
Federal highways: great opportunities, great challenges

For many decades, the financing of federal highways was inadequate and subject to strong fluctuations. In 2000, for example, the "Infrastructure Financing" commission (Pällmann Commission) convened by the federal government had come up with proposals as to how a gradual system change from taxation to user financing could be arranged. Key starting points were the introduction of user charges, which should be consistently secured for investments into infrastructure. In addition, experts proposed the participation of private third parties in the funding of federal highway projects (Public-Private Partnerships, PPP).

Thus, the Pällmann Commission laid the foundation for the work of subsequent expert committees – including the Commission "Future of Transport Infrastructure Financing" (Daehre Commission, 2012) and the Commission "Sustainable Transport Infrastructure Financing" (Bodewig-Commission, 2013).



State budget for federal highways in Bavaria (investments, operational service, others)



Although on average funds provided for federal highways have increased continuously since 1950, the overall development has come in waves. In 2009, for example, the Confederation launched two stimulus packages aimed at stabilising the economy affected by the banking crisis. From 2012 to 2014, two infrastructure acceleration programmes followed to further finance construction-ready projects. As a result, the federal government started the investment ramp-up for transport infrastructure with its future investment programme – and increased the funds for road construction from 6.5 billion euros (2015) to 7.3 billion euros (2016). 8.1 billion euros were already available in 2017, and by 2019 a further increase to around 9.4 billion euros is planned for Germany. The bottom line is the need for 8.5 billion euros per year, which experts at Daehre Commission have determined for the construction and extension, maintenance and ongoing operation of the federal highways.

Thanks to consistently forward-looking planning, Bavaria has always benefitted from the additional financing impulses in federal highway construction. Therefore, it was also possible to raise substantial additional funds already in the capital investment ramp-up and to increase investments by a staggering 55 percent between 2015 and 2017 to more than 1.5 billion euros in 2017. As much-needed as this money blessing was, so too are the challenges associated with it: after all, huge construction volumes have to be planned and secured under planning law within a short time frame; in addition, there is the announcement and control of all construction works. Significant additional burdens for

our employees are associated with this, especially since numerous additional jobs created were difficult to fill due to the booming construction industry. The increased allocation of services to engineering firms also requires additional personnel capacity. So, if we want to capitalise on the opportunities inherent in capital expenditures to increase the efficiency of our highway network, road construction administration, construction industry and freelance engineers must work together.

User financing on the right track

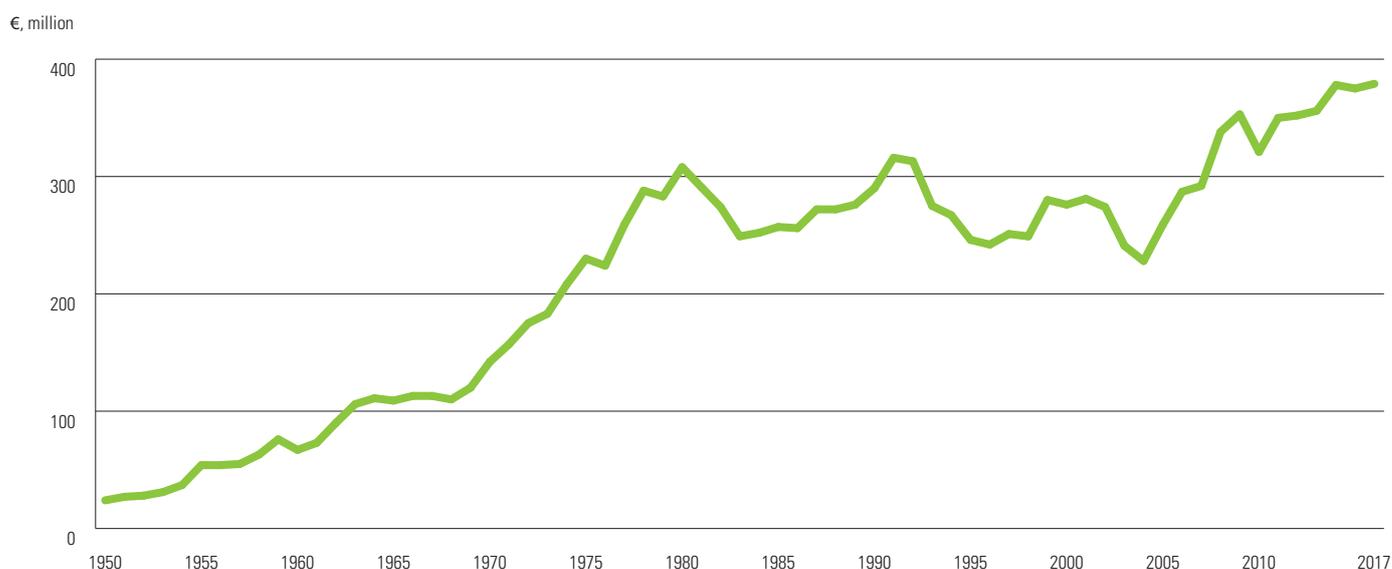
Budget increase is flanked by gradual conversion from pure tax financing to user financing. Since 2005, for heavy trucks from 12 tons permissible gross weight in road haulage a distance-dependent toll on federal motorways has been in force. Their precise sum is determined by the number of axles and the specific pollutant class of the individual vehicle. Since 1 August 2012, the federal government levies a toll for the use of the roughly 1,000 kilometres of four-lane federal roads following motorways; on 1 July 2015, this was extended to a further 1,000 kilometres of four-lane federal roads. Since 1 October 2015, the toll also applies to trucks with a gross vehicle weight of more than 7.5 tonnes and from 1 July 2018, the distance-based truck toll in road haulage has been extended to all federal roads.

While the model of user financing in road freight transport has already been established, passenger transport policy has

"The acceptance of user financing increases to the extent that the users can perceive what happens with their money."

Torsten R. Böger, Verkehrsinfrastrukturfinanzierungsgesellschaft mbH

State budget for state roads in Bavaria (investments, operational service, others)



yet to create the legal requirements for a time-dependent infrastructure tax. Frequently discussed controversially in public, this tax, known as the "car toll", would be due annually for passenger cars registered in Germany. However, vehicle owners would not incur any additional costs, since in return a reduction in the vehicle tax is provided for. In particularly low-emission vehicles, the relief may even be higher than the tax. Holders of vehicles registered abroad must also pay the network charge, but initially only for the use of the motorways. The network charge is to be introduced by 2021 when the necessary advance payments for the construction of the system have been completed.

State roads: high standard with room to improve

As with the construction of federal highways, the funds earmarked for state roads in the state budget are subject to

considerable fluctuations. Since 2011, however, there has been a clear upward trend. The budget for investment in this area in 2018 will be 310 million euros, 170 million euros for conservation and 140 million euros for reconstruction and expansion. There is still a great need for maintenance and expansion as well as continuously increasing demands on Germany's state road network.

PPP on the road to success

As already mentioned, one of the proposals of the Pällmann Commission was to involve more private third parties in road funding in the future. Refinancing should be based on user income, the prerequisite for which was satisfied by the introduction of the truck toll. The PPP model gives the contracting authorities valuable latitude to implement further urgent projects in addition to regular budget-financed projects.

The first PPP operator model nationwide was the expansion of the A 8 motorway between Augsburg and Munich completed in 2008, and followed three years later by the section between Ulm and Augsburg. In both cases, a private project company was granted the six-lane development, structural preservation, operating service and financing of the relevant sections of the route over a concession period of 30 years. Refinancing is provided through start-up funding and the transfer of revenue from the truck toll. So far, the expectations for high-quality construction have been fulfilled – and thanks to tailor-made financing, construction processes could be expediently optimised. Although planning and tendering for these projects had been more extensive compared to previous projects, in return they benefitted from lower costs in terms of construction preparation and monitoring. Participating banks are a "natural partner" of the builder within the context of project financing – not least because, as venture capitalists, they pursue their own interests in construction quality, cost certainty and on-time delivery.

Since 2016, the Forstinning – Markt section of the A 94 has been under construction as a PPP project in its second season. Its refinancing is carried out independently of toll income via start-up financing and agreed monthly instalments. Deductions are always payable on the monthly instalments if the operator restricts the availability of the route beyond the contractually agreed level. The expansion of the A 3 between Würzburg/Biebelried and Fürth/Erlangen is also currently being prepared according to this so-called availability model. Despite various objections from the Federal Court of Auditors and criticism from the mid-sized construction industry, the federal government has announced that it will continue to run and further develop PPPs in federal highway construction as an alternative procurement model.

In state highway construction too, PPP experience has already been gained in Bavaria: up to now, in six projects, maintenance and financing in addition to construction have been awarded to private partners. Refinancing takes place in ten annual instalments from the state highway budget.

In July 2008, the local Miltenberg bypass (St 2309) went "online" as the nation's first PPP state road measure. Essential components are a 350 metre long tunnel and a 357 metre long bridge over the Main. Since then, the main bridges Bergtheinfeld (St 2277), Segnitz (St 2277), Volkach (St 2260) and Klingenberg (St 3259) and the construction section IV of the Munich Airport Tangent East (St 2580) as PPP models have since been realized.

In future, so-called functional construction contracts will increasingly be used in state road construction: in this PPP version, construction and maintenance are private players, while operation and financing remain in the hands of the state. A pilot project is the construction project "bypass Sommerau" that has been running since 2016 (St 2308, Eschau district in the district of Miltenberg). In the future, as a viable alternative, the model of functional construction contracts will also be used in the construction of large bridges.

Municipal road construction: proven promotion

Municipal roads (about 100,000 kilometres) or district roads (18,800 kilometres) account for about 85 percent of the entire Bavarian road network. Districts, cities and communities are obliged to build, maintain and operate "their" roads. The fact that they can count on the support of the Free State has a long tradition in Bavaria. Basically, two funding areas can be distinguished here: on the one hand, the municipalities receive annual lump-sum subsidies under the Bavarian Financial Equalisation Act (BayFAG) for the ongoing permanent tasks, in particular the ongoing maintenance and operation of the roads including winter service. On the other hand, the Free State promotes specific individual projects via the Bavarian Municipal Transport Financing Act (BayGVFG) and BayFAG.

The aim of the BayGVFG is to promote the construction and development of particularly important roads. These include, for example, inner-city major roads and feeders to the local road network or important community roads

» A 8, Augsburg
West intersection;
looking towards
the PPP model
Ulm-Augsburg

» St 2277, Main
Bridge Segnitz



or intersections with other modes of transport such as railway lines and waterways.

By contrast, the funding possibilities of the hardship fund, which judges a project's traffic-technical meaning to be less crucial than the weight of the burden of the municipality, are even broader. Accordingly, grants from the hardship fund can also be awarded in a manner that is complementary to the funding according to BayGVFG.

Another special feature of BayFAG: a municipality can also be financially supported if it assumes responsibility for construction management on a state road. While the state road special building load programme (Art. 13f BayFAG), which was set up in 1999, initially only promoted city bypasses in the course of state roads, since 2009 also so-called dependent pedestrian and cycle paths run alongside state roads and the conversion of intersections

into state roads with municipal or county roads is worth funding. Since 2017, the funding catalogue also includes the construction of autonomous cycle paths, which – especially with regard to the mobility mix of the future – are of particular importance for local cycling.





DIGITALISATION CHANGES

Bavaria on the way to becoming a smart state

Authors **Christian Peetz, Roland Degelmann**

Progressive digitalisation is changing our society at a rapid pace. Be it the world of work, where digital processes and business models are increasingly replacing traditional patterns, or the private sphere in which the use of digital sources of information has become an integral part of everyday life. But however promising the new possibilities may be, the fast and barrier-free access to digital technologies is crucial for one's future viability.



Equal opportunities for everyone!

A look at the current development makes it clear: at present, not all regions and population groups benefit to the same extent from the opportunities offered by digitalisation. For example, the discrepancy between urban and rural areas will be exacerbated by digitalisation itself, but also in the wake of demographic change. This contradicts the constitutional principle of equal living conditions and poses the danger of an increasing social division. Digitalisation also opens up new opportunities for improving living conditions and social participation; but as already mentioned, this can only succeed if fast broadband connections are made as widely available as possible. This goal must therefore be the focus of political action and be consistently pursued. In this context, it is also important to think digitally in the future and to concretise real application options in the regions in order to keep rural areas alive and developing along with their inhabitants and businesses.

Keyword development: digital technologies enable and improve the connection of different spaces as well as the ecologically sustainable provision of goods and services: for instance, public and private transportation can be combined in a sensible way in digitally organised mobility chains. The same applies to the interlinking between passenger and logistics traffic: the potential that digitalisation offers here is enormous.

Aim: smart Country

In this context, the term "smart country" comes into play. Unlike the more familiar term "smart cities", it is much broader – and explicitly includes rural areas in its search for solutions to the challenges of the 21st century. In this way, it creates a conceptual framework within which – by means of intelligent technology and networking – a participation of all can be facilitated and equivalent living conditions can be secured in cities and regions.

For the term Smart Country, there is still no clear and generally accepted definition. Translated, "smart" means as much as clever, skilful, sharp or – in general terms – intelligent. According to the statements of the German Institute for Urban Studies, "smart country" describes a region in which intelligent solutions for a wide variety of areas of spatial development (infrastructure, buildings, mobility, services or security) are achieved through the use of innovative technologies – from increasing the energy and resource efficiency as well as economic competitiveness, to improving the quality of life.

Overall, behind the discussions around the development of a Smart Country stands the vision to integrate key components of infrastructure and services optimally into the regions – in other words: in areas such as environmental protection, emergency management and traffic and energy

"We are launching an offensive to digitalise the construction industry. Construction projects are to become more efficient with state-of-the-art digital methods and realised in a timely and cost-effective manner. We will make planning and building with BIM for our infrastructure projects mandatory from 2020 onwards. We will optimise the deployment of these planning methods with pilot projects. This is a modernisation offensive for the German construction industry, which operates worldwide."

Alexander Dobrindt, Federal Minister of Transport and Digital Infrastructure 2013 - 2017

management, in the long term, all existing capabilities are to be combined with digital functions and applications in the best possible way.

However, it is essential to overcome the patchwork of single solutions and rigid structures that still exists in many places. Only then can the Smart Country vision become reality: a technological innovation field that fundamentally changes spatial processes and thus makes a significant contribution to better quality of life and successful social change.

What this means for the tasks of road construction management is obvious: in the interaction with citizens and companies, it must always set up processes in such a way that the end result is the greatest possible benefit for the people. It falls within the remit of the state, in particular to make real-time data accessible and usable in order to be able to make better decisions on this basis. The already existing trends towards open government and open data will give this requirement additional impetus.

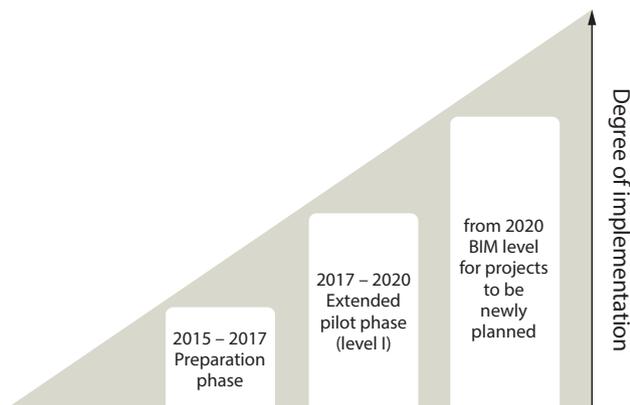
The aim of the developments must therefore be to be able to comprehensively access information when it comes to the decision on or the preparation of important tasks – and to organise this access across tasks. The buzzwords in the construction sector are Building Information Management and Building Information Modeling (BIM), each in their own respective current development stages.

Building Information Management

Higher quality, more efficiency and speed: digital technologies such as Building Information Management offer enormous potential – which is why their widespread introduction is planned – and will lead to a comprehensive change in existing processes and ways of thinking in the construction sector. For this transformation, the Federal Ministry of Transport and Digital Infrastructure (BMVI) has published a "Step-by-step plan for BIM in Germany – plan-build 4.0". Primarily geared towards the needs of infrastructure construction and infrastructure-related building construction, it describes the path to the application of digital planning, construction and operation as well as the associated future requirements. Target groups are contracting authorities and customers. The BIM facilitates the early networking of the respective players and thus forms the basis for intensive communication between all project participants. This in turn leads to efficient, standardised processes and simplified risk management.

The phased plan for the introduction of the BIM in Germany initially provides for various scientifically accompanied pilot projects. Based on the findings, measures for standardisation will be initiated and further recommendations for action developed. In stage two, a much larger number of pilot projects are on the agenda in order to gain experience in all planning and construction phases. Added to this is

➤ Digital Mobility – what city dwellers want



➤ Schedule for the launch of digital planning and construction (step-by-step plan)

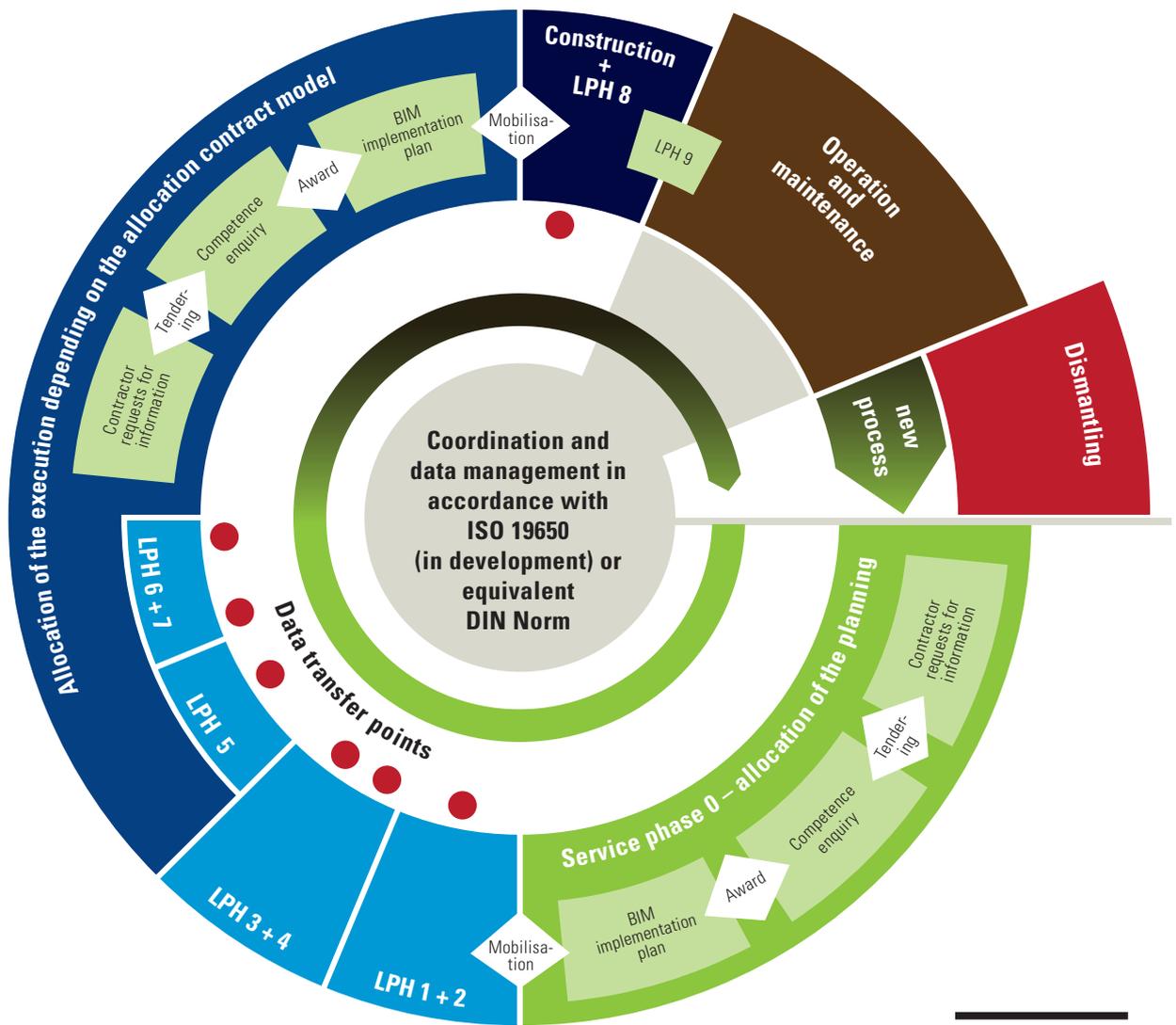
the development of comprehensive guidelines, checklists and samples – including the clarification of legal issues. In addition, a database concept is developed, which should make working with BIM much easier. Finally, from 2020, the third stage will be the regular implementation of BIM for projects to be planned in the entire federal transport infrastructure construction.

A BIM pilot project of the Free State of Bavaria is the replacement of a flyover over the S-Bahn in the course of the eight-lane expansion of the A 99. For this construction, the BIM method is applied from the design planning through the execution planning to the construction work. Lack of exchange formats and different modelling methods led to difficulties in the data exchange between the two software products used, so that numerous model elements had to be recreated. Regardless of the extra work involved, such experiences are generally considered to be positive, as only in this way can improvements be initiated that will benefit future projects.

Shaping the change

However, BIM is not just a pure planning method. Rather, BIM-compliant models must be recognised as comprehensive sources of information about existing structures; the knowledge gained from this can then be used, for example, for efficient operation and maintenance planning – which maximises the benefits of the BIM. As a result, thanks to BIM, entirely new possibilities are opening up for surveying the operating phase of a construction in the sense of a "lifecycle" analysis.

With BIM, the change from two-dimensional line-based to three-dimensional object-related viewing was completed. Although the BMVI's goal of a nationwide BIM application by 2020 currently seems very ambitious, the momentum and the potential are enormous. The question of whether the BIM method prevails is basically no longer in doubt. It is therefore all the more important for road construction management to vigorously pursue this issue in order to make the most of BIM's opportunities as efficiently as possible. In addition, we must ask ourselves how we can optimally adapt our structures and internal and external processes to BIM.



≈ BIM process over the life cycle of a construction

What this development means for the structures in the construction industry or for planning offices is difficult to estimate. One thing is clear: this technological leap will be as extensive as it is sustainable. Smaller companies and offices especially are facing great challenges. In order not to leave the field free for large corporations and large offices to roam, it is therefore essential to pursue medium-sized solution approaches when introducing BIM.

NEXT STOP: THE FUTURE

Just like on the A 9, technologies and concepts for tomorrow's road traffic are being tested



Author **Reiner Scharrer**

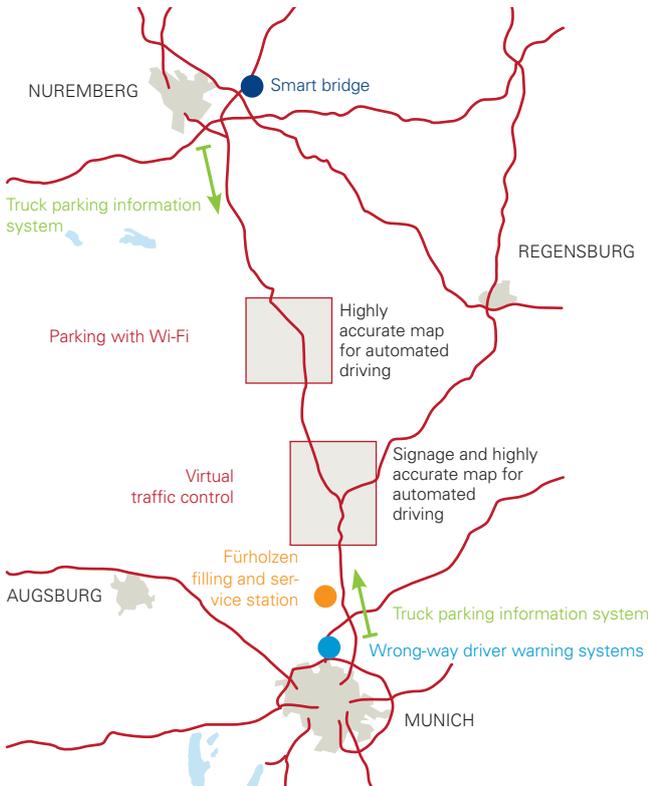
Digitalisation is finding its way into more and more areas of life and work and will be part of our mobile everyday life in the foreseeable future. Industry and science have long been working on the development of automated vehicles that are designed to handle a large part of driving activities autonomously. In order to master this highly complex challenge, it is also necessary – at least in its initial stages – to have a suitably equipped infrastructure that can be used to digitally connect road and traffic.

A milestone in this area is formed by the innovation charter "Digital test field motorway" signed on 4 September 2015 by the Federal Government, the Free State of Bavaria, the German Association of the Automotive Industry (VDA) and the Federal Association for Information Technology, Telecommunications and New Media e. V. (bitkom). It opens up the possibility to all interested parties from the automotive industry, the digital economy and science to test intelligent traffic systems for the digital road infrastructure under real traffic conditions and prepare them for market readiness.

One of the most important motorways in Germany serves as a "laboratory under real conditions": the A 9 between Munich and Nuremberg. The heavily loaded route, which regularly reaches international traffic peaks of up to 140,000 vehicles a day, has both straight-lined and winding sections and leads through a dynamic topography in the Altmühl valley; it also has state-of-the-art road equipment – from traffic control systems with temporary clearance to dynamic variable traffic signs to freely programmable full matrix panels – and is optimally connected with the Nuremberg-Fischbach and Munich-Freimann transport and operations centres in northern and southern Bavaria – ideal conditions for testing a variety of applications on "one road".



Overview map
digital test field A 9



Traffic sign for
vehicle self-locali-
sation



Important milestones for automated and interconnected driving

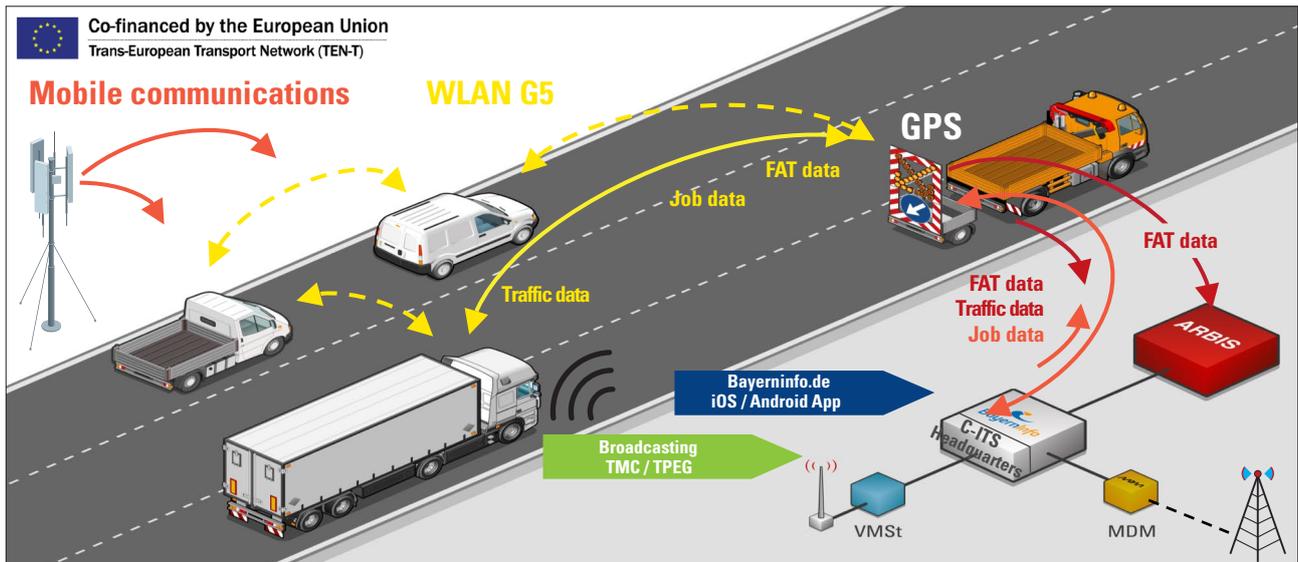
Despite these good starting conditions, automated and interconnected driving still has numerous other requirements for the equipment of the Digital Test Field on the A 9 motorway. Precisely specifying this is the task of a working group founded in 2015, to which representatives of the Bavarian Road Construction Administration, the Federal Ministry of Transport and Digital Infrastructure (BMVI) and the VDA have joined forces. Thus, additional redundant fixed points – so-called landmarks – were defined to support the lateral guidance, which can be easily recognised by the on-board sensors of automated vehicles. For this purpose, signs are placed to the left and right of the roadway for which a special design coordinated with the road traffic authorities has been designed. Located at a distance of about 2.5 kilometres and in each case a few hundred metres before the exits, they facilitate an exact lane assignment, especially in multi-lane sections or at junctions. Additionally, additional

conventional reflectors on bollards or guards may improve lane demarcation.

In addition, it uses existing lane markings for the longitudinal guidance and transverse positioning in automated and interconnected driving. This proves to be sufficient if it complies with current labelling regulations and is renewed at regular intervals.

In order to limit the outlay, the additional signs are initially only fitted on one subsection of the A 9 – south and north of the motorway junction Holledau. The choice of this part of the route was mostly down to the fact that it is a traffic-sensitive feeder section into a junction (of the motorway interchange Holledau). In addition, a high-precision digital reference map was created. Thanks to this – by means of mobile laser scanning – the 25 or 35-kilometre long road sections from Greding to Kösching (motorway directorate for Northern Bavaria) as well as between Langenbruck and Allershausen (motorway directorate for Southern Bavaria) are recorded in three-dimensional format and with centimetre-precision (+/- 2 centimetres).

≡ Car2X communication for mobile shut-off board (FAT) for construction site warning

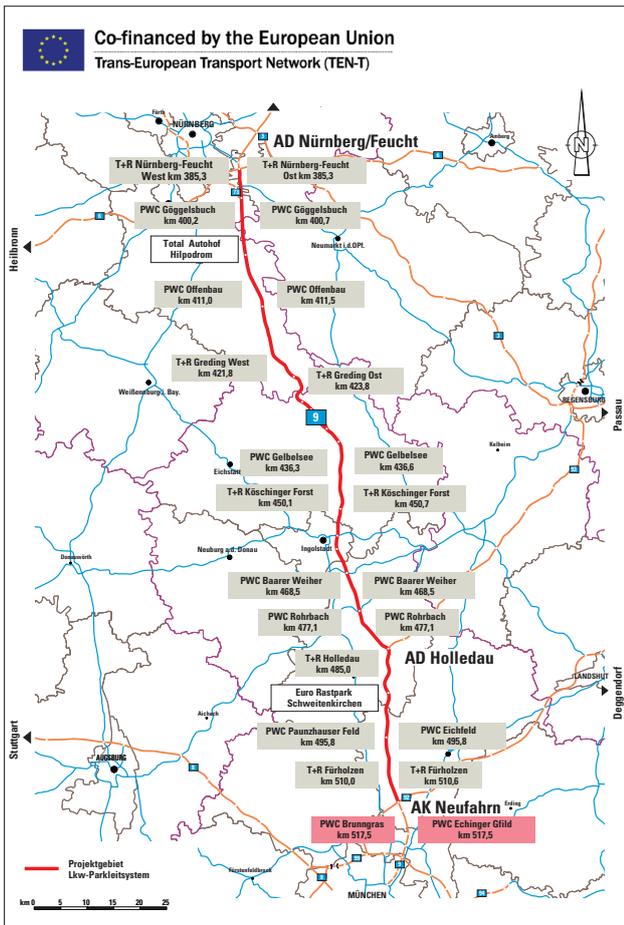


Maps, signs, sensors and more – a smooth and regular exchange of data between vehicles and infrastructure, for example, via roadside units (RSU), is required for secure automated and interconnected driving. The purpose of this communication function is to provide Dedicated Short Range Communication (DSRC) networks based on the G5 WiFi standard, which has been optimised for data exchange over short distances, as well as seamless high-speed mobile communications, which in turn ensure fast data transmission over long distances. The Car2X communication created in this way (X refers to both "Car" and "Infrastructure") will then provide the vehicles with real-time additional sources of information – be it in traffic jams, accidents, construction sites, aquaplaning, other vehicle speeds, current traffic control displays or much more, thus expanding the "view ahead and behind" considerably. The RSU radio systems, which are to be introduced throughout Germany and beyond Europe by 2020, were developed within C-ITS: a BMVI-coordinated corridor project between the Netherlands, Germany and Austria which is dedicated to the development of intelligent traffic systems and services on motorways.

The road operator has the following types of information that are important for automated and interconnected driving:

- Detector data
- Dynamically displayed speed limit in route control systems (SBA)
- Temporary opening of the hard shoulder (TSF)
- Dynamic Signalling from Network Control Systems (NBA)
- Construction site information
- Hazardous areas

The focus here is on dynamic information – for example, temporarily defined speed limits – that could be displayed directly in the vehicle display in the future. Advantage: the number of signs could be significantly reduced in the long term.



Overview map of the truck parking guidance system

Of course, automated and interconnected vehicles should find their way from A to B independently in subsequent operation, in other words, the (cost) scope for additional structural changes as support for the self-navigation of vehicles will remain manageable. The situation is different with the digital networking of the systems. Here, it is necessary to develop corresponding standards for data exchange and Car2X communication that cover data protection and other IT-related security issues.

The fact is: automated and interconnected vehicles are gradually becoming part of our road traffic; but it will still take a while until fully autonomous vehicles, which do not need a driver, are on our motorways especially as many questions about automated and interconnected driving are still yet to be answered. In the medium term, for example, existing regulations have to be adapted or even created. The first milestone on this long journey was set by politics in 2017 by amending the Road Traffic Act, according to which people and computers are now legally on equal terms.

Space for the big ones: new truck parking guidance and information systems

Parking spaces for trucks have been in short supply on German motorways for many years. There is an urgent need for action here as truck traffic will continue to increase according to current forecasts. In addition to the construction of new parking spaces, the solution lies in making the best possible use of the existing stock; only in this way can we effectively avoid overcrowding, traffic looking for parking spaces, exceeding the driving times and unused parking spaces. This is where interconnected lorry parking guidance or information systems come into play. The provision of the information they need is therefore listed as a priority action in the European Commission's ITS Directive 2010/40/EU.

Against this backdrop, the planning and construction of the A 9 interconnected lorry parking guidance system began in July 2013 and therefore before the announcement of the Digital Test Field. In May 2015, the first 14 service stations between Nuremberg and Munich went into operation. The parking space can be determined by means of a balancing method that records the vehicles entering and leaving each



➤ A 3 truck compact parking

parking space. This information can then be accessed via www.bayerninfo.de or special smartphone apps. In addition, they will be offered to third-party users via the mobility data marketplace and will in future be available as a Transport Protocol Experts Group (TPEG) service. Completion of the overall system on the A 9 – the first of its kind in Germany – is scheduled for 2019. In addition to the 21 plants already approved, the two PWC plants Brunngras and Echinger Gfild will also be integrated into the parking guidance system.

In addition, there are two more pilot projects outside of the A 9 with "compact parking" and "convoy parking", which create additional parking spaces through intelligent parking space compression. Here, the respective algorithm calculates an optimised parking sequence according to departure times, which allows the space required for parking to be compressed. While the compact parking project (www.kompaktparken.de), which is located on the A3 (Jura West rest stop), is already in operation, regular operations for convoy parking on the A 93 (Inntal West rest stop) begin at the end of 2018.

We are going the right way: warning systems for people who are not

Another aspect of infrastructure measures is the prevention of accidents caused by drivers going the wrong way down motorways and dual carriageways. Already at the end of 2014, three warning systems designed to send an alert when precisely this is the case were set up on the A 9 at the Eching and Garching North and South junctions. Their testing for the so-called level 1 – i.e. the detection and warning of the driver heading the wrong way – was concluded in 2017. According to the previous evaluations, the systems recognise events where drivers go the wrong way specifically at night with closed junctions. For level 2 (warning of other road users), however, a further increase in detection reliability is required, since false alarms can occur in special situations in the detection area – for example, when vehicles roll back down the ramp in traffic or stationary broken-down cars. Here, the BMVI and the Federal Highway Research Institute are in close contact with manufacturers in order to discuss targeted improvement measures.

≡ A 9 wrong-way driver warning system



⤴ BAG inspection office near Sophienberg

Control is good, safety is better: electronic channelling at truck controls

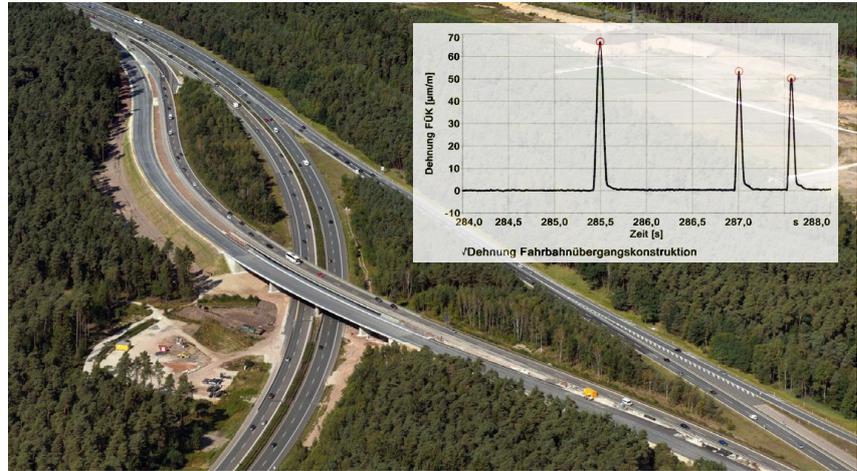
The automated channelling of truck traffic during stationary checks by the Federal Office for Freight Transport (BAG) to PWC systems also brings a clear plus in safety. Within the scope of the pilot project "Safe channelling at BAG stationary checks", the motorway directorate for northern Bavaria carried out the detailed design, tendering and awarding as well as the support for all technical and organisational questions. The system was completed and put into operation at the PWC plant Sophienberg on the A 9 in September 2017 as the first of its kind by a total of five control points in Germany. It is based on an ANPR system (automatic number plate recognition by cameras). Within this context, the development of new visualisation, operation and control software was required in coordination with the BAG. Now the lorries can be routed "at the click of a mouse" without a police officer having to enter the motorway. Both the safety of the control personnel and the efficiency of the channelling can be significantly increased in this way.

Always up to date: recording of traffic situations and incidents

Furthermore, the traffic situation recording and incident detection in the entire test field are to be optimised. Even though the Federal Motorway A 9 already has numerous systems for traffic situation detection within the traffic control systems, there is still a need for action, for example, to detect dangerous accidents such as traffic jams even better. Basically, a distinction is made between three different route categories on the test field, for which the local traffic data recording in combination with route-based travel time determination should be implemented in the best possible way:

- › Sections in agglomerations with existing traffic data recording
- › Sections in agglomerations without existing traffic data recording
- › Sections outside metropolitan areas

» A 9 Smart bridge



For this purpose, the A 9 is equipped with local traffic detection sensors and laterally arranged Bluetooth scanners. The latter record Bluetooth addresses of activated devices in passing vehicles, such as hands-free systems and smartphones, by means of which travel time between two detection sections can be determined. By combining the two technologies, travel times over a stretch of road can be measured more accurately than with classic sensors. So that a reliable determination of the travel times from individual vehicles can also be guaranteed in off-peak hours, for example, at night, and a visual verification of the traffic measurements is possible, one additionally uses camera-based license plate recognition. Of course, all of these individual entries are protected in terms of data protection law. The findings gained on the A 9 should in future be transferable to other BAB routes and improve the traffic situation and incident detection in the future. In addition, the traffic information can be used for accurate incident detection in the testing of automated and interconnected driving. Results will be available during 2019.

How are we today? Intelligent bridges with sensor-supported construction maintenance

In October 2016, Germany's first so-called intelligent bridge with sensor-assisted building maintenance went into operation at the Nuremberg interchange. It is equipped with intelligent sensors and evaluation algorithms that

allow a reliable condition assessment. Thus, in addition to expansions, displacements and inclinations in the structure, the sensors can also register temperature, humidity and current payload of the traffic on the bridge. From the data, experts can use new computational algorithms to draw conclusions about the current state and the remaining functionality. In this way, it should be prevented that damage is recognised only during the regular construction inspections.

Beautiful (and sustainable) fuelling: the filling and service station at Fürholzen West

Electricity charging stations, hydrogen and natural gas tank options, an intelligent energy concept and much more besides – you have been able to see for yourself what the filling and service station of the future looks like ever since 22 September 2017. On this date, the innovative Fürholzen West facility was put into operation. The overarching goal of this future concept is the fulfilment of the Energy Plus standard. In this way, for example, the operation of the facility by the intelligent use of electricity, which is mainly obtained from locally installed photovoltaic systems, is facilitated.



Traffic management directly in the car: the virtual traffic control system

The collective, official signalisation takes over the role of road operator on the basis of traffic data and information to benefit the entire collective of vehicles in the road network. However, the routing suggestions of the navigation systems often deviate from the route specified by the road operator. Since there is still no harmonisation of state traffic management and commercial navigation systems, there are always contradictory route recommendations, meaning the compliance rates of the official routing are reduced, producing congestion elsewhere. In order to avoid the discrepancy between navigation systems and the collective routing on the road, the data of the changing direction signs on the digital

test field A 9 has been provided to the automotive industry since 2017. At the same time, the current readings on variable traffic signs (speed restrictions, overtaking bans, traffic jam warnings) are transmitted to the vehicle's display.

In the case of changing direction signs, it can be assumed that the compliance rates will increase as a result of these also being integrated into the navigation systems. By "mirroring" speed limits, overtaking bans etc. in the

navigation or driver assistance systems, a much better compliance can likewise be expected, which in turn increases road safety. This data is also important for automated driving, since the vehicles can then automatically adopt the traffic regulations.

Park & Surf: Wi-Fi in PWC parking spaces

Of course, the expansion of high-speed Internet access is also on the agenda to ensure that the Digital Test Field fully lives up to its name – especially as car and truck drivers have been cut off from free Internet supply during their sometimes long journeys. A first step here is the equipping of initially six PWC parking spaces with WiFi, which can be used free-of-charge by road users during rest periods. The provided bandwidth should be 50 Mbit/s.

Platooning, 5G and Co.: further projects out on the A 9 Digital Test Field

In addition, numerous measures are planned or being implemented on the A 9 Digital Test Field, some of which are being driven forward by the industry. These include the following projects:



➤ A 9 filling and service station facility of the future: Fürholzen West

- › Improving LTE's 5G wireless technology standard for faster data transfer, for example, for Car2X communications
- › The platooning or the so-called electronic drawbar. Under Platooning, one understands a system for road traffic, in which several or even many vehicles can drive with the help of modern technology at a very small distance behind each other, without affecting traffic safety
- › Use of existing emergency pillar infrastructure for Car2X communication
- › A traffic-adapted, telematically controlled guidance in front of and in construction sites
- › The testing of cooperative radar sensors for nationwide detection of traffic flow, obstacles and traffic jams
- › The video-based use of fast telecommunications technologies for the development of a "real digital twin" as a preview of the upcoming road section

Other test fields

In addition to the A 9, additional nationwide test fields have been planned or are already in place since 2015, some of them cross-border, but especially inner-city test fields. They all focus on testing automated and connected driving functions and their effects on traffic and the environment, but have different objectives in detail. Some of the projects are financially supported by the BMVI.

INFORMATION IS EVERYTHING

The road information system BAYSIS

"Knowledge means knowing where to look."

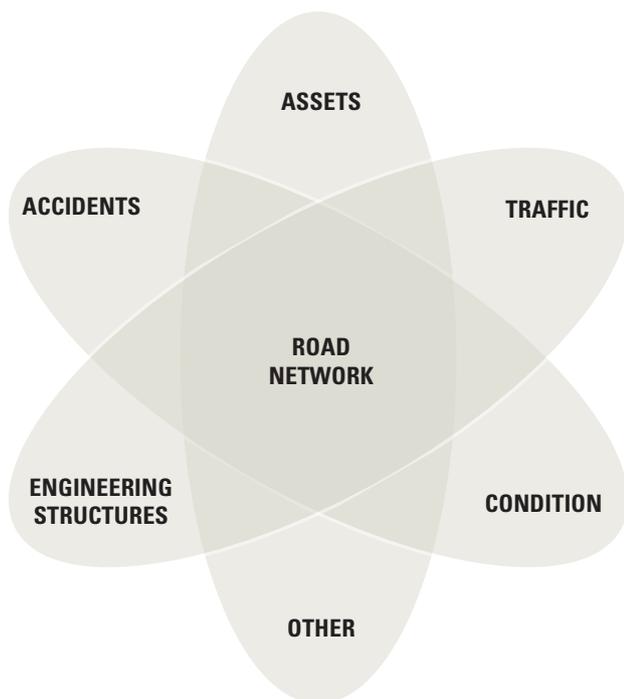
Albert Einstein



Author **Georg Ertl**

Any decision should be made on the basis of reliable information. This principle not only applies since the age of digitalisation. However, with the rapid spread of digital technologies, the nature of information has also changed radically: it has become an independent, valuable resource in the 21st century. Whether or not an organisation succeeds depends therefore particularly on its ability to handle this resource and, for example, to retrieve the content that is currently needed from the flood of information. A challenge that is also faced by the Bavarian State Building Administration; after all, their manifold tasks in the areas of





↗ Specialised content in BAYSIS

planning, construction, operation and traffic are based to a large extent on relevant technical information. But the need is far from just the administration itself; citizens, private companies and research institutes are also increasingly demanding reliable sources of information today.

Intelligently linked

This is exactly where the Bavarian road information system BAYSIS comes in. With it, the Bavarian State Building Administration provides a central platform that makes technical information available on the supra-local road network of the Free State – both inside and outside the administration. The central element of the system is the illustration of the road network: federal motorways and federal, state and county roads are shown in their precise geometric course with the exact lengths and kept up-to-date. All further technical information is connected to this visualisation; stationary signs provide the necessary precision, with the words "road", "section" and "station" clearly describing every location on a road.

A particular advantage of BAYSIS lies in the linking of information from a wide range of topics. For example, for the roads in the administration of the Free State, existing road data (for example, road cross-sections), structures (for example, load-bearing capacity), expansion programmes (e.g. demand planning), conservation (for example, condition recording) and traffic (for example, road traffic counting) and traffic safety (for example, accident clusters) are all provided. This data is modelled according to the specifications of the national instruction Road Information Bank (ASB), where it can be passed on to third parties via the Object Catalogue for Roads and Transportation (OKSTRA) and according to the specifications of the EU Spatial Data Infrastructure Directive (INSPIRE). Extensive explanations of the technical meaning of the content can be

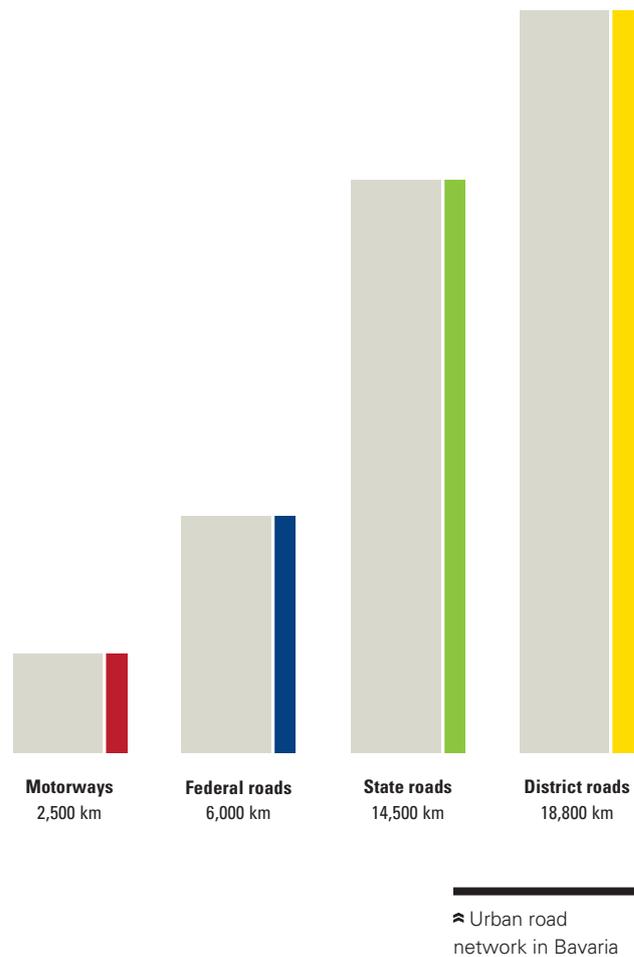
"BAYSIS facilitates our scientific work with its geo-referenced data, which is available in the same format for all of Bavaria."

Dr. Ralf Berger, Technical University Dresden

found in BAYSISwiki, an online encyclopaedia in the form of Wikipedia.

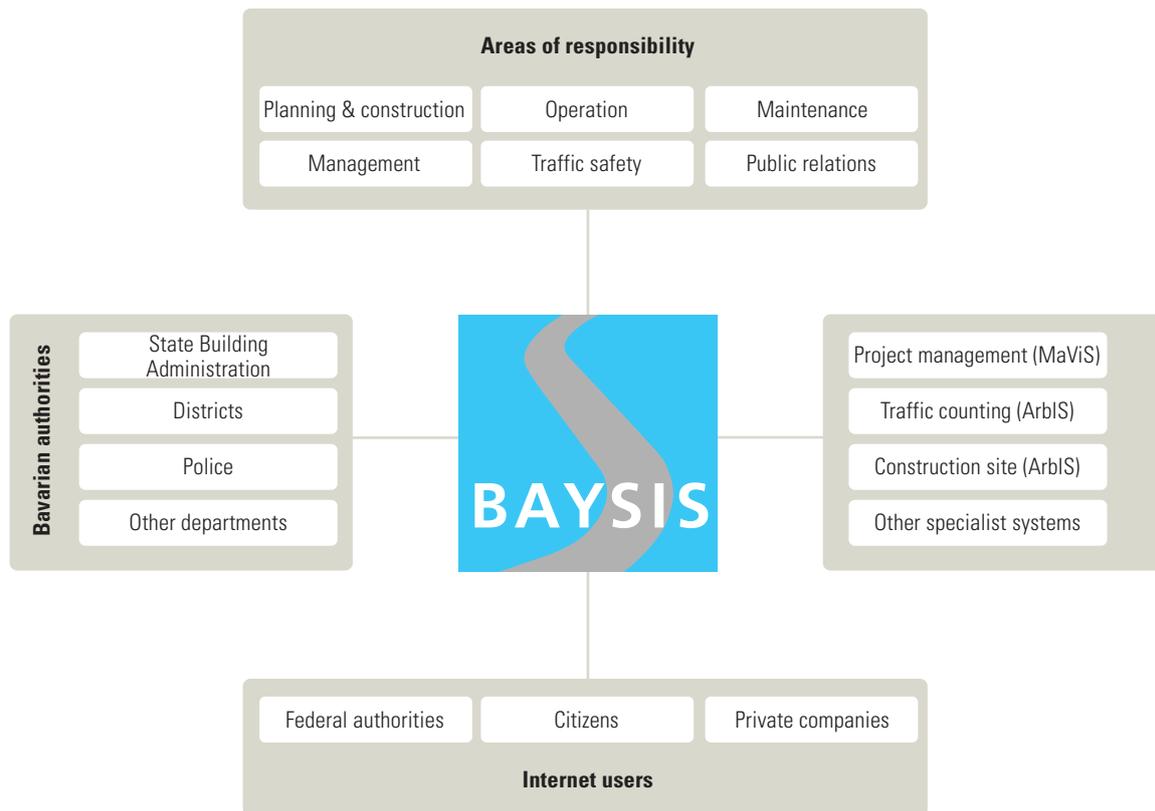
Information with system: what is behind BAYSIS?

The responsible authority behind BAYSIS is the Bavarian State Ministry for Housing, Construction and Transport. The provision, maintenance and further development of the system is carried out by the Central Office for Information Systems (ZIS). Special importance is attached to the BAYSIS caretakers at the two motorway directorates and the 19 state building authorities: they take care of the ongoing maintenance of the technical data for their respective areas of responsibility and thus ensure not only high information quality but also topicality. Bavarian districts also have the opportunity to feed their data into the system. For this purpose, changes to the road network are reported to the ZIS which maintains the network data throughout Bavaria. The provision and support in the field of accident analysis is again carried out by the Central Office for Road Safety in Road Construction (ZVS) in cooperation with the police. The results of the road traffic counting and condition recording are taken from these nationwide procedures. From a technical point of view, BAYSIS is based on various specialist databases, programme modules and geoinformation system components (GIS components). Their complex interaction runs completely in the background, meaning the user finds a uniform interface in which all information converges and is prepared accordingly.



Focusing on what matters – with the BAYSIS map window

Since all road information has a geographical reference, the main focus of BAYSIS is on the cartographic visualisation.



^ Use of BAYSIS

Here, the BAYSIS map window shows its strengths, a modern, web-based and interactive geographic information system (WebGIS). It provides the user with a cartographic representation of the road network and a variety of technical information. Thanks to extensive functionalities, the user can carry out cross-topic queries and visualisations in a freely chosen spatial context: for example, content organised into levels can be combined flexibly, in-depth information can be retrieved, or new map printouts can be easily created. In addition, the user has the option of integrating specialist content, which is provided by other departments as services, for example.

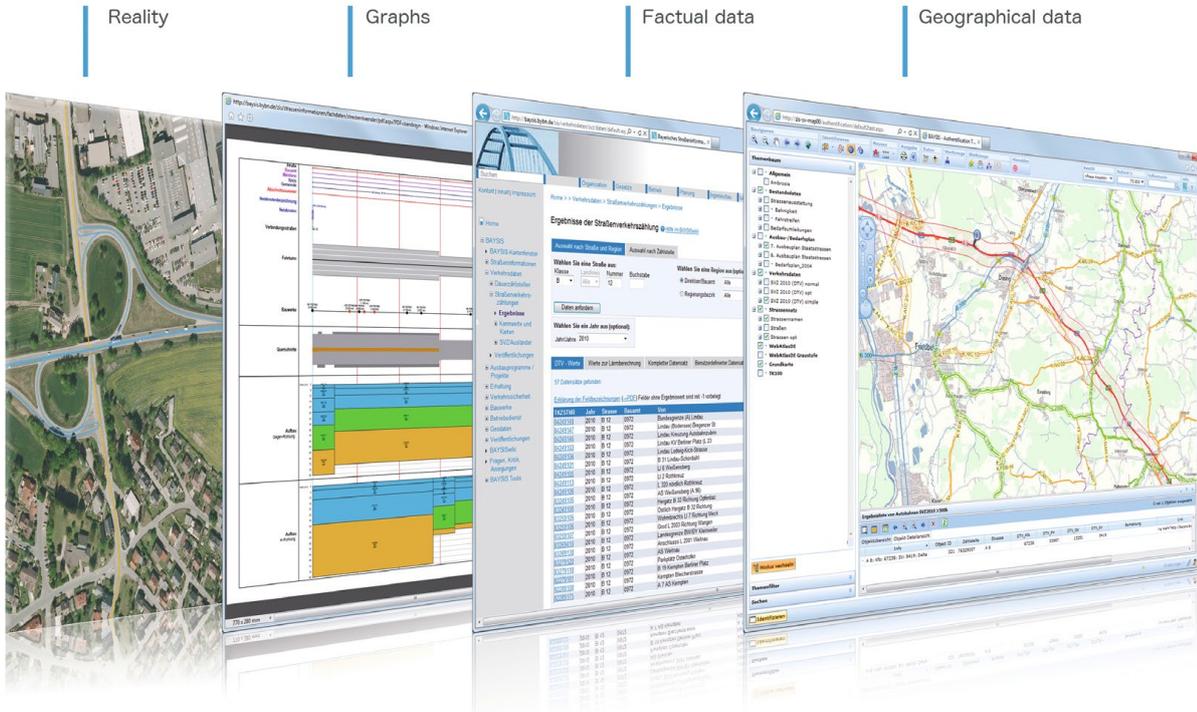
A tool for (almost) all cases

The fact is: without BAYSIS, the Bavarian State Building Administration could no longer process many of its tasks to the necessary extent. The system has become an

indispensable tool in recent years, for example, in the area of maintenance management, the evaluation of accident figures or in public relations. From an organisational point of view, the system also offers clear added value: for example, thanks to BAYSIS, data entry only needs to be done in one place, which considerably simplifies business processes within the administration. Numerous specialist procedures now have a BAYSIS interface, including the MaViS project control system, the Workplace Integration System (ArbIS), traffic counting (SVZ), various winter services, geo-risks and tree control systems, as well as the approval of large-capacity and heavy-lift transport in the future. They all access their individually required data from the platform and, in turn, make specific specialist information available again on BAYSIS. In addition, other Bavarian specialist departments – for example, the State Office for the Environment or authorities or the police – and numerous districts intensively use the possibilities offered on the intranet at <https://baysis.bayern.de>. Federal

"The data from BAYSIS forms an essential basis for the calculation of noise pollution on major roads within the framework of the EC Environmental Noise Directive."

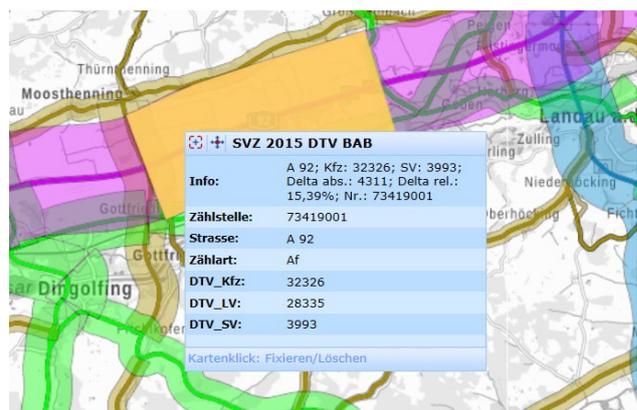
Traffic data in the BAYSIS map window



↗ Data views in BAYSIS

↘ Traffic data in the BAYSIS map window

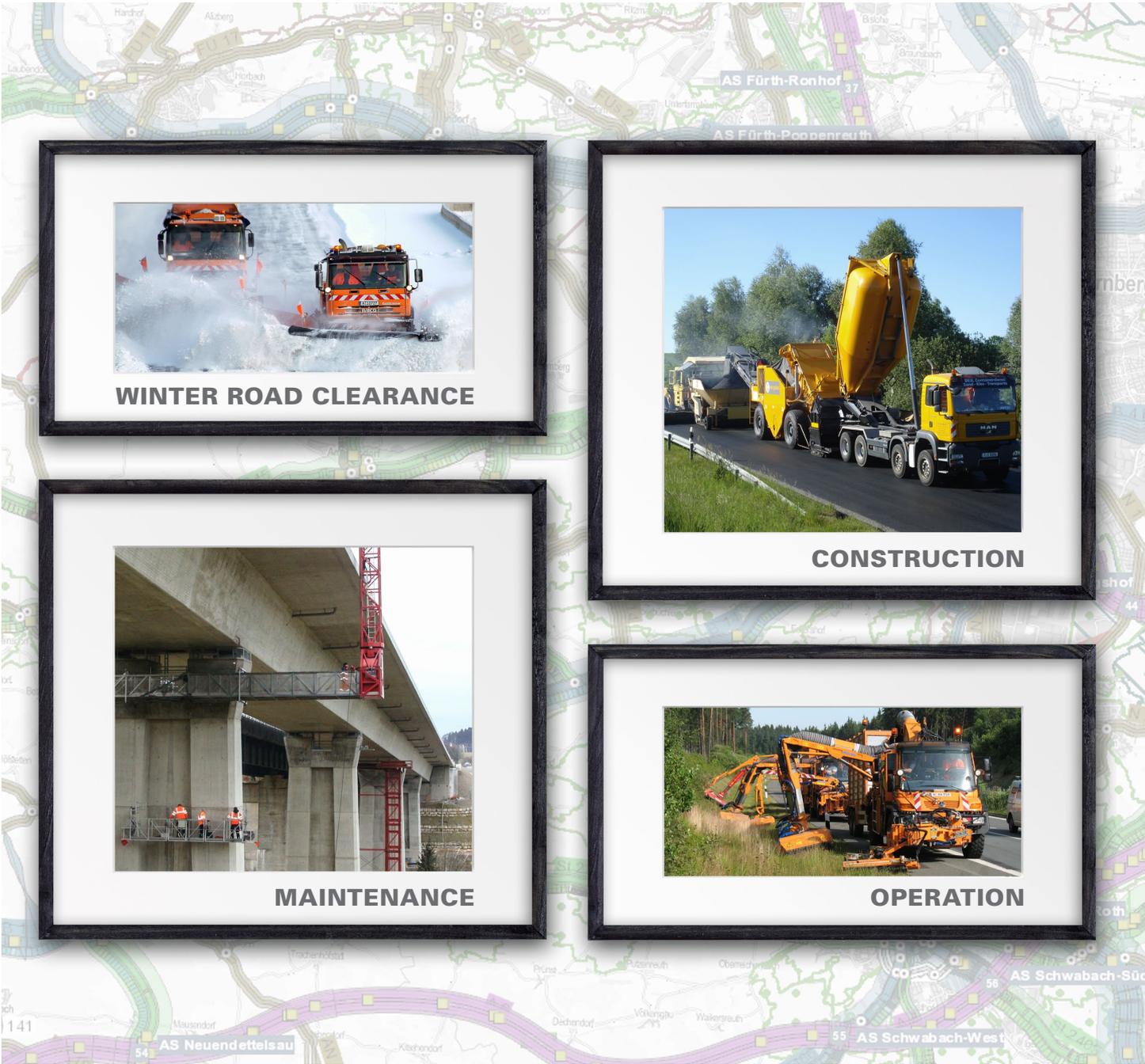
authorities, research institutions, private companies as well as citizens are given free access to the data on offer at www.baysis.bayern.de. In addition to static documents, thematic maps and graphics, a large part of the information is created in the form of dynamic online queries, each of which uses the current database. BAYSIS has also been designed to integrate certain information directly into external third-party systems. A special feature is the stock images stored in the system, which are created every four years during the condition tracking process. They reflect the specific situation on the ground and can thus contribute, among other things, towards the reduction of on-site appointments.



ALWAYS IN THE PICTURE

Plan and build with modern geoinformation systems

Areas of application of geodata in road construction administration



WINTER ROAD CLEARANCE



CONSTRUCTION



MAINTENANCE



OPERATION

Author **Stefan Schnitzhofer**

W

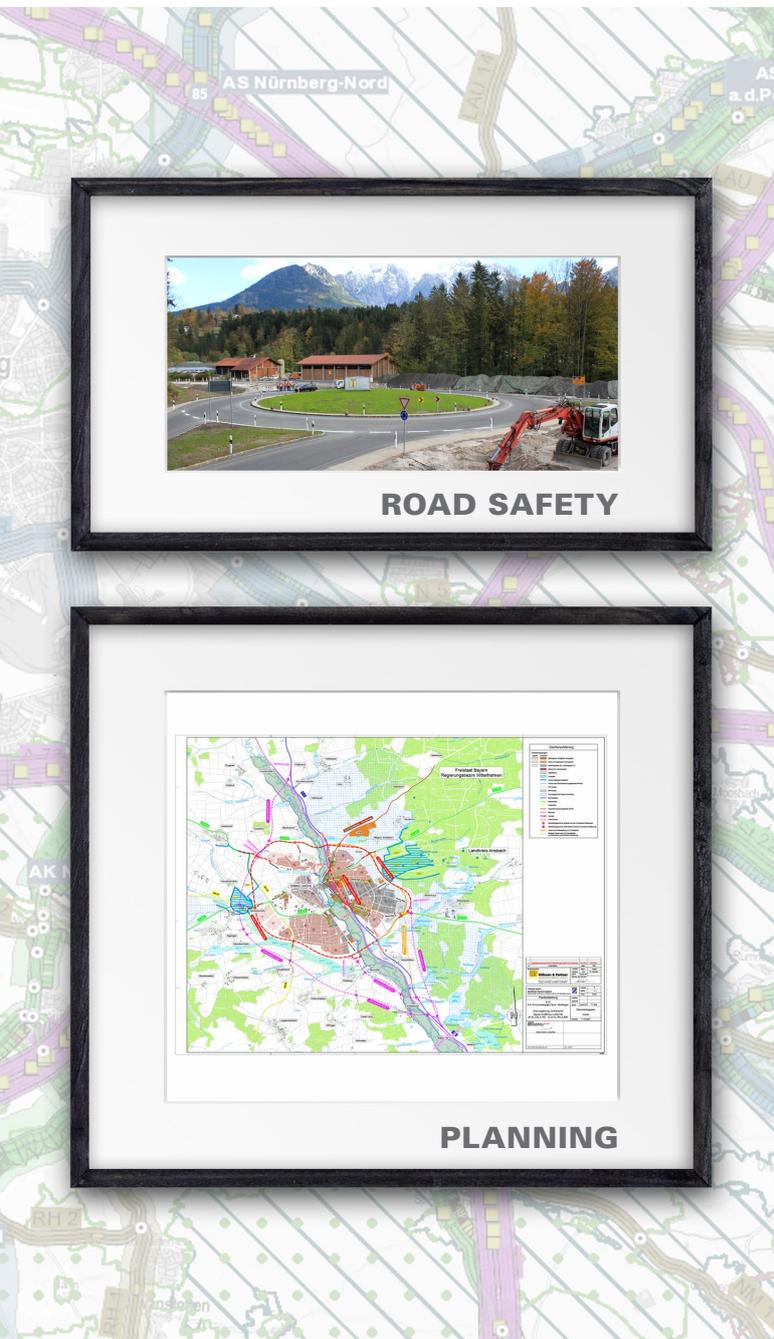
What environmental aspects should be considered when planning a new bypass? How can accident blackspots be effectively made safer? On which roads will the approaching cold front lead to snowfall and dangerous black ice in the next few hours? Which sections and structures need to be renovated most urgently? On which routes should protective measures against rockfall be taken?

Questions such as these reflect the broad range of tasks that the Bavarian Road Construction Administration can offer, from planning and construction through operation and control to the preservation and refurbishment of its network. Together with numerous other network measures, these activities make a decisive contribution to the overriding main goal of the Bavarian State Development Policy to create and secure equivalent living and working conditions in all parts of the Free State.

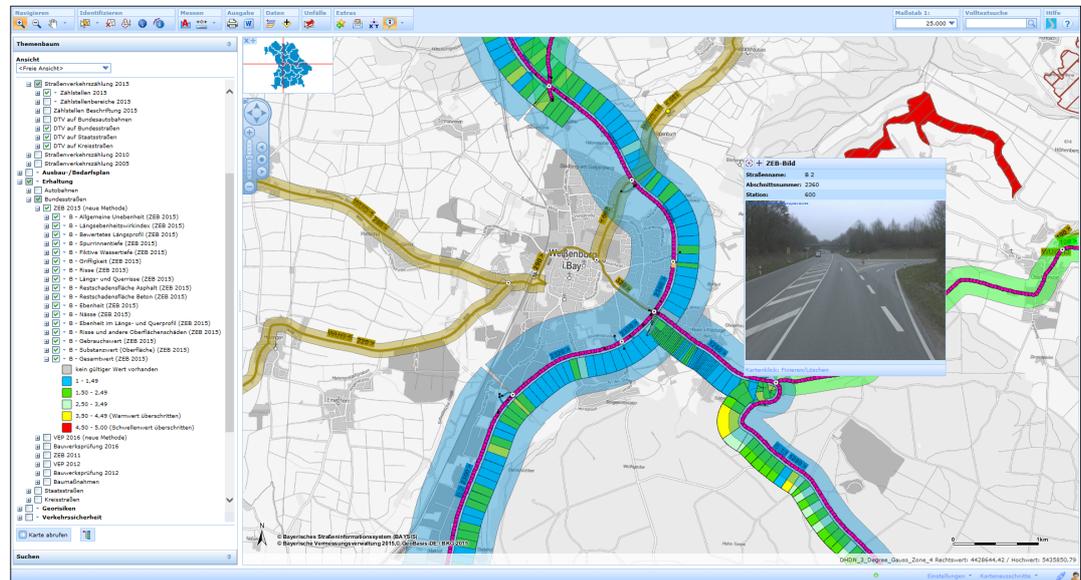
Powerful and established

Anyone who has to meet such challenging and multi-faceted requirements needs, in addition to appropriate specialist expertise, first and foremost powerful tools and a high-quality database. In the latter case, several areas are relevant: on the one hand, information about the road infrastructure plays an important role, i.e. data on the course, structure and cross-section of a road, its equipment, condition or existing structures. On the other hand, it requires detailed information about the traffic and the road users who use this network. Here, for example, average traffic volumes, the current traffic situation or information on accidents are in focus. It is also important to consider ecological, geological, economic and political circumstances. The key here is therefore the meaningful combination of spatial information – so-called geographic information – or derived data (geodata) from different disciplines.

In addition to the obligatory CAD applications for the fulfilment of planning tasks, the Bavarian Road Construction Administration in the area of existing documentation, demand planning and prognosis since the mid-1990s



» WebGIS application BAYSIS map window



increasingly focused on geographic information systems (GIS). They allow the integration as well as the targeted analysis of a wide range of geospatial data, and not just for experts. While these can create complex evaluations using powerful GIS desktop applications, easy-to-use Web GIS applications enable a broad user base to access extensive technical information. For example, the map window of the Bavarian Road Information System (BAYSIS) has become an indispensable tool for the employees of the Bavarian Road Construction Administration. Using this powerful tool, users can create geographic visualisations of the road network, integrating a wide range of road-related expertise, from conservation and demand planning to traffic volume and safety information to geo-referenced data. This information can in turn be overlaid with geobasis data from the Bavarian Surveying Administration as well as with specialist content from other ministries – for example, the environment, historic preservation, geology and regional planning. Furthermore, BAYSIS offers the possibility of exporting

or retrieving the information obtained in various ways, for example, as a PDF or Excel documents and permalinks.

Through the consistently implemented dynamic interaction with the BAYSIS websites, it is also possible in many places to switch between alphanumeric or tabular and cartographic representation modes.

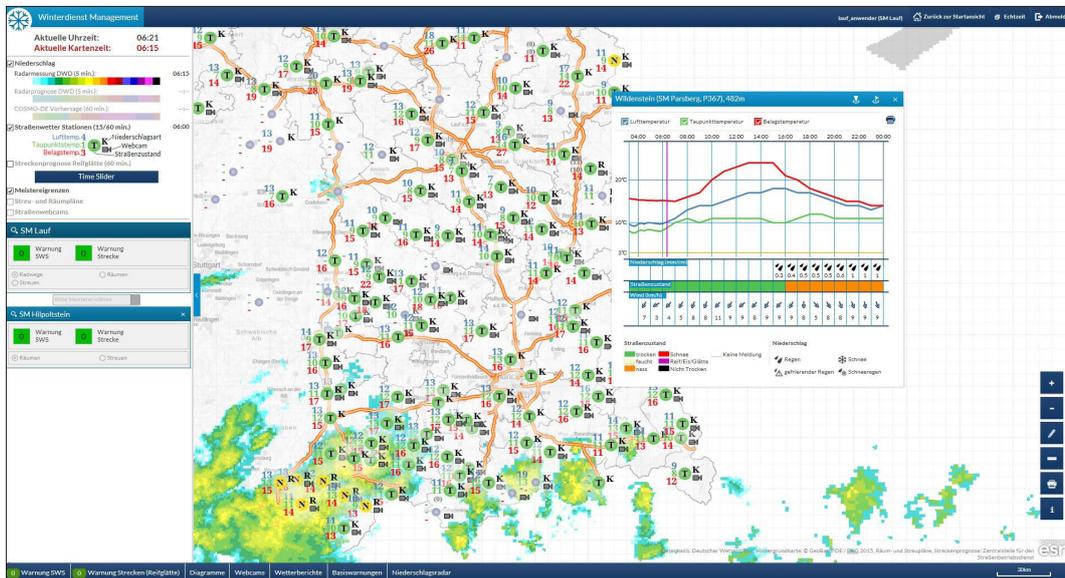
More and more users are using more and more data

Digitalisation is omnipresent in our modern society but it means much more than a mere transformation of analogue information into digital data. Rather, the core issue is to redesign and intelligently interconnect existing work processes through appropriate information and communication technologies and service-oriented architectures (SOA).

Netz
Bestand

Betrieb
Zustand
Bauwerke
Unfälle
Programme
Erhaltung
Verkehr

Working with geodata is also undergoing a fundamental change here. Its storage and administration has already changed massively in recent years. For a long time, geodata was mostly file-based but today relational database systems are still widely used for (geo-)data storage. In the age of "Big Data", approaches such as Hadoop or NoSQL have to absorb the rapidly growing data volumes and provide them with high-performance accessibility.



« WDM-BY uses BAYSIS web services

Whether at the expert workstation, in the web application or on the mobile terminal out in the field: the required (geo-) information must be up-to-date and of high quality at any time from any location. In modern, distributed applications, this is now only reasonably possible in many areas only on the basis of geodata services (web services), which also make the problem of redundant data management largely avoidable. However, in the sense of a service-oriented architecture, the use of (web-based) services is not limited to the mere provision of data.

For example, it is also important to make process logic or entire application components available to other applications. The overarching goal is always interoperability, that is: the combinability and interaction of data, processes or system components.

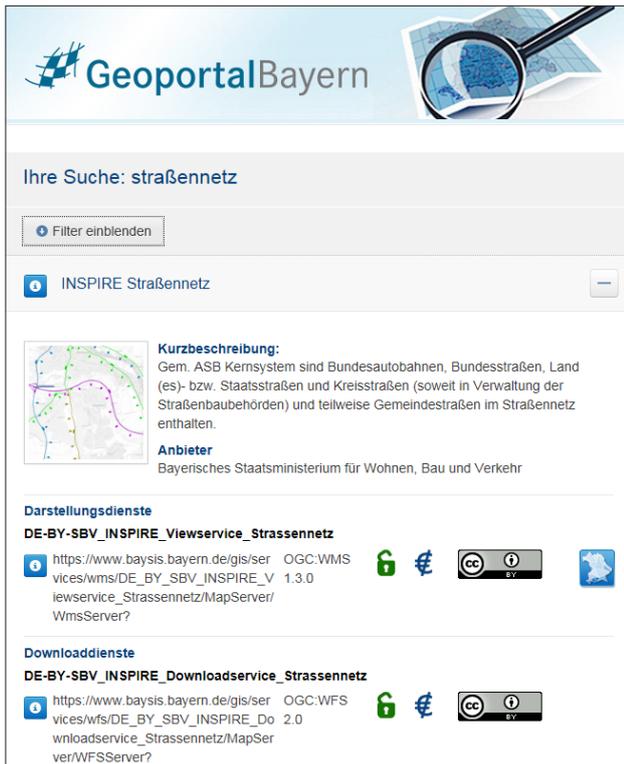
By using modern, integrated GIS technologies and solutions, the Bavarian Road Construction Administration takes these challenges into account. The BAYSIS geodata organised in databases, as well as road-related functionalities, for example, are provided via different, standardised types of service (presentation, download and geo-processing services) within the BAYSIS GIS components, but also distributed to other specialised procedures or third parties.

This is how for instance the construction site integration system (ArbIS), the technical procedure tree inspection or

the Bavarian winter maintenance management (WDM-BY) services all use the webservices from BAYSIS. Likewise, the integration of geospatial reference data or specialist information from other specialist procedures or departments is also purely service-based, for example in the BAYSIS map window. This enables a significantly improved linking and further processing of the data – and the users are able to precisely access the information that is needed for their individual tasks. For road construction management, this provides a dense and continuous picture of the conditions of the network, the traffic and other conditions on site (such as the current weather conditions) – and as a consequence – also leads to a better knowledge of whether, when and where disruptions requiring intervention will occur.

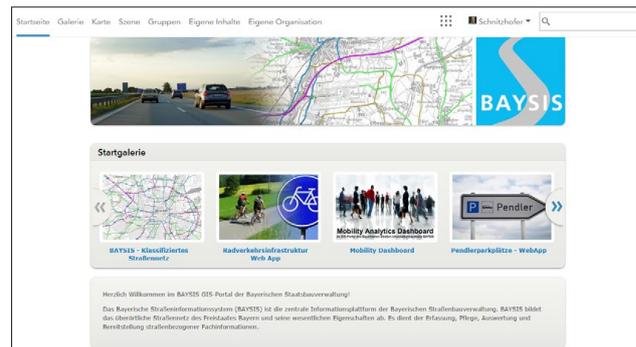
Cross-border and barrier-free – the spatial data infrastructure after INSPIRE

In addition to the mere availability of geodata or geodata services, their findability and interoperability must also be guaranteed. Of correspondingly high relevance are therefore the development of central spatial data infrastructures (GDI) as well as the implementation and compliance with international standards. Within this context, the entry into force of "Directive 2007/2/EC of the European Parliament and of the Council dated 14 March 2007 establishing an Infrastructure for Spatial Information in the European



« BAYSIS road network in the GeoportalBayern
www.geoportal.bayern.de

» BAYSIS GIS portal



Community" (INSPIRE) plays a crucial role. Finally, its declared objective is, inter alia, to simplify the complex reporting obligations in the area of EU environmental monitoring and to make the cross-border use of geodata across Europe much easier. In short: geodata should be generally available, accessible, combinable and reusable. INSPIRE obliges the member states to provide all geospatial reference data and geo-specialised data affected by one of the 34 defined Annex subjects interoperably via web services. This not only includes a consistent description of the content using metadata but also its provision on the Internet based on search, presentation and download services. The specialist and technical requirements for implementation are laid out in the so-called Implementing Rules, which were formulated in accordance with international standards (DIN, ISO, OGC, W3C, etc.).

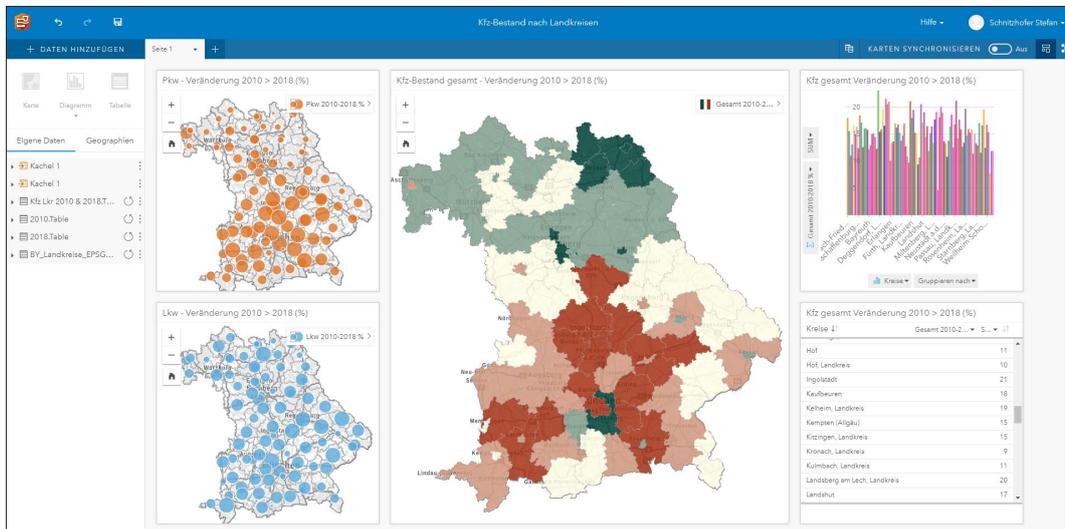
The Federal Republic is implementing these requirements in the individual federal states by creating central spatial data infrastructures. Geoportals that act as geodata search engines make it considerably easier for users to find and use the geodata registered there. The road authorities of the federal states are among others affected by the INSPIRE subject "Transport networks" in Annex I which is why the Bavarian Road Construction Administration not only offers a large amount of technical data via the GDI-Bavaria Geoportal but also a dataset on the classified road network including the INSPIRE- and OGC-compliant geodata services.

Although INSPIRE regulates the contextual and technical implementation and the provision of geodata and services, there are no specific requirements for access modalities or conditions of use. The acceptance of geodata, however, depends significantly on the provision of cost and barrier-free access in the sense of the concept of open data. Only in this way will it be possible to achieve the intended synergy effects and added value of a cross-application and cross-border data use. That is why the Bavarian Road Construction Administration publishes its INSPIRE services as well as most other geodata services under the currently most open Creative Commons license CC-BY 4.0, which in addition to free and uninhibited access also allows commercial re-use of the data.

GIS platforms – open to new ideas

For a long time, modern geoportals are no longer limited to the mere supply of geodata. Rather, they are evolving into centralised application platforms that provide non-GIS experts with rapid de-/centralised development and delivery of problem- or task-oriented mapping applications. In addition, there are special apps that enable statistical evaluations for specialist users, taking into account spatial differentiation and temporal developments; apart from that, the applications support the mobile data usage or data collection for field workers or local citizens, provide

Statistical evaluations with Insights for ArcGIS



dashboard views for decision-makers, and allow the interactive presentation of results for laymen.

These technologies can be used to implement highly modular GIS platforms that map all phases of the infrastructure life cycle. In addition to networking and the associated optimisation of process sequences, they allow a holistic view of existing framework conditions, whereby the solution-oriented benefits of the application are always in focus.

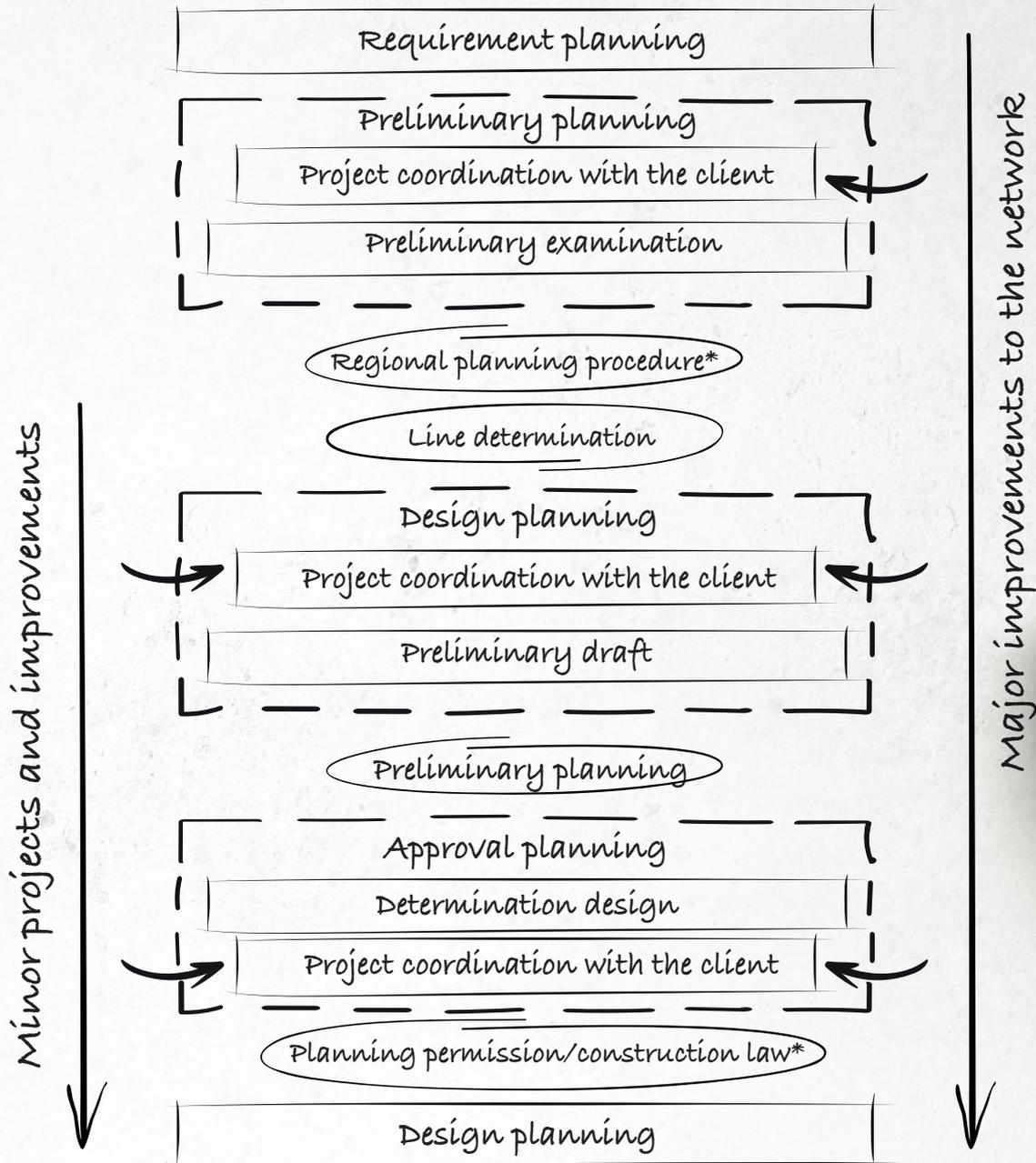
Currently, the establishment of the software-supported Building Information Management is being discussed as a future standard method of optimised planning, execution, management and the conversion of buildings or other structures. Against this background, new perspectives are opening up especially for road construction management. For example, the intelligent combination of GIS and BIM approaches could help make construction projects more efficient. Finally, the consistently digitalised planning and implementation-relevant processes and information could be mapped within the context of spatial reality – not to mention expected improvements in the areas of communication, cooperation and resource planning.

Both social and economic demands on mobility and traffic are currently undergoing massive changes. Accordingly, the requirements for a sustainable road infrastructure and the

range of tasks of modern road construction administrations are growing. The intelligent use of high-quality geodata and powerful geographic information systems will definitely play a crucial role in this process.

MAKE SWIFTER PROGRESS TOGETHER

Planning processes and planning acceleration



*with public participation

« The planning process according to RE 2012

Author **Christian Peetz**

Road planning has become a highly complex process in recent decades; on the one hand, this results from the steadily increasing legal and technical requirements and, on the other hand, from the rapid development of the possibilities in the IT sector. Clearly structured project preparation is now more important than ever.

The realisation of a road construction project requires a whole series of planning steps – from the determination of the demand to the ready-to-go implementation planning. These are uniformly regulated nationwide in accordance with the "Guidelines for Uniform Design of Design Documents and the Planning Process in Road Construction, 2012 Edition" (RE 2012).

Basically, the RE 2012

- › accelerate and streamline planning and approval processes
- › improve the readability and comprehensibility of drafting documents
- › increase planning efficiency and security, by establishing a unified communication and coordination process between the Federation and the states
- › and provide support for more in-depth public relations in the future.

A long way: the planning process according to RE 2012

From the determination of the requirement to the award-ready execution document: for the development of a road construction measure, various planning stages including the associated administrative procedures have to be run through. This is shown in the diagram on the left using a federal highway project as an example.

"Planning faster to build faster – with a modern and citizen-friendly planning law. We will drive forward digitalisation, simplify procedures and make environmental protection workable. In this way, we can use the record funds from the investment ramp-up even more efficiently."

Alexander Dobrindt, Federal Minister of Transport and Digital Infrastructure 2013 – 2017

The preliminary planning creates the basis for deciding which route or site variants of a road construction project should be pursued. Accordingly, it is important to identify and assess all traffic, economic and spatial aspects of line variants as well as their respective impact on the environment. For spatially significant planning, this investigation also forms the basis of a regional planning procedure. If necessary, the administrative procedure of the line determination according to §16 Bundesfernstraßengesetz (FSTRG) is connected. In the course of the line determination, the Federal Ministry of Transport and Digital Infrastructure (BMVI) stipulates the planned route for the new construction of federal highways as the basis for the design planning for the planning approval procedure. The line determination is a level-specific trade-off decision that takes into account the public interest involved in the project, including the environmental impact and the outcome of the regional planning procedure.

In the stage of the design planning, then, among other things, the position and height development of the favoured variant takes place. All relevant technical details of the traffic system are presented in the accuracy required for the test; the quality of the traffic flow, traffic safety as well as the economy are to be proven and evaluated according to relevant procedures. In addition, the second planning stage includes, besides the in-depth processing of environmental and nature conservation issues, a comprehensive presentation of the corresponding requirements. For this purpose, a landscape conservation plan (LBP) with a contribution towards conservation will be developed. Accompanying this, studies on drainage and emission control, where appropriate on Flora-Fauna-Habitat-compatibility tests (FFH compatibility tests) as well as in individual cases supplementary reports are on the agenda.

As part of the approval planning, the documents now available are supplemented by those documents that are required for the public assessment in the planning approval procedure: the result of this step is the so-called declaratory draft. In it, all relevant aspects are presented as detailed as the legal assessment requires. It is not only clear from the plan documents to what extent interventions into existing orders are required or by what measures these interventions are to be compensated where appropriate; likewise, it must be clear to all involved in what form or extent they are affected by the planning. Thus, the draft assessment forms the basis for the overall assessment of all public and private interests.

The approval planning is followed by the execution planning. During this phase, any conditions or regulations from the planning approval decision will be incorporated; furthermore, the development of the planning for construction readiness or the determination of position masses for the award documents takes place here. However, execution planning is no longer part of the RE planning process.

The discussions conducted during the planning process are formally assigned to the respective planning phases and documented. Finally, project-oriented federal state coordinations require a timely discussion of the planning criteria and costs of a measure as well as the definition of essential planning parameters. In order to make the coordination process as efficient as possible, a minimum number of project coordinations (PA) is planned within the procedure; in addition, meeting content is specified, which is to be logged in forms. All this helps to focus on central topics of discussion, to document agreements and to facilitate the control of the processing.



➤ Participation in community meetings

Public participation in the planning process

From the very beginning, public participation in the planning process has a high priority at the Bavarian Road Construction Administration; one is aware of the valuable contribution it can make towards better education, higher acceptance and good planning results. Nevertheless, many citizens do not feel sufficiently involved or often that they were involved too late in planning the construction of roads. This often leads to protests and resistance, although at all levels of traffic route planning, involvement is provided for by law.

For this reason, a broad public participation takes place for the first time in the phase of preliminary planning in the context of a regional planning procedure. In the subsequent planning approval procedure, all those affected in their rights will also have the opportunity to raise objections. In addition, since 2015, early involvement of the public outside the

formal procedural shareholdings has been possible, allowing interested parties to express their views before filing an application.

How the early public participation should formally take place is not uniformly regulated; there are various methods available for public participation. Which method is then specifically used depends on the particular planning case as well as the corresponding target groups. The following list is an example of some methods of public participation:

- Council meetings/town meeting
- Website
- Active press work
- Information on site
- Round tables with stakeholders



- › Planning workshop
- › Submission of comments
- › Steering procedure
- › Planning dialogue

- › national environmental tests
- › as well as European environmental law

The planning acceleration innovation forum

In July 2016, Federal Minister Alexander Dobrindt initiated the planning acceleration innovation forum. In it, high-ranking representatives of project owners and approval authorities, planners, construction executives and other experts worked out various reform proposals for infrastructure planning with the aim that the funds made available in the future can be fully retrieved and invested as promptly as possible into infrastructure.

The recommendations for action of the innovation forum concern the topics

- › optimisation of cooperation and knowledge transfer
- › efficient planning and approval procedures
- › jurisdiction and procedures
- › digitalisation of infrastructure planning

and form the basis for an intensive professional, legal and political discussion. Various proposals can be implemented by federal and state governments; others require extensive changes to national or European law. Where European or even international law is concerned, rapid success cannot be expected even though European environmental law plays a significant role in the lengthy planning and procedural processes. The Planning Acceleration innovation forum, however, had less of a focus on the regulations governing the planning approval procedure, especially since – including the desired increased public involvement – hardly any relevant room for acceleration is seen.

On 24 May 2017, the innovation forum finally presented its final report, which is intended as a "toolbox" with a wide range of recommendations for action. On the basis of this document, the BMVI has developed the planning acceleration strategy – a 12-point programme designed to contribute towards accelerating German planning and approval procedures. Specifically, it includes

- › integrated planning and approval processes
- › simplified approval procedures, in particular for replacement new buildings

« Ongoing project coordination in the RE process

"We're accelerating infrastructure construction. The goal is to eliminate bottlenecks and ensure no time is wasted! Our record funds should quickly flow into specific renovation, extension and new construction measures. The planning and approval procedures become simpler, more efficient, more transparent and faster. We want to avoid duplicate testing, reduce bureaucracy, strengthen transparency and digitalisation in citizen participation and complete the legal action more swiftly."

Federal Transport Minister Andreas Scheuer

- › preliminary approvals of preparatory construction measures
- › the commissioning of a project manager for the planning approval procedure
- › a stronger involvement of the German Bundestag in the routing
- › a reliable financing for rapid planning and implementation of rail projects
- › strengthening the partnerly collaboration
- › the digitalisation of citizen participation in the planning approval procedure
- › the extension of Building Information Modelling (BIM) to the plan approval procedure
- › the creation of a knowledge platform for environmental protection as well as the systematic registration of map and species data
- › the reintroduction of the preclusion and the assurance of legal certainty
- › as well as the current update of the species protection lists.

Scenic
integration of the
A 7 with central
reservation
greenery in the
Nesselwang –
Füssen section near
Eisenberg





A HEALTHY COEXISTENCE

Landscape care, nature and health protection in road construction

Authors **Amelie Gansmeier, Manfred Kinberger, Steffen Miethig**

Roads and bridges decisively shape the picture of our (cultural) landscape. In this awareness, the road construction administration pursues the claim to consider building culture concerns in its plans. After all, it is important to integrate the constructions carefully into the evolved environment so that they are perceived by the citizens not as foreign bodies but as a natural part of the landscape.

The guiding principle "preserving the cultural landscape" thus goes beyond purely technical-functional requirements to the road construction; additional facilities such as parking lots, rest or noise protection facilities, excavations, landfills and drainage facilities must also be an integral part of the design concept.



« Result of the planning competition for the Lange Berge filling and service station on the A 73 section Coburg – Suhl near Drossenhausen

» Green connection for local recreation and habitat inter-connection, Aubing tunnel, A 99 motorway Munich ring road

» Production-integrated compensation measures for radiations within the context of the A 71 section Mellrichstadt – Münnerstadt (B 19)



In addition, landscaping compensatory measures can make a valuable contribution to the successful integration of the "road construction" into the landscape. In this context, interdisciplinary planning competitions and design audits have proven themselves. In particular, in the case of complex remodelling and expansion projects such as the construction of filling and service stations or the expansion of old existing motorways, these instruments help to meet the requirements of maintaining a native cultural landscape at an early planning stage.

Various pilot projects resulting from this process are in turn exemplary for comparable projects and fill the guiding principle of "preserving the cultural landscape" with additional life.

Create balance: between compensation and cooperation

In principle, it is not possible to completely avoid the use of nature conservation areas or impairments of environmental protection goods such as soil and water in road construction projects. Nevertheless, environmental impact assessments offer the opportunity to minimise environmental impacts by identifying low-conflict corridors and lines. For the compensation of unavoidable impacts, however, there are various compensation and mitigation measures. So far, in connection with construction projects on the federal road and regional state road sectors, around 6,000 hectares of secondary biotope areas have been



created to date. They make a valuable contribution to the conservation of biodiversity by providing a habitat for native plants and animals. In addition, such measures support the integration of the "road construction" into the landscape and at the same time often form appealing attractions for nature-related recreation.

Concerning maintenance, even if many farmers look after these areas on behalf of the Road Construction Administration and benefit from the payments, the compensation of impacts often requires the additional use of agricultural land. A way around is the creation of so-called compensation pools which are maintained by the road construction administration on public areas. For example, the planned expansion of the A 8 between Rosenheim and Salzburg it was possible to secure around 90 hectares of land on the former military training ground Nussforf am Inn (Rosenheim district) as a compensation pool at an early planning stage.

Within this context, the testing of production-integrated compensation measures (PIK) should also be mentioned. Through a cooperation between agriculture and road

construction, the land ownership remains with the previous owner who at the same time carries out the necessary maintenance for the responsible authority of the project. On the one hand, this will further reduce the decrease of agricultural land through road construction projects; on the other hand, the PIKs serve the protection of many native animal and plant species which are now rarely seen or even severely endangered in the cultural landscape.

Destination diversity: interconnection of habitats, preservation of biodiversity

The Free State of Bavaria is committed to the preservation of biological diversity. This is reflected, among other things, in the implementation of international conventions (Convention on Biological Diversity (CBD) of the UN and the EU Biodiversity Strategy). Within this context, the Bavarian Biodiversity Strategy 2030 is obligator for the public authorities to a special degree, including the Road Construction Administration: it makes an important contribution to the preservation of biodiversity by attaching particular importance to the connection and rebuilding



📍 Green bridge
Rehauer Forst via
the A 93 between
Rehau-Süd and
Schönwald

of wildlife habitats during conversion and expansion of federal highways. Especially on older existing routes, which often show deficits on this point, one takes the opportunity to strengthen the functional connections between previously separated landscape components by optimising buildings or building green bridges. This benefits not only endangered species such as the lynx and wildcat. It also allows common species such as the local red deer, roe deer and wild boar, fox, badger and pine marten, to whom it provides a safe crossing of roads, to benefit from the reconnection of formerly separate sub-populations. Besides these facts, they ensure a functioning biotope interconnection thanks to the plant seeds and small animals transported in their fur, "on their backs" so to speak. So far, seven green bridges on federal highways have been realised in the Free State of Bavaria. Another four green bridges are under construction or are being planned in the course of current expansion projects. In addition, a total of 250 constructions on existing routes due to their dimensions and location in the field have a good suitability as animal crossing aids.

Since inter-habitat restoration measures can now be counted as compensation, they offer an additional opportunity to reduce the use of land from third parties and thus at the same time increase the acceptance of necessary measures for nature conservation and landscape management.

In addition to the species already mentioned, amphibians also rely heavily on interconnected habitats. Especially frogs, toads and newts, which change between water and land habitats in the course of the year, are seriously endangered by road traffic. To offer them sustainable protection, a lighthouse project of the Bavarian State Building Administration has set itself this target: the voluntary Amphibian Protection Programme for the Implementation of the Biodiversity Programme Bavaria 2030. For this purpose, together with the Bavarian Ministry for the Environment and the Federation of Nature Conservation in Bavaria e. V., a comprehensive protection concept is being established for the 39 most important amphibious crossings over federal and state roads. On this basis, finally, the construction of amphibian tunnels and

control systems took place, for which the road construction authority provided a total of 11.9 million euros from 2010 to 2016. A sustainable investment in many respects, especially since the implemented measures not only protect the amphibians, but also decisively improve the safety of road users and the many volunteer helpers.

Beyond the preservation of various animal and plant species, biodiversity also includes the maintenance of intraspecific differences that develop as a result of environmental factors – in particular soil and climate. In order to maintain these differences, the State Building Administration is using its own territorial specific plant and seed material for the establishment of road sides and compensation measures as of 1 March 2020 before the legal requirement even comes into force.

In addition to preserving the cultural landscape, biodiversity and the protection of natural assets, it is important to consider other environmental and, ultimately, approval-relevant topics when planning roads such as emission protection. Even if the later effects can be mathematically predicted and assessed beforehand, we often only become fully aware of them when traffic is actually moving. For example, the topic of air pollution control is increasingly becoming the focus of public perception. One example is the debate about the emissions of diesel vehicles; and although the discussion is currently very emotional, it is expected that this issue will play a more important role in the licensing process in the future than was previously the case.

Measures for air pollution control

From industry and agriculture right up to private households and traffic – air pollution is caused by a variety of human activities. Accordingly, a good air quality should be achieved or ensured by means of various measures. An important legal basis within the relevant European legislation is the "Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and

Amphibian guidance devices on the B 470 near Burk between Forchheim and Wimmelsbach



Habitat for small animals by creating natural biotope structures near Massbach within the context of the A 71, section Műnnerstadt (B 19) – Pfersdorf

cleaner air for Europe" (Air Quality Directive), amended by the Directive (EU) 2015/1480 of the Commission dated 28 August 2015. The purpose of the Directive is, inter alia, to define and establish air quality objectives to avoid, prevent or reduce adverse effects on human health and the environment as a whole and to assess air quality in the Member States using common methods and criteria. Another objective is to maintain air quality where it is good and to improve it where it is not. For this purpose, area-related limits have been established for nitrogen dioxide (NO₂), nitrogen oxides (NO_x), particulate matter (PM₁₀ and PM_{2.5}), sulphur dioxide, benzene, carbon monoxide and lead.

The legal basis for air pollution control in national law is the Federal Emission Control Act (Bundes-Immissionsschutzgesetz, BImSchG) and the Federal Emission Control Regulations based thereon, which in turn pursue different approaches (for example, plant- and company-, product- and area-related).

In particular, these provisions have resulted in the setting up of air pollution control plans in many cities, each of which includes measures to improve air quality in a given area; they are intended to ensure compliance with the limit values on a permanent basis and are required wherever the limit values for one or more air pollutants are exceeded. The legal basis is §47 BImSchG and the 39th BImSchV (Bundes-Immissionsschutzverordnung, Ordinance on Air Quality Standards and Emission Limits). Air quality plans are more likely to be longer-term. The measures they contain may range from restrictions on combustion plants, to the establishment of environmental zones, to urban lorry transit bans, the introduction of speed limits, parking management solutions and other traffic control measures; it is also possible to include infrastructural measures, incentives for the use of e-mobility or to strengthen public transport and cycling in the air quality plans.

The air quality in Bavaria has improved over the decades and is now at a largely good level, as evidenced by the data from air quality monitoring. However, in 2017, the limit value set for the average annual level of nitrogen dioxide of 40 µg/m³ at least on busy roads of some major Bavarian cities (with poor air mixing) was exceeded in some cases significantly. Clean air plans were drawn up or updated for these cities with NO₂ pollution. It is a central concern of the Bavarian State Government to comply with the mentioned limit nationwide.

Nitrogen oxides, which mainly arise in combustion processes in motor vehicle engines, industrial and heating systems, are problematic. Thus, studies on the health effects show that NO₂ acts primarily as irritant gas to the respiratory tract and mucous membranes. Since motor vehicle traffic is a major cause of urban NO₂ concentrations and diesel cars account for around 75 percent of local NO₂ emissions, a holistic approach to transport policy is required, especially as the problems with air quality are also a consequence of population and traffic development in metropolitan regions. Such a concept has to take into account the mobility interests of people and companies on the one hand, and health protection on the other – i.e.: it must maintain the proper balance between the need for protection of the inner-city population and the mobility needs of (especially) commuters who have their centre of life outside the polluted areas. It should be remembered that individual mobility is a basic human need and at the same time represents a social and economic necessity alongside freight and public transport.

For an effective reduction of nitrogen oxide pollution, a reduction at the source, i.e. the exhaust of the vehicles, is decisive – in real operation, that is. This is where the new Real Driving Emissions (RDE) come into play; they have been in force since September 2017 for the registration of new vehicle types and from

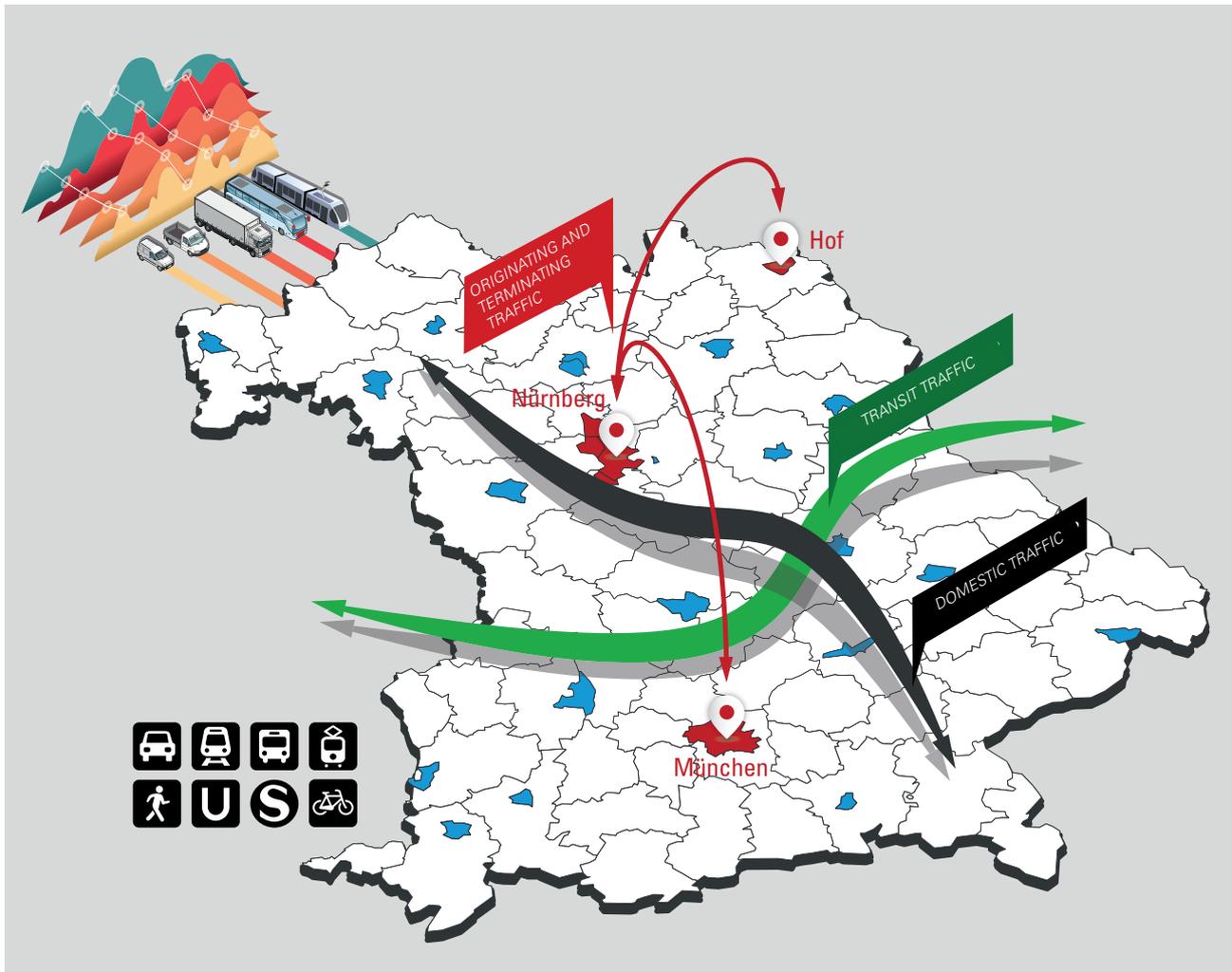
☞ The bicycle in interconnected traffic – interface station



September 2019 for the registration of new vehicles. With it, important steps have been initiated to reduce NO₂ pollution. In addition, the Bavarian State Government is relying on a comprehensive package of measures to achieve nationwide compliance with the nitrogen dioxide emission limit values as quickly as possible. In doing so, it pursues the goal of supporting the affected cities of Bavaria in coping with their environmental and traffic problems and, in this context, also initiating a realignment of the entire mobility spectrum.

MOBILITY WITH VISION

Foresighted planning thanks to digital traffic surveying and traffic modelling



Modules of the regional transport model

Authors **Reiner Scharrer, Christoph Maget, Georg Ertl**

An efficient transport infrastructure forms the foundation for social prosperity – in Bavaria, Germany and Europe. But the more economic development progresses, the more demands it has to fulfil for the infrastructure. Both areas, infrastructure and prosperity, are therefore inextricably linked. It is therefore all the more important to regularly check the available transport networks for future needs and, if necessary, optimise them. In addition to purely transport-related matters, spatial planning, economic and legal conditions also play a role here. In assessing whether a structural measure is necessary and useful, the transport planners must therefore take a look far enough into the

"Forecasts are extremely difficult, especially if they affect the future."

Karl Valentin, cabaret artist

future – and so-called traffic models are used at this point. By providing valid traffic development assessments, these tools significantly support evaluation and decision-making at all planning levels. They can be used to map the complex interactions of the "transport" system, to investigate the effects of operational measures, and even to consider social trends in the field of mobility. The interactions can in turn be compiled and compared in different scenarios.

A traffic model for all cases

In the past, the traffic models used were mostly limited in space and related only to the respective application. In addition, they were often based on different databases or prognosis assumptions and thus offered only limited possibilities of comparison. For this reason, the Bavarian State Building Administration with the Bavarian State Transport Model (LVM-By) has for the first time developed a consistent, nationwide model for uniform and intermodal transport planning. A central added value of the system is that it keeps traffic and structural data in combinable form; this not only significantly increases planning efficiency, but also minimises the need for time-consuming re-engineering as the user can access a consistent database. In the LVM-By, all modes of transport – in particular road and rail, but also bicycle traffic, air traffic and waterway – are displayed digitally and their mutual dependencies taken into account in further planning calculations.

This involved integrating the following modules into the system:

- Domestic traffic: all traffic flows that have their origin and destination within Bavaria
- External traffic: all traffic flows that start and/or end outside of Bavaria
- Freight trucks: traffic flows with trucks, divided into weight classes
- Freight rail: traffic flows with freight trains

This modular structure increases the practical benefits of the LVM-By, makes the system particularly adaptable and at the same time ensures the greatest possible transparency.

Well built: the structure of the LVM-By

The LVM-By is a software system with a uniform database for the entire Free State; it depicts both the current (status 2015) and the planned traffic infrastructure (as of 2030 according to the Federal Transport Infrastructure Plan (BVWP)) for the road and rail transport modes. Decisive for the choice of the current status of the infrastructure is the simultaneous availability of empirical traffic censuses, thus currently the Road Traffic Census (SVZ) 2015. By linking the infrastructure as a transport offering with official spatial structure data as traffic demand, planning-relevant parameters for today's and future scenarios can be calculated. The LVM-By maintains forecast horizons for the years 2030 and 2035.

"With the regional transport model Bavaria, we have, together with our colleagues from the Bavarian State Building Administration, created one of the largest multimodal transport models in the world in a short time. In the comprehensive application, it will show its great value."

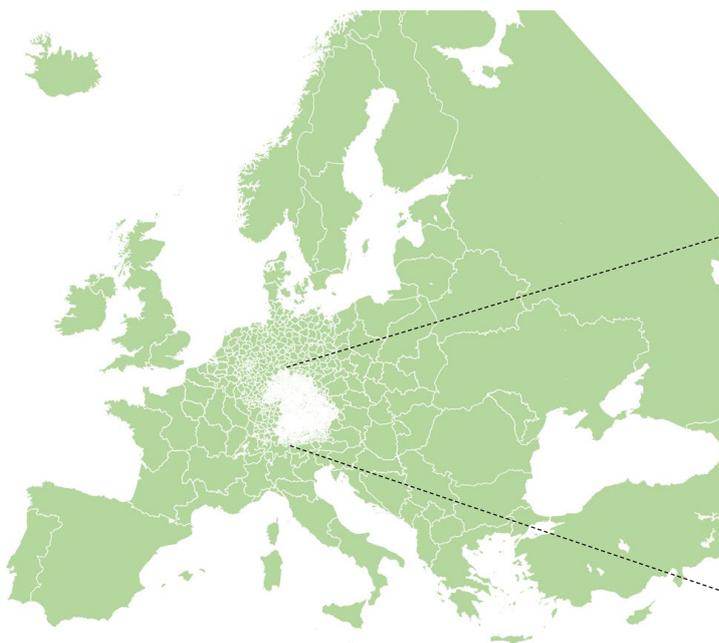
Dr. Volker Waßmuth, Head of Transportation Planning and Traffic Engineering at PTV Transport Consult GmbH

☞ Planning room LVM-
By (red: bavaria, blue: extended planning area (belt), green: remaining Germany and Europe

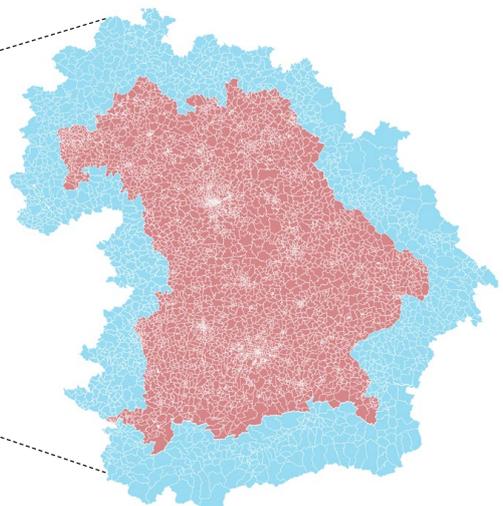
The spatial structure model – i.e. the exemplary subdivision of Bavaria into planning units (traffic cells) – is based in Bavaria and a belt around the Free State on the official municipality division. Municipalities with more than 10,000 inhabitants were subdivided further, resulting in a very detailed digital image of Bavaria in terms of the size of the model area. In the remaining model area, the rest of Germany and Europe, the division of the BVWP 2030 (forecast of Germany-wide traffic interdependencies (PDVV)) was used. The bottom line is that there are around 6,500 traffic cells for the spatial structure.

The road network model of the Federal Ministry of Transport and Digital Infrastructure (BMVI) is being used for transport services in the area of private transport (IV);

it is titled "Network Model for Federal Highway Planning" (NEMOBFStr) and has been validated on the basis of the Bavarian Road Information System (BAYSIS). The special feature of this network model is, among other things, that it measures the "project list road" of the BVWP already included as digital planning measures. Due to the link with the expansion plan for the state roads of the Free State of Bavaria, all roads from federal motorways to municipal roads are included in the model area. The network model of the Bavarian Railway Company (BEG) is used for the public transport service in the field of passenger transportation service; for passenger transport, the corresponding timetable of a normal workday (see www.bayernfahrplan.de) is saved.



Area	Number of districts
Remainder of Germany and Europe	427
Belt around Bavaria	1,220
Bavaria	4,870





« Digital network model: detailed in Germany, in the rest of Europe limited to main traffic axes

The forecast horizon for the LVM-By is the year 2030 as in the current BVWP. Structural measures, which according to the Federal Transport Infrastructure Plan are assigned at least to the level "urgent needs", are shown as implemented in the software. In addition, the network model contains the assumed demographic and transport policy framework conditions of the "Traffic Forecast Bavaria 2030". On multiple request – among other things on the part of the state building authorities – in addition a prognosis horizon 2035 was integrated, whereby one looks for the greatest possible compatibility with the BVWP.

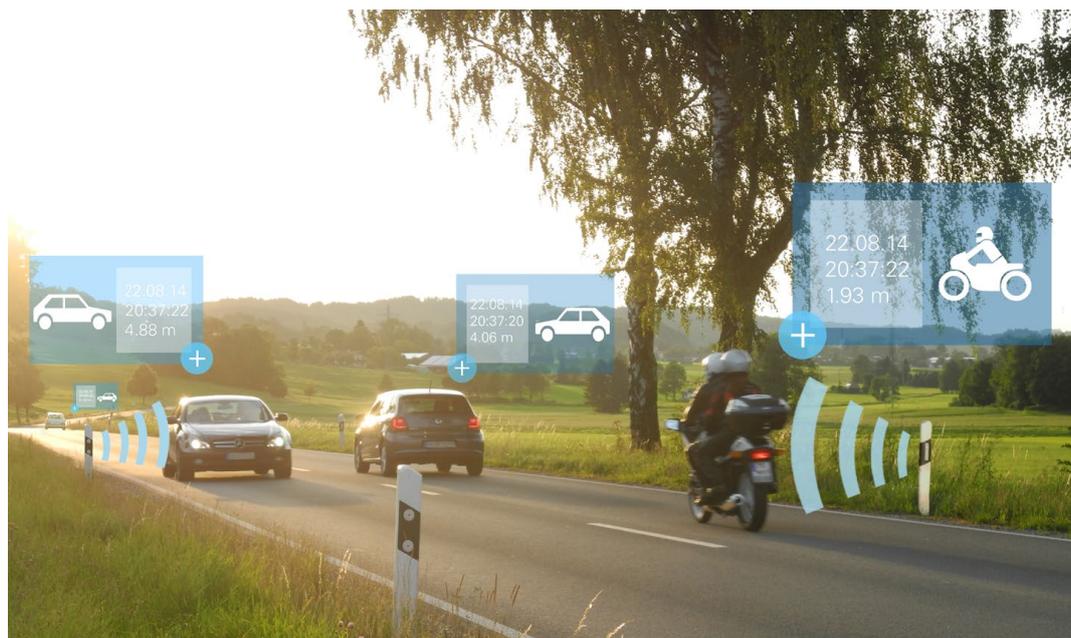
From a technical point of view, the regional transport model Bavaria consists of a central database as a storage location for all data records and calculation results used as well as a computer system for carrying out case studies. The system uses state-of-the-art technologies with standard software from the PTV (Planning Transport Transport) Group, a market leader in Germany and Europe, which ensures a high level of compatibility with the planning tools of municipalities, other states and districts, including the contracted engineering firms. At the same time, the LVM-By also has interfaces to map applications in Web 2.0.

All that counts: road traffic counting

A central basis for the LVM-By is the data from the SVZ, as this can be used to validate and possibly calibrate the calculation results generated by the model. The SVZ takes place every five years nationwide and covers all motor vehicles including motorised two-wheelers and bicycles. In the Free State, the counting extends alongside federal highways (motorways and federal roads) onto state roads and most of the county roads. On the basis of this data, comprehensive and representative statements can be made on the traffic load on the qualified road network, which is of great importance not only for the work of the road construction administration.

The road authorities of the federal states are responsible for the implementation of SVZ, which is based on national guidelines, and is coordinated by the Federal Highway Research Institute (BAST). In order to arrive at the average daily traffic volume (DTV) and other characteristics from the determined counts, the collected data is extrapolated using a complex mathematical procedure.

» Traffic detection
by means of side
radars



So far, the SVZ in Bavaria was consistently manual, which was accompanied by a high organisational and personnel expense. For this reason, within the context of SVZ 2015, Bavaria decided for the first time to use temporary measuring devices for automatic detection. These are so-called side radars, which are installed in guide posts with special sockets. Thanks to a so-called Doppler radar, the devices can determine the types of vehicles required for the SVZ and send their counting data via the mobile network to a central computer for evaluation.

Another big advantage of such side radars: unlike manual counts, they not only deliver results every five years, but also make it possible to get traffic values for certain routes every year – a big plus in terms of data validity. With this method, approximately 7,000 of the 9,500 total counting points in the Bavarian road network can be processed automatically. At the remaining 2,500 counting points, the use of the side radars is not feasible due to local conditions, since the devices are optimised, for example, only for installation on roads with one lane in each direction.

For the authorities of the Free State of Bavaria, the results of the SVZ have been available in BAYSIS since 1995. For example, users have the option of displaying the results in the BAYSIS map window on an interactive map. The system also allows the public to see the SVZ results. In connection with the development of the spatial data infrastructure in Europe (INSPIRE) at national (GDI-DE) and regional (GDI-BY) level, the Bavarian Road Construction Administration also offers various BAYSIS web services on the Internet.

Via a Web Map Service (WMS), the SVZ data can also be integrated into a compatible Geographic Information System (GIS).

Powerful and versatile: the LVM-By in practice

In everyday use, the LVM-By convinces as a high-performance planning tool, especially since it can also carry out model calculations that comply with the specifications of the "Manual for the Design of Road Transport Installations".

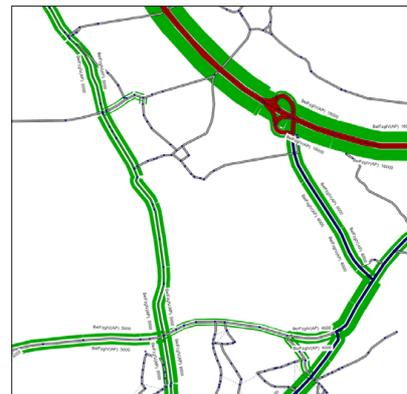
In the model, users can play through a wide variety of changes to the transport infrastructure as planning cases – such as extensions, new buildings, construction sites and transport policy measures such as tolling or planned modifications of settlement structures. Based on these simulations, it in turn becomes possible to estimate the impact on traffic loads. Likewise, users are able to contrast different combinations of measures in the form of scenarios, also with regard to demographic or economic development, and thus make more informed decisions.

Access to the LVM-By and its content is made possible by the Central Traffic Management Office (ZVM), in particular by the state building authorities and motorway directorates, which can provide it for the project-related use of the experts commissioned by them. Important: the appraiser is hereby obliged to return the model results

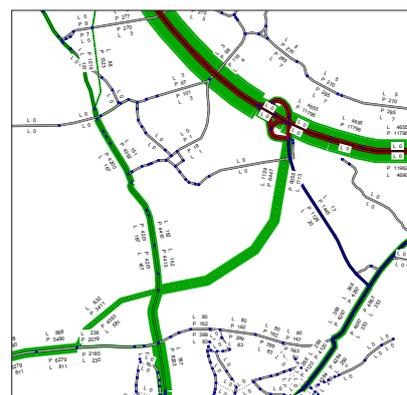
"It was our goal to create a user-friendly, serviceable model that unites the network model with the structural data and integrates the corresponding behavioural models. After calibration and validation, this resulted in a demand model for all of Bavaria, which takes into account both passenger and business traffic."

Dr. Juliane Pillat, Project Manager at PTV AG

of the respective expert report as a calculable model. Its results can also be transferred back into the LVM-By, which makes a decisive contribution towards optimising the system on an ongoing basis.



« Current status (example)



« Planned state (example)



(CO-)SHARING AND INTEGRATION

Road construction in times of social media

« Social media usage allows people to communicate their needs and views in a broad context

Authors **Roland Degelmann, Dr.-Ing. Stefan Meier**

How can citizens be best involved in public planning processes today? At the latest with the new station building Stuttgart 21, this question has reached a previously unheard of social dimension. The topic is by no means new; for example, the Bavarian Road Administration has practised the principle of early and comprehensive citizen participation for many years. Regardless of this, in addition to growing public interest, the technical possibilities for citizen participation have changed profoundly in recent years – keyword: social media.

Why contemporary public participation is important

The involvement of the public in the planning and construction process of infrastructure projects today uses a wide variety of procedural forms. These range from pure information and road planning to direct participation through active participation in the planning process. This always requires a differentiation by target group, which should be achieved through public participation. Is this about the general public, i.e. the population of the planning area, road users or potential users of a road? Or should the so-called organised public be addressed, such as citizens' initiatives and environmental organisations? A third target group are people directly affected by the planning, who may have to fear that their rights will be infringed upon or other disadvantages.

Although, due to the sheer number of conflicting interests, road planning is generally not expected to be approved by all involved; nonetheless, the involvement of the public beyond the legally prescribed level not only increases transparency,



Thomas – the commuter

„Ich verbringe viel Zeit auf der Straße – frühzeitige Informationen sind mir daher besonders wichtig.“

Name: Thomas
Alter: 35
Wohnort: Dorfen
Beruf: Architekt
Familienstand: verheiratet, 2 Kinder
Hobbys: Sport, Technik, seine Familie
Nettoeinkommen: 3.100 €

Persönliche Ziele

- Karriere und berufliche Weiterentwicklung haben hohen Stellenwert – dafür nimmt er auch die große Distanz zwischen dem ländlichen Wohnort seiner Familie und seinem Arbeitsplatz in Kauf
- Langfristig möchte er aber näher an seinem Wohnort arbeiten, um mehr Zeit für seine Familie zu haben

Digital/Social Behaviour

- Sehr trendbewusst und „always-on“ auf verschiedenen Geräten
- Nutzt besonders unterwegs beinahe ausschließlich digitale Informationskanäle und hat daher hohe Ansprüche bspw. an die mobile Verfügbarkeit von Inhalten
- Social Media spielt eine große Rolle in seinem Freundes- und Bekanntheitskreis, er nutzt sie allerdings auch zur Kommunikation mit Unternehmen und zur Informationsbeschaffung

Device-Nutzung

Genutzte Informationsquellen: f, x, l, i, n, s, k

- Online-Medien
- Apps
- Fernsehen
- Fachmagazine
- Radio auf dem Arbeitsweg

Medienaffinität

offline: online:
 funktional: social:

Erwartung an Informationsangebot

Thomas' Wunsch ist es, schnell und komfortabel zur Arbeitsstätte und wieder zurück zu kommen. Die Fahrzeit ist für ihn ein „zöliges Übel“, besonders durch den starken Berufsverkehr. Informationen zu seiner Strecke benötigt er nur im Störfall – dann allerdings frühzeitig, präzise und verlässlich und am besten auf digitalem Weg. Auch die Möglichkeit, sich bei Bedarf mit einem Ansprechpartner in Verbindung zu setzen, schätzt er sehr.

Wahrnehmung des Straßenbaums

Freiung: Etwas versäubert in der Wahl der Kommunikationskanäle

Träge, aber transparent in der Informationsvermittlung vs. schwer zugänglich

Thomas' Lebenswelt

Bedürfnisse und Wünsche

- Pendeln mit dem Auto wird als unabhängig empfunden
- Dennoch Wunsch danach, so wenig Freizeit wie möglich unnötig auf der Straße zu verbringen
- Großes Bedürfnis nach Informationen, die Störungen planbar machen
- Alle Infos, die er in seinem täglichen Leben braucht, müssen mobil verfügbar sein

Pain Points als Pendler

- Stressfaktor Stau
- Keine „Vorwarnung“ und damit keine Ausweichmöglichkeiten (z.B. auf die Bahn)
- Informationen nicht mobil optimiert verfügbar
- Schlechte Kommunikation von Ausweichstrecken

Chancen in der Kommunikation

- Bieten einer Anlaufstelle für Fragen rund um Baustellen und Behinderungen
- Verringerung des „Frustrationspotenzials“ durch frühzeitiges und präzises Informieren
- Stärken von Mitarbeitern (z. Bsp. Abklärung verschiedener Ausweichstrecken gegeneinander)
- Ausbau der Informationsvermittlung auf digitalen Weg

Erwartung an Informationsquelle

- Angebot einer digitalen Kontaktmöglichkeit für Rückfragen
- Angebot der wichtigsten Infos über verschiedene (digitale) Kanäle
- Transparente und präzise Informationsvermittlung
- Angebot von zusätzlichen Informationen, bspw. zu Ausweichstrecken

Erwartung an Inhalte und Informationen

- Frühzeitig und präzise
- Regelmäßig aktualisiert
- Wunsch nach möglichst lokalen Infos
- Keine widersprüchlichen Informationen

Legende: Annahme, Daten aus Datenanalyse oder sekundärer Quelle, Aussage eines Kontakts, Direkt von der Persona erhaltene Daten

Persona-Hypothese

Social media is not a one-way street

The social media strategy developed in this way describes a long-term plan to create, distribute and manage digital content in social networks. It clarifies exactly who is involved in the creation of this content and what roles and dependencies exist. Of course, the concept primarily addresses the desires and expectations of users, while helping the organisation achieve its business goals.

The social media strategy was presented and discussed finally at the 2017 closed-door meeting. Although it promises a clear image boost for the Road Administration management, the resource requirement should not be underestimated – all parties were clear on this from the outset. Providing a corresponding offer and meeting the real-time information needs of the target group is only possible with massive effort, even for large building authorities. In particular, the fact that it currently does not correspond to the usage behaviour of the target group to obtain traffic information via an area-limited newsfeed (here the users expect

much more entertaining content) must be considered critically; at the same time, the algorithms of channels like Facebook are not designed for such a procedure. The result would be a low visibility of the road construction management – despite great commitment. Nevertheless, there is an even greater risk of non-action, especially since the road construction administration is already passively part of social media today, i.e. it has no influence on communication.

Leading by example

Looking at the topic of public participation as a whole, it is clear: active participation processes require intensive preparation. Depending on the project, the time, the audience and the chosen procedure must be precisely defined with the individual sub-steps. This is the only way to succeed in achieving a jointly supported result for an infrastructure project.

Persona descriptions support the target group-specific analysis of different needs

Channel	Quantitative target group	Qualitative target group	Outlay	Costs	Potential
Facebook	 All target groups	 High conformity	 Very high, with focus on the employer image medium high	Free profile, advertising can be used wisely starting from 50 euros per month depending on the objective	 High – high reach, high functionality
YouTube	 All target groups, the older, the more "passive"	 Medium conformity	 Very high – Videos must be specially created, otherwise only "storage channel" with little effort	Free profile, advertising can be used, but is not necessary	 Medium – especially if you invest in your own YouTube videos
LinkedIn	 Few very active users	 Engineers and skilled workers	 Medium – content from Facebook can be mirrored	Basic profile for free, ads and job listings depending on the target group	 Medium
XING/ Kununu	 Few very active users	 Engineers and skilled workers	 Medium – content from Facebook can be mirrored	Basic profile Free, more extensive profile costs 500 euros/month. Costs per job advertisement depend on the scope	 Medium – costs are high, benefits almost replaceable compared to other measures
Instagram	 Younger target groups	 Medium conformity – students and trainees	 High – content must be created separately and can only be partially taken over by Facebook	Free profile, advertising can be booked selectively depending on the objective	 Medium (implementation possibly via trainee channel)
WhatsApp	 All target groups	 High conformity	 Maintenance: medium high Setup: high	Depends on the number of subscribers	 Medium
Twitter	 Few very active users	 Primarily press and media industry	 Medium – high	Free profile	 Low – medium (for PR topics yes)

« Social media channel matrix with employer image focus

A pilot project for such a comprehensive process of modern public participation was the expansion of the A 8 Rosenheim – Salzburg. As part of the dialogue process, the Bavarian Road Administration, in addition to the then Federal Ministry of Transport, Building and Urban Development (BMVBS – now the Federal Ministry of Transport and Digital Infrastructure BMVI), also involved the various local actors as a cost bearer – with the stated goal of coming up with as balanced and sustainable a planning solution as possible. For example, the

necessary foundations were developed for decision-making in local working groups in which all relevant interests were represented: from the affected municipalities, through local citizens' initiatives, to nature conservation associations. In the meantime, this example has been followed by many other projects, including the planning project for the B 15 in the Landshut area or the design of a northern bypass around Passau in the future. In addition, various other forms of public participation are used today: this can be both

planning workshops with those directly affected as well as round tables with interest groups or citizen reports (planning cells) by means of which a broad public can be addressed. In addition, Internet blogs have already been set up as open discussion forums for various projects in the area of state building authorities.

These and other examples illustrate: broad participation of the population at an early stage make sense both in a temporal and sustainable sense. It corresponds to a democratic basic understanding, which is not about serving particular interests and fulfilling every individual demand; instead, it must be made transparent from the outset that construction measures can potentially have adverse consequences for individuals and that road construction measures always aim at the common good. —

"The topic of social media is relevant to the work of the state building administration. The first step in a strategy is to carry out a comprehensive analysis. Central issues are the envisaged target groups and the possible contents."

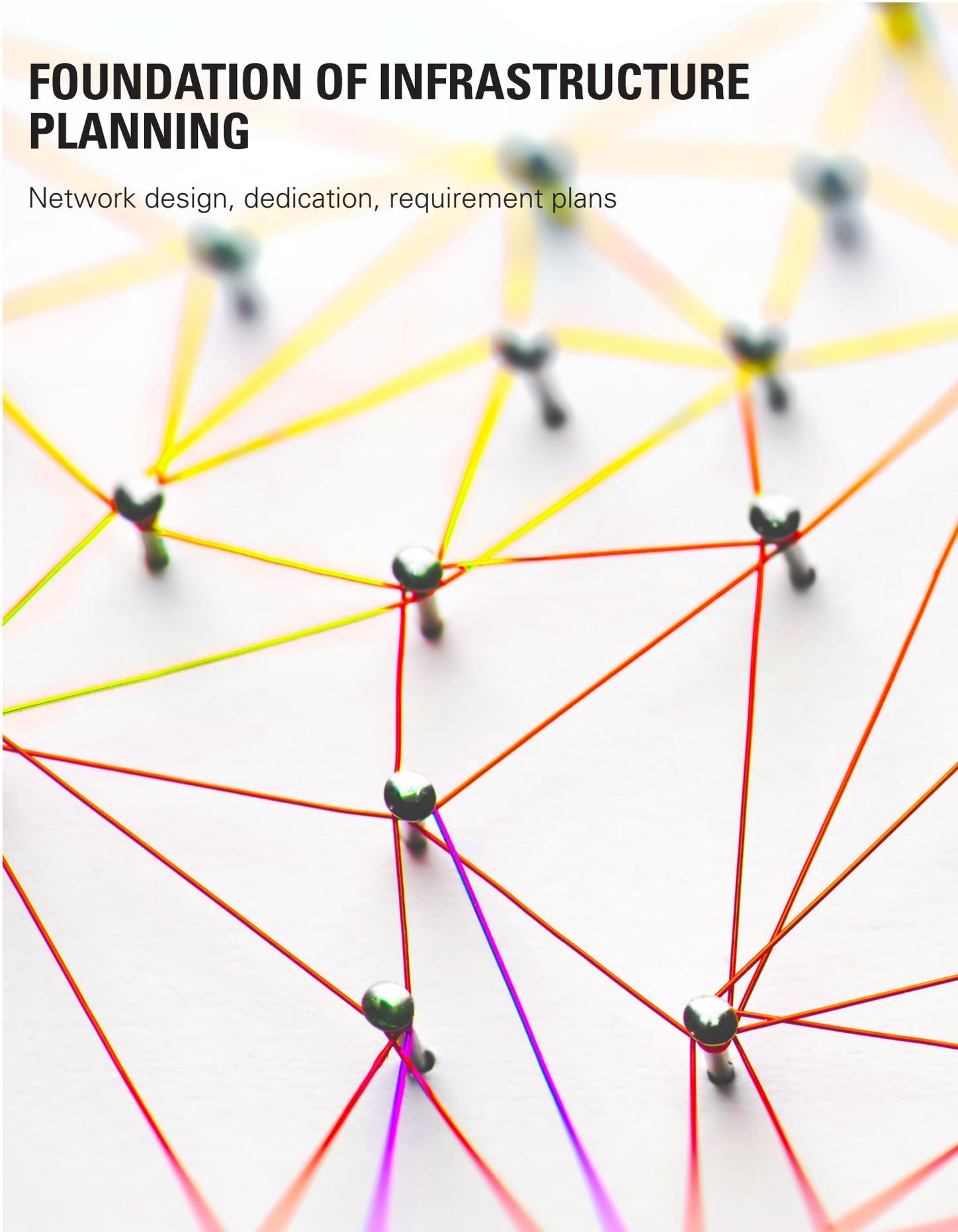
*Helmut Schütz,
Head of Supreme Building Authority,
11 November, 2016*

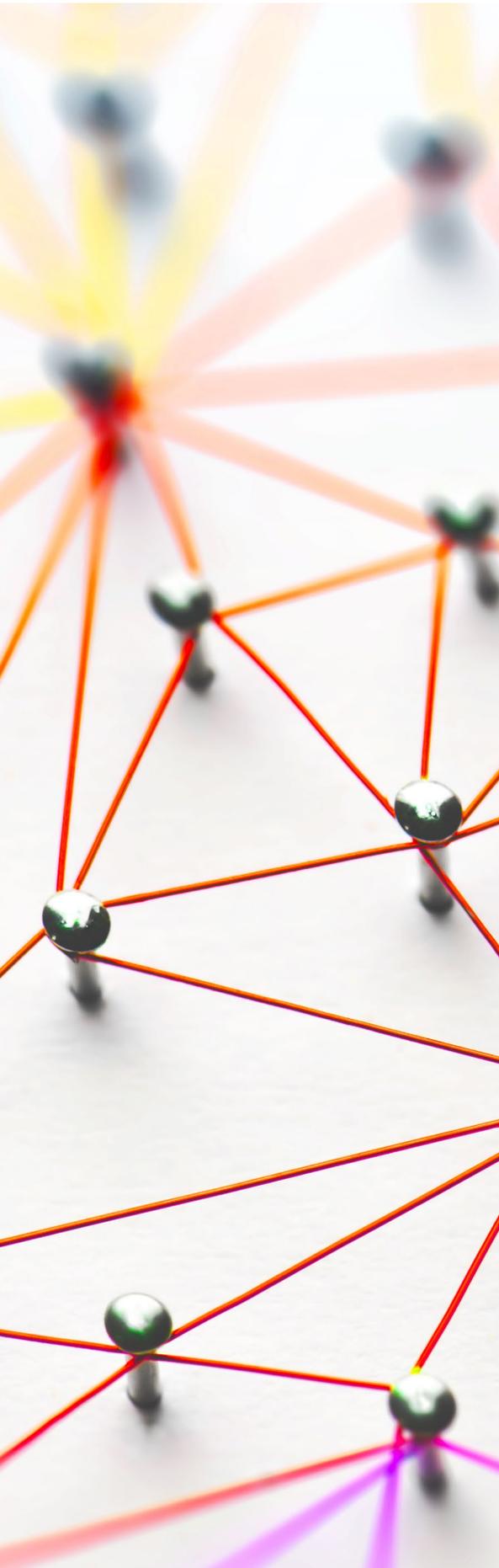
Active participation process within the framework of the citizen participation



FOUNDATION OF INFRASTRUCTURE PLANNING

Network design, dedication, requirement plans





Author **Christian Peetz**

The strategic development of transport networks is an integral part of state planning and spatial design. Their goals are in turn linked to the projects of traffic planning by the "Guidelines for Integrated Network Design" (2008 edition, RIN 2008) which allocate certain functions to important road elements. The focus is always on the accessibility of central places. The move towards this functional structure of the transport network is fundamental since it can provide valuable answers to a wide variety of issues – be it project appraisals in connection with the drawing up of demand and expansion plans, the reorganisation of federal, state and district roads, or the definition of design parameters.

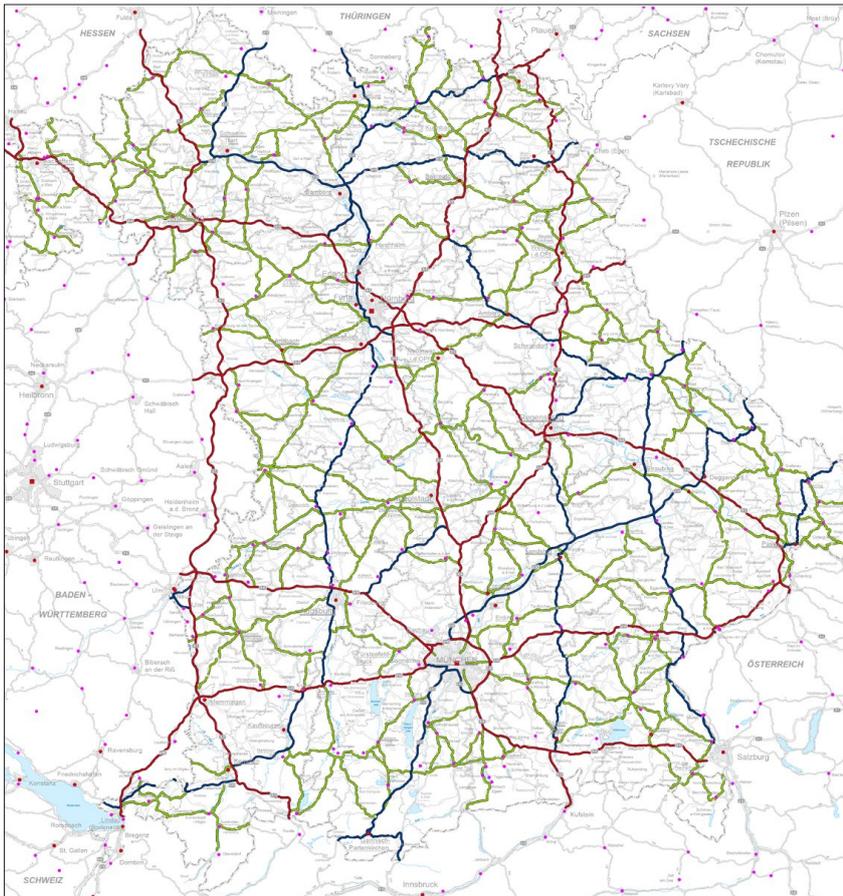
Form follows function

For the network design, the task is thus clearly defined: it must implement a functional structure of the super-regional road network according to RIN 2008 – whereby the requirements for the road network result from the quality requirements with regard to the accessibility of the central locations. The targets for the development of transport systems are based on a uniform spatial planning approach.

There are two steps for this:

- The functional structure of transport networks
- The evaluation of connection-related offer qualities.

In the first step, the network elements of a traffic route network are each assigned a category which results from the significance of the connections which extend over these network elements. The overarching goal is to design the network elements of a traffic route in such a way that they can fulfil their function in the best possible way. Due to the high degree of complexity, special software is used today for this functional structure according to RIN. The basis for this is a traffic model that gives, for example, indications of the long-distance traffic share of the respective road elements. Already from this, the first potential for improvement can be derived and, if necessary, substantiated. These and other



« RIN-compliant road network in Bavaria

findings gained form an ideal starting point for drawing up a demand plan for federal highways as well as an expansion plan for state roads.

Dedication and reclassification – the purpose decides

Public roads are assigned to a specific road class according to their purpose or function in the transport network. One speaks in this context of consecration. The consecration of a road must always be made when the road construction authority has the authority to dispose over the road plot, the road has the classification characteristics of a road class and the construction work is completed. Only then are all consecration requirements fulfilled. As long as a newly created road is not consecrated, it is considered a private road – and there is no public use of it. The latter is one of the most important legal institutions of road law; it allows anyone to use the road within the framework of traffic regulations. In addition, the consecration opens up resident use and brings the road legal cultivation prohibitions or restrictions with it. Another consequence of a consecration is the obligation to provide development contributions. Who makes the consecration depends on the

respective road class. For federal highways and state roads, the consecrations are issued by the Bavarian State Ministry of the Interior, Construction and Traffic.

If the conditions relevant for a classification change, the road class must also be adapted. This change is referred to in the legislation as "re-classification"; because of the hierarchical order of the road classes, a distinction is made between downgrading and upgrading. A reclassification may also be considered if there are overriding reasons for the public good – for example, urban planning, living environment improving or environmental protection-related issues. Responsibilities are subject to the same rules as for the consecration, with the reclassification in principle being made by the road authority responsible for the future road class.

Federal highways – investments at record level

The Basic Law of the Federal Republic of Germany determines the federal government as the responsible body for the construction as well as maintenance of the federal traffic routes. The basis for this is formed by the

Federal Transport Infrastructure Plan (BVWP), which contains all relevant road, rail and waterway projects. The BVWP is set up by the Federal Ministry of Transport and Digital Infrastructure (BMVI) and – after official and public participation – adopted by the Federal Cabinet; as a rule, the BVWP is valid for between 10 and 15 years, until it is replaced by a successor plan.

Although the BVWP acts as the basis for the expansion laws, including the associated requirements plans, nevertheless, the financing basis of the corresponding construction and new construction projects will only be laid with the passing of the expansion laws by the Bundestag. It is not the BVWP 2030 but the requirements plans contained in the expansion laws that determine which construction and new construction projects are to be planned and financed from the federal budget.

When the BVWP 2030 was drawn up, the public was also widely involved for the first time: from 21 March to 2 May, 2016, all German citizens had the opportunity to comment in writing on the draft of the BVWP 2030. Subsequently, the revision was carried out by the BMVI on the basis of the evaluated statements. Within this context, the handling of the opinions was also documented in summary. The model of public participation has been used in Bavaria for a long time. In 2012, for example, the citizens of the Free State were able to take a position on a list of projects considered from the Bavarian perspective. In addition to around 300 mandate holders, the departments of the Bavarian State Government concerned as well as around 280 associations and institutions, around 25,000 Bavarian citizens took advantage of this opportunity – in the form of 2,200 letters/postcards, over 4,000 e-mails and around 40 signature lists. These comments were balanced in the final registration list and taken into account in the further planning.

On 31 December 2016, the 6th legislation amendment to the motorway expansion, including the demand plan for

"Strategy is not the consequence of planning, but the opposite: its starting point."

*Henry Mintzberg,
Management theorist*

» One of the focal points of the BVWP 2030 – the elimination of bottlenecks on federal motorways

» Requirement plan for state roads (map of the greater Nuremberg area)



federal highways, came into force. It is based on the BVWP 2030 which was adopted on 3 August 2016 by the Federal Cabinet. For Bavaria, the current demand plan for federal highways has a total volume of 18.5 billion euros. Of these, by 2030 alone, around 12.2 billion euros are to be invested into ongoing projects (FD) and urgent needs (VB) projects. This means that the Bavarian share of the total investment volume is at a new record level.

Bavarian state roads – efficiency in mind

First set up in 1970, the expansion plan for the Bavarian state roads was regularly updated. On 10 November 2011, the Bavarian Council of Ministers adopted the 7th expansion plan for the state roads and put this retroactively into force as of 1 January 2011.

The content of the document includes both expansion projects, such as the expansion of existing roads, building renewal or the elimination of level crossings, as well as new construction projects such as bypasses, relocations or new roads. Conservation projects as well as simple conversion and development projects – i.e. measures with a total cost of less than one million euros gross or length-specific costs of less than 0.5 million euros per kilometre gross – are not the subject of the expansion plan.

As with its predecessor, on the development of the 7th expansion plan, a macroeconomic evaluation process was performed. This made it possible, on the one hand, to sort the projects according to their urgency, taking into account uniform criteria throughout Bavaria. On the other hand, this procedure allows statements to be made about the respective building credibility and thus also fulfils budgetary requirements. Since not all project effects can be described



in monetary terms, the updated assessment procedure – based on the Federal Procedure for the preparation of the BWVP – also integrated an Environmental Risk Assessment (URE) and a Spatial Activity Analysis (RWA) as further components.

Overall, the 7th expansion plan includes 666 projects with an investment volume of 3.2 billion euros gross. Not listed in the expansion plan are now completed, evaluated projects or no longer pursued project variants, the realisation of which is no longer provided for in state building load. Projects for which there is no longer any need or which do not appear to be worth building in the assessed form for the Free State are left out.

In contrast to the demand plan for the federal highways, the expansion plan for the state roads has no legal applicability. As a programme of the state government, it is not decided

by the state parliament, but by the Council of Ministers. This decision is binding on the State Administration and constitutes a work assignment to the Road Construction Administration; it determines for which projects in the coming years the planning and legal bases have to be created and which – if the corresponding budget funds are provided – should be structurally implemented.

SUSTAINABLE SOLUTIONS

Of engineering structures, tunnels, georisks and innovations in bridge construction





« Heidingsfeld valley bridge: incremental shifting of the superstructure

Author **Prof. Karl Goj**

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Whether bridges and tunnels or support structures and protective structures – the progressive traffic development and environmental influences require a continuous development as well as the adaptation of engineering structures to the current requirements.

Maintenance before new-build – special programmes bridge strengthening

The majority of the 14,000 road bridges in the Free State were built in the 1960s, 1970s and 1980s, including especially the large valley bridges. As a change in use has practically occurred in the course of the past decades due to the strong increase in heavy goods traffic, more and more of the constructions have lost their originally planned load reserves – i.e.: they are reaching their performance limit; in addition, in some places, construction type- and construction period-related deficits have a negative effect on the respective load-bearing capacity. In light of these facts, it is urgently necessary to make older bridges fit for the future. It is therefore important to act in a timely manner on problematic structures along highly-loaded routes – after all, bridges are the critical points in the road network where use restrictions usually lead to considerable, long-lasting traffic disruptions.

Accordingly, the focus of the investments for the preservation of existing bridges, which have been significantly increased in recent years, is now also having to be channelled into bridge strengthening – and thus the implementation of replacement new constructions or reinforcements which lead to an increase in sustainability. What is particularly pleasing within this context is that the funding possibilities for the corresponding measures on federal highways and state roads were also significantly improved by means of various special programmes.



"Every refurbishment measure for a bridge that receives construction rights will be financed. The infrastructure is the central nervous system of our country – and bridges the most sensitive points."

Alexander Dobrindt, Federal Minister of Transport and Digital Infrastructure 2013 – 2017

Old and new
Saalebrücke
Hammelburg with
test stand on the
old bridge

Particularly noteworthy is the renovation of the bridge over the Franconian Saale near Hammelburg. As a result of the long-term load, in particular by heavy military traffic, the bridge had become so damaged in the course of the former B 27, which has now been re-assigned as a state road, that the option of a refurbishment was eliminated. The pre-stressed concrete bridge from 1955, which spans a total of 163 metres over seven bridge sections, has been replaced by a new structure immediately adjacent to it. However, prior to its demolition, the old bridge was subjected to technically complex tests for research purposes: it was loaded to failure in a total of five bridge sections – and thus provided valuable insights for the recalibration of existing structures.

In addition to the urgent treatment of critical individual constructions, the focus is on network-oriented bridge strengthening. For this purpose, Bavaria has defined a main network of major highways for transit and heavy traffic which is to be continuously upgraded by 2030 through investment prioritisation. This "bridge strengthening priority network" covers more than half of the Bavarian motorway

» Bridge strengthening priority network

» Entry section Aubing tunnel



network. The aim is to interlock and coordinate all necessary bridge-building projects with the upcoming maintenance measures on the roadways and planned expansion projects. When building amidst traffic on busy motorways and federal roads, traffic obstruction should be kept to a minimum.

Tunnel in Bavaria 2004 to 2017

Road tunnels are the subject of planning when difficult topographical conditions are present or the noise pollution of the development or the required location development cannot be guaranteed otherwise. While in the first case predominantly mining tunnels are used, the second scenario refers mainly to tunnels with a so-called open design. In Bavaria, a total of 16 tunnels were built or put into traffic operation in the course of motorways, federal highways and state roads between 2004 and 2017, 14 of which were open-plan tunnels. One of them is the Aubing tunnel, which was opened in 2006 as part of the A 99 motorway feeder road, which, with its almost two-kilometre length, is one of the longest motorway tunnels in Bavaria. The construction

of this motorway connection in the densely populated Munich west region was only possible in conjunction with the tunnel and otherwise would have failed, among other things for reasons of noise pollution. Since the A 99 in the area of the tunnel already in 2014 had a daily volume of around 76,000 motor vehicles (while in the first full year of operation in 2007 this was still 55,000), this was certainly a "ground-breaking" decision.

☞ The dragon of the folk play "Further Drachenstich" leaves the Deschlberg tunnel



☞ Rescue tunnel – Deschlberg tunnel

An example of a mined tunnel construction is the Deschlberg tunnel in the course of the B 20. Built for topographical reasons and put into operation in 2013, it forms the core of the 4.3 km long bypass around Furth in the Forest which should reduce through-traffic in the town close to the Czech border. The single-lane tunnel with oncoming traffic and a carriageway width of 7.50 metres passes through the Deschlberg north of Grasmannsdorf over a length of 745 metres. Running in parallel to the main tunnel, there is a walk-in rescue tunnel which is connected via two cross passages.

At present, 62 road tunnels with a total length of 39.7 kilometres are in operation under the responsibility of the Bavarian State Building Administration. Tunnels are particularly critical road sections that have to meet high traffic and operational safety requirements. The severe tunnel fires in the Montblanc Tunnel (1999), the Tauern Tunnel (1999) and the Gotthard Road Tunnel (2001) made regulations for road tunnels in the EU significantly more stringent. The EU Tunnel Directive 2004/54/EC has brought numerous new regulations to the forefront. This was implemented nationally in Germany primarily by updating the "Directive for the equipment and operation of road tunnels" (RABT), version 2006. Accompanying research has shown that especially the self-rescue phase is very important for the safety of tunnel users. Both an early alarm, as well as a sufficiently small distance between the emergency exits of 300 metres, is therefore crucial.

Since around 2005, a retrofit programme for road tunnels has been ongoing in Germany. The goal is to significantly improve the level of safety. In most cases, the retrofitting includes mainly operational measures such as the identification of escape routes, the installation of emergency lighting and emergency or fire extinguishing equipment. In several tunnels, however, extensive construction measures – especially to create the necessary escape routes in case of fire – were required. So far, 84 million euros have been invested in Bavaria for the structural retrofitting and 126 million euros for the operational retrofitting.

From hard rocks to rolling stones – georisks on bavarian roads

The topic of natural hazards is increasingly becoming the focus of road building administrations in Bavaria due to recurring damage events. Finally, public safety authorities are required to deal effectively with all risks posed by gravitational mass movements such as stone chips, falling rocks, landslides, etc., and by events that will become more frequent in the future in view of climate change forecasts.

With the aim of systematically minimising the risks posed by natural hazards, the central body for engineering structures and georisks (ZIG) was founded in 2014, thereby creating a contact point that operates across Bavaria, which has since been expanded several times due to the high demand for advice from the subordinate authorities. Their range of tasks essentially includes the following points:

- › Development of an overall concept
- › (On-site) advice on current events
- › Identification of potential hazard areas with regard to prevention measures
- › Assistance in planning and execution of safeguards
- › Implementation of further education
- › Provision of work aids
- › Support in the field of control and testing of safety structures against natural hazards

In addition, so-called "contact persons rock" were appointed in the respective state building offices who are very familiar with the local conditions. They take care of the communication and mediation between the respective state building offices and the ZIG.

The topic of natural hazards is particularly virulent for the "Mountain Offices" located at the edge of the Alps, in whose catchment area numerous safety structures protect the traffic area from mass movements.

For example, in the area of responsibility of the Staatliches Bauamt Weilheim, a comprehensive safeguard against

☞ Rockfall protection fence with boulder



natural hazards was carried out on the section of the B 23 called "Ettaler Bergstraße". The important link between the towns of Oberau and Ettal or large spaces between Augsburg and Garmisch-Partenkirchen had a particular stone chip and rockfall risk which is mainly due to the so-called main dolomite, an about 215 million year-old carbonate rock. For this reason, rock-clearing and small-scale security measures had been regularly carried out on this stretch of road.

However, a rockfall event in January 2017, in which about eight cubic metres of rock hit the road, made it finally clear that the above measures to improve road safety in the short term are no longer sufficient here. Therefore, measures were developed in the spring of 2017 to create a sustainable solution for the Ettaler Bergstraße.

After the clearing of unstable rock material over a length of 2,200 metres, the linking up of a major part of the rock embankment with around 8,000 square metres of steel wire mesh took place at a regular nail grid of 3 by 3 metres; some larger blocks were secured by means of special rock nails. From now on, back-anchored shotcrete seals on progressively eroded rock areas prevent progressive erosion in the foot area of the large blocks. Flanking trees and shrubs were removed up to two metres behind the upper edge of the slope, as they

weaken the rock formation in the long term by the forces of their root system.

Even in the northern parts of Bavaria, the road network often runs at the foot of towering rock formations, which – in addition to their imposing appearance – can have a considerable potential for danger. Overall, the risk of gravitational mass movements on the traffic area cannot be completely ruled out with economically justifiable effort; nevertheless, thanks to the good cooperation between ZIG and the state building authorities, it was possible to largely identify potentially endangered sections of the route. This created the basis for their systematic and uniform processing. Thus, numerous areas have already been secured in recent years.

From tree trunk to "intelligent bridge" – innovations in bridge construction

The "art" of bridge construction looks back on a thousand-year-old history. Even the first humans deliberately placed fallen trees or stones to overcome obstacles such as ditches or rivers. Since then, bridge construction has continued to evolve – not only traditional materials such as wood, stone or steel are shaping the image of the bridges, but in many places so too are newer building materials such as steel, pre-stressed or carbon concrete. The human ability to solve problems through new ideas and the power of creativity has given rise to impressive bridges across deep valleys or wide waterways – all admirable testimonials of our engineering prowess.

Numerous regulations and stipulations in Germany ensure that the safest and most robust bridge structures are constructed and realised today. Insights from past mistakes, which led to the adaptation of corresponding design rules or to the change of calculation principles, also flowed into these regulations.

Unlike in earlier eras, innovations in bridge construction are less fundamental today; rather, these are developments in detail. For example, new waterproofing materials that can be installed in winter temperatures are used, high-performance concretes with a denser structure and higher load-bearing capacity, or low-noise transition structures designed to protect residents from unnecessary noise pollution.

A particularly innovative bridge project shows that it is also possible in Bavaria to break new ground: the road bridge near Neumarkt in der Oberpfalz, which was built in 2015

in cooperation between the Free State of Bavaria and the Max Bögl Group. It is a segment bridge about 16 metres wide and about 32 metres long, mostly pre-fabricated in the factory, without any waterproofing or road surface. For its construction, it was necessary to place only twelve segments of high-strength concrete on composite precast beams on site and to clamp them together by internally composite tendons. After that, it took only a few steps before the finished structure could be opened up to traffic via the B 299. This novel construction has several advantages: thus, the high degree of prefabrication ensures good bridge quality and a short construction time. Another advantage is the straightforward replacement of the segments – regardless of whether the bridge's life cycle involves a complete refurbishment or adaptation to changed conditions (such as changes in the width of the carriageway): all these measures are associated with much less effort and correspondingly shorter traffic restrictions than is the case with conventional bridge constructions.

The Free State of Bavaria took a significant step towards the era of digital infrastructure at the Nuremberg motorway junction with the realisation of Germany's first "smart bridge". The term is understood to mean the development of a system that provides continuously relevant information about the current condition of the structure; the data required for this purpose is provided, among other things, by intelligent lane transitions and bridge bearings fitted with sensors. For example, since the 2016 traffic clearance, vehicle characteristics such as vehicle speeds, axle loads and distances, climatic data, dimensions of the structure and vibrations of the external tendons have been measured on the approximately 156-metre-long pre-stressed concrete bridge. On the one hand, the object-related load model is to be continuously updated on the basis of this data; on the other hand, they serve to analyse statements regarding the remaining life and reliability of the bridge. Of course, the findings of an intelligent bridge can under no circumstances replace a building inspection in accordance with DIN 1076; nevertheless, the indications of expected damage and changes in status can be of great value for preventive action planning.

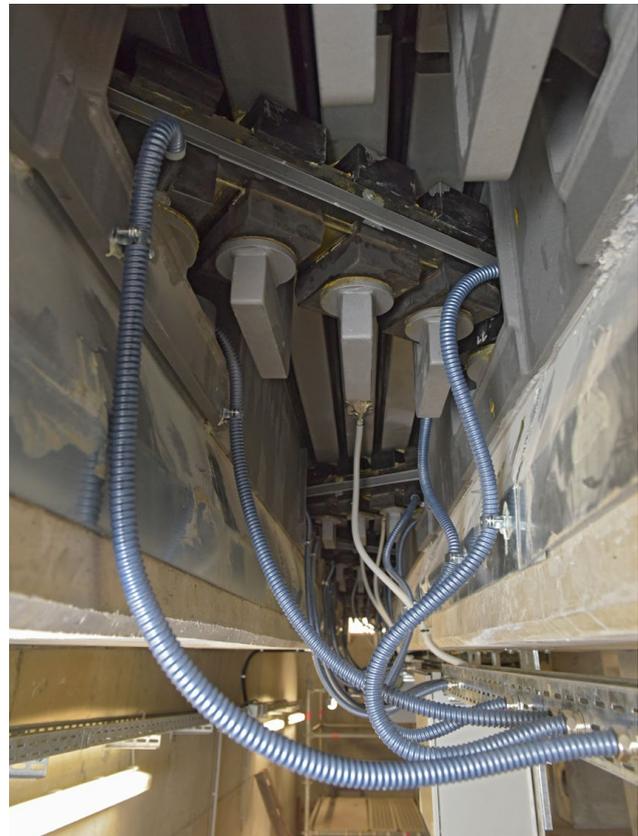
"Innovation does not always mean euphoria; a great deal of strength, time, money and patience is required too."

Johann Bögl, partner and chairman of the Max Bögl Group

» View of segment bridge Greißelbach



» Carriageway expansion joint equipped with sensors



KEEP GOING: THE CHALLENGE OF ROAD MAINTENANCE

The right action at the right time in the right place





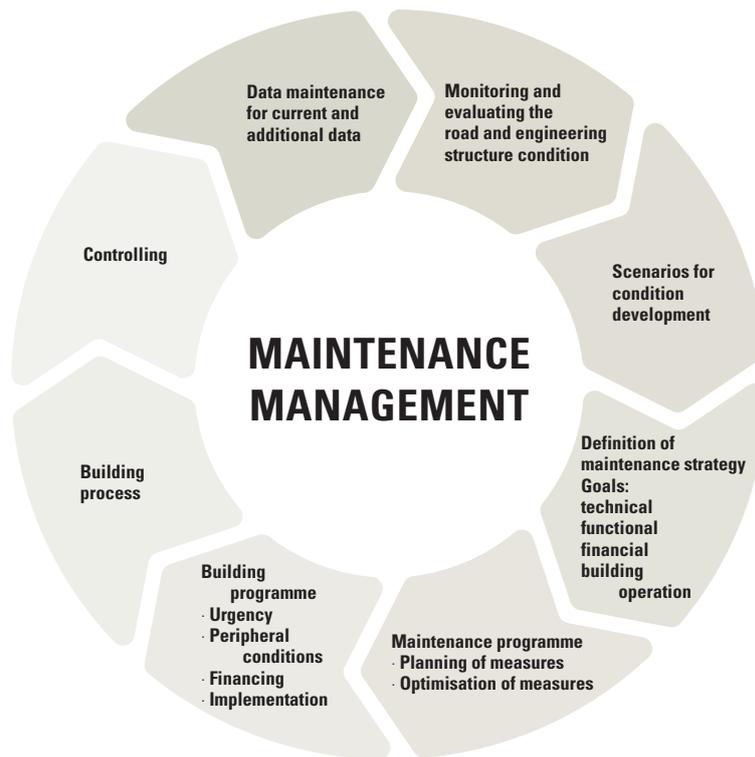
« Maintenance measure with renewal of the upper asphalt layers

Authors **Birgit Kressirer, Andreas Dormeier**

An efficient, well-developed transport infrastructure is the lifeblood of every economy and is also of decisive importance for Bavaria's economy, characterised by mid-sized companies, in order to survive amidst the international competition. In addition, according to current forecasts, the transport performance of goods traffic on the road will continue to increase significantly. This makes targeted maintenance management and needs-based further development of the infrastructure all the more important.

Since the network of supra-regional roads in Germany has grown successively over the decades, today there is a large number of different standards of construction with regard to routing, width, ice safety, load-bearing capacity of the roadway fortifications as well as construction and load-bearing capacity of the structures. In accordance with the economic development of the Federal Republic, a significant proportion of the population in the old federal states dates back to the 1960s and 1970s. In the coming years in particular, important maintenance measures will be needed on the roadway fortifications and engineering structures to ensure that they will continue to meet traffic requirements in the future.

From a financial point of view, the approximately 23,000 kilometre-long network of federal highways and state roads in Bavaria represents a fixed asset of more than 40 billion euros. The aim of the Bavarian State Building Administration is to maintain this value and use the available budget funds as effectively as possible. What is already a major challenge is made even more demanding due to increasing traffic volumes and the aging structure of the lanes and constructions. In addition, in the lion's share of construction measures, sufficient availability for the road users must be guaranteed at all times.



« Process cycle maintenance management

Therefore, the Bavarian State Building Administration relies on a systematic conservation management strategy for the maintenance, repair and renewal of federal highways and state roads. Our offices are working on a multi-year maintenance programme which, in addition to the current state, also incorporates the traffic load and the accident situation. But not only stress and age structure play a role; demands for the most economical and appropriate use of budget funds are also increasingly forcing road building authorities to systematise maintenance across the entire road network.

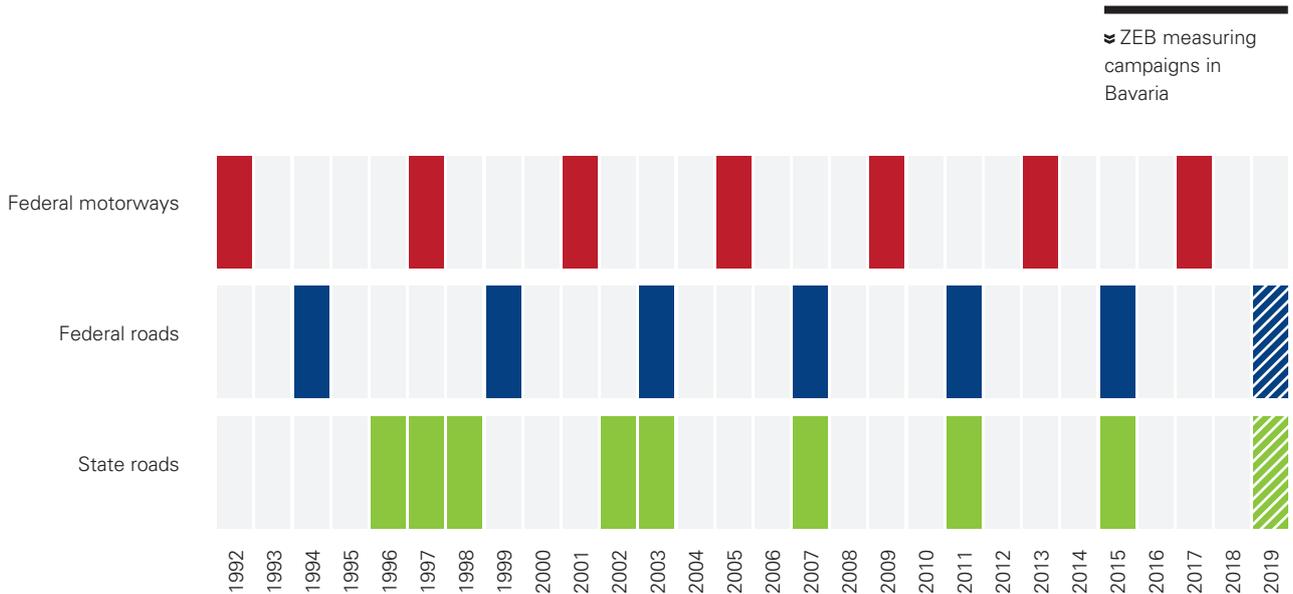
In order to continue to be able to offer a functioning infrastructure in the face of these challenging conditions, it is essential to have the broadest possible knowledge of the current condition of the system components. This knowledge must be integrated into a closed-loop process that defines the essential administrative tasks of an efficient maintenance management system (EMS) for roadway, bridge and engineering structures.

During the process steps in this process cycle, specialists can use a variety of modern tools – including, for example, Pavement Management Systems (PMS) at the strategic level, as well as solutions for processing operational construction and budgetary programmes. The budget for maintenance has increased significantly in recent years. In the meantime, conservation has priority over new construction and improvement measures.

Good roads, bad roads? Monitoring and evaluation of pavement condition (ZEB)

The Free State of Bavaria has carried out a condition assessment and evaluation every four years for the federal and state highways since the 1990s.

This is a standardised procedure set up jointly by the federal government and the federal states, which has been continuously developed over the years and most recently revised in depth in 2015. Within the framework of an ZEB, special measuring vehicles record the condition of the road and evaluate it by means of a standardised procedure that provides information about the structural condition (substance value) and road safety aspects (usage value). For example, the recorded characteristics include transverse and longitudinal unevenness, grip, cracks and patching. The acquired condition variables are converted into condition values with state scores from 1 to 5 according to a standardised procedure. From the individual condition values, the utility value and the substance value and then the total value are formed. The basis of the procedure is the "Additional Technical Terms of Contract and Guidelines for Condition Assessment and Assessment of Roads" (ZTV ZEB-StB). Particular importance is attached to the condition values 3.5 and 4.5. According to ZTV ZEB-StB, the former describes the so-called warning value – i.e. a condition that gives rise to intensive observation, root cause analysis



and, where appropriate, the planning of suitable measures. The condition value 4.5 is also referred to as the threshold value; in this case, it must be examined whether structural or traffic-restricting measures must be initiated. Nevertheless, with both values: although they are what are known as "condition-sensitive areas", the roads are in a condition that is proper and safe for all road users.

Another important factor for successful maintenance management is the comparison of successive ZEB campaigns, because it allows optimal assessment of condition trends and can be used to determine the future orientation.

Within this context, however, the change to the 2015 ZEB procedure needs to be taken into account. It leads to a stricter assessment of the road condition, which may result in worse condition values. In order to guarantee the comparability of the campaigns nevertheless, the measurement results of the ZEB 2011 and the ZEB 2007 for the federal and state highways were again evaluated according to the new evaluation procedure.

Everything according to plan: pavement management systems in practice

The term "pavement management system" refers to the systematic planning of maintenance measures on roads

on the basis of comprehensible criteria. In the narrower sense, this often also means the use of modern information technology, as used in Bavaria, for example, for the maintenance planning of the federal motorways. It serves as a tool for the planning engineer, but cannot replace the work of a technically competent road construction engineer.

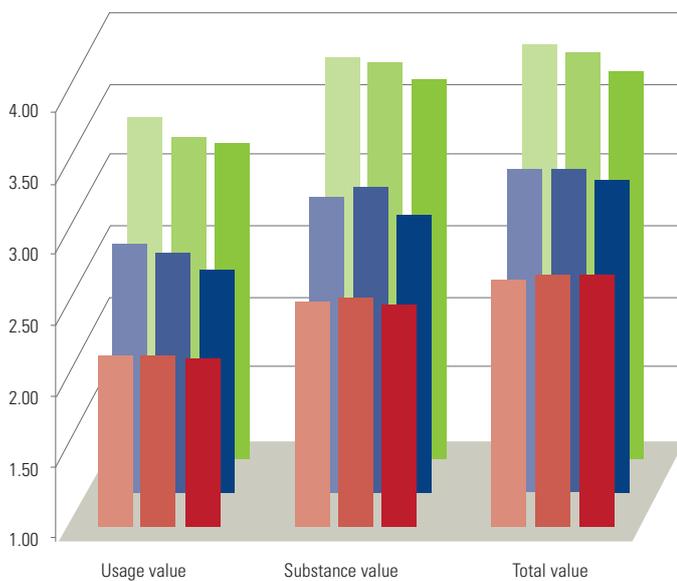
In order to determine the most efficient conservation measure, an EDP-based PMS requires different input data. This includes road condition and structure as well as traffic data and available budget. On the basis of the predicted further development of the condition values according to ZEB, the road sections are first divided into damage classes. Subdivided by year, type and costs as well as the potential condition improvement, the system now calculates possible maintenance measures for each individual section. With the help of a mathematical optimisation function, the plethora of proposals determines the ones that best serve the maintenance of the entire network, taking into account the budget. Important: the selected measures are only congruent with the technically optimal measures for the individual sections if sufficient funds are available.

The catalogue of measures created by the PMS subsequently serves as the basis for the preparation of the coordinated maintenance planning for a period of four to five years. Finally, the planning engineer carries out a plausibility check of the proposals and a comparison with accident priorities,

"Need for maintenance is not the same as derelict."

Minister of State Joachim Herrmann,
press release dated 26 February, 2016

Development of condition values in the course of the ZEB campaigns



ZEB measurement campaigns:

2007	2011	2015	State roads
2007	2011	2015	Federal roads
2009	2013	2017	Motorways

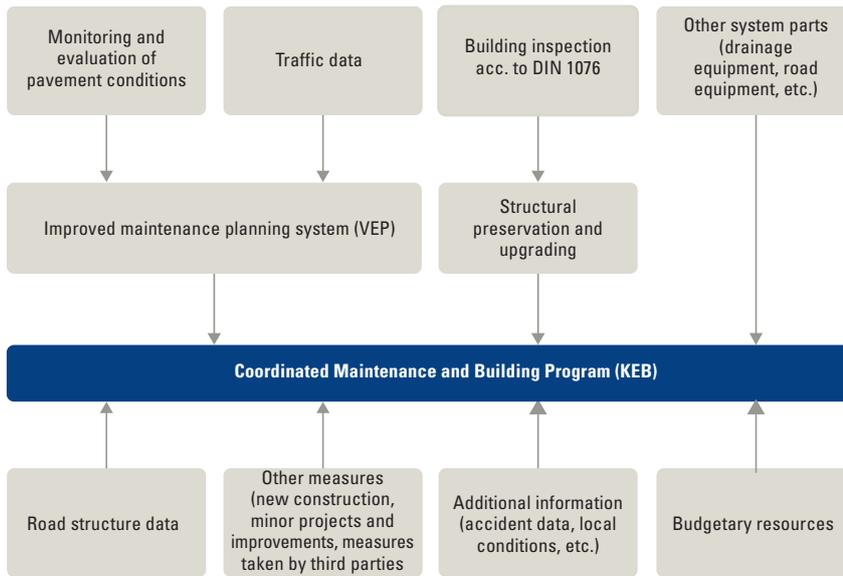
bridge construction measures and other already planned projects. The developed maintenance programme is updated annually.

From VEP to KEB: effective maintenance planning and programmes

As far as federal and state roads in Bavaria are concerned, the prerequisites for maintenance planning using PMS are currently not fully met. For this reason, the Free State is currently using the so-called improved maintenance planning system (VEP), in which maintenance sections are automatically generated and subjected to an urgency ranking in order to support the engineering considerations. In addition to ZEB data, the VEP also takes into account the traffic load in the respective road section, including heavy goods traffic. This procedure was designed by the Bavarian State Building Administration, the nationwide introduction took place in the years 1999 and 2000. Since then, the VEP has been undergoing a process of continuous development.

The VEP also forms the basis for the coordinated maintenance and building programme (KEB), which has been established since 2008 by the state building authorities as a multi-year programme. The automatically generated conservation sections of the VEPs serve as suggested measures in this context. In addition to route sections, KEB also integrates structures in which action potential has been determined on the basis of the results of the construction tests in accordance with DIN 1076. In addition, various other information is taken into account, such as road construction data, further construction measures and specialist programmes, the accident situation and the available financial resources and human resources. KEB includes the conservation projects that are likely to be structurally realised over the next four years.

The KEB is updated annually by the state building authorities as part of the construction programme and subjected to extensive controlling by the governments. It thus takes into account the experience at all levels of the administration, both strategically and operationally, and impressively demonstrates the consistent use of the fundamentals, which were created under considerable effort – from ZEB and the building inspections to the VEP. The necessary maintenance measures are processed systematically and in a comprehensible order of priority according to urgency, and all decisions made are documented in detail. Taking into account the road and structural conditions, the route



« Factors influencing the establishment of the Coordinated Maintenance and Building Programme (KEB)

lengths and construction areas as well as the traffic load in the respective subnetwork, the available financial resources are distributed in a targeted manner and as needed to the state building authorities.

Carrying role: bridge structures in Bavaria

There are currently more than 14,000 road bridges in Bavaria. They are of particular importance in maintaining an efficient transport infrastructure. In particular, due to the pronounced increase in heavy traffic, many of these engineering structures have to "stem" the volume of traffic that planners had initially expected several times. Accordingly, many bridges today have reached the limit of their capacity reserves. In addition, there are partly design-related, partly age-related deficits. Therefore, it is not only about the substantial preservation of the buildings, but also about their reinforcement with the improvement of the load-bearing capacity for future traffic loads. The tailor-made solutions range from repairs to reinforcements and renewal measures.

In accordance with DIN 1076, all engineering structures undergo regular structural testing. In the process, the individual damages are evaluated with regard to the criteria of stability, traffic safety and durability. From the respective damage assessments, a condition score of 1 (very good condition) to 4 (insufficient condition) is calculated. Without consideration of traffic safety, the so-called substance index can also be determined. Finally, the

latter as well as the condition score form the essential basis for the determination of the maintenance requirements, for the preparation of the KEB as well as for the specific planning of the maintenance measures. Of course, it is part of a coordinated maintenance planning to optimise the maintenance intervals in this way.

Investment into the preservation of buildings has increased significantly over recent years. In 2017, a total of more than 320 million euros were spent on construction maintenance and 140 million alone from the special programme bridge modernisation for federal highways. This also relates to the area of state roads with a share of 33 million euros, where the cost of maintaining the structures is also developing positively. Since 2016, the necessary budget funds have been made available for larger individual measures via the bridge improvement programme on state roads, so that here too, significantly improved framework conditions for funding can be found.



NEW ROADS FOR BAVARIA

Outstanding individual projects in the Free State

↗ A 94, Goldachtal
bridge in section
Pastetten –
Heldenstein



Author **Michael Neupert**

"The traffic routes are the lifelines of our economy." This saying, which has often been cited since motorisation began, is more valid today than ever before. Mobility is a basic need in the 21st century; it forms the basis for national and international flows of goods, on which our economic success and thus social prosperity are based. This makes it all the more important to keep the existing transport networks of all modes of transport in good condition and - where necessary - to expand and extend them in line with demand

The fact is: the road will remain the number one mode of transport for the foreseeable future. The efforts to strengthen alternative modes of transport in the area of freight transport to promote bicycle traffic or even to completely avoid individual transports within the framework of progressive digitalisation that have been ongoing and successful in principle for many years will not change this.

The following figures support this assessment. In Bavaria, it is estimated that in the year 2025, around 89 percent of motorised passenger traffic and around 72 percent of goods traffic will be handled by the road. Experts also assume that traffic in Bavaria will continue to increase disproportionately compared to Germany as a whole by the middle of the next decade – both on the part of motorised passenger and freight traffic. As early as 2007, growth rates from just under 23 to over 53 percent were predicted by the year 2025.

On the move at top speed: motorway projects

In the development of the road network in Bavaria is faced by motorways are of the greatest importance; after all, just over 50 percent of traffic handled in the Free State is non-local in nature. In addition to the production of new



» A 94, construction management on a motorway construction site

establishing new connections, the focus is increasingly on the performance-enhancing expansion of existing route sections

The last remaining motorway construction project is the A 94 between the state capital of Munich and the A 3 at near Pocking, which will be around 150 kilometres long when complete. After its completion, it will be the most important east-west access and development axis for south-east Bavaria, in particular for the Bavarian chemical hub surrounding Burghausen and the Lower Bavarian spa region. Currently, almost 70 kilometres of the total distance are operational. Probably the most important milestone of this project so far was the ground-breaking ceremony for closing the gap between the previous motorway ends in Pastetten and Heldenstein in 2016; this was preceded by more than 30 years of planning with in some places very complicated route discussions and fierce opposition from individual citizens. The 33-kilometre section will be built as part of a PPP (Public-Private Partnership) project, which, in addition to construction within the 30-year contract period, also includes maintenance and operation of the line. Completion of the project is scheduled for the end of 2019. The project has a volume of over one billion euros

Also under construction since 2016 is the approximately 5.5-kilometre-long section Malching – Kirchham. For the part from Kirchham to the east up to the A 3, the building permit has been acquired recently. Over the next few years, planning activities will concentrate primarily on the

30 kilometre gap remaining in the Simbach area, with a current cost volume of around 400 million euros. No planning activities have taken place there for more than ten years, which was due only to the subordinated classification in the former demand plan for federal highways (2004 – 2016). The currently valid demand plan now confirms that the project is needed urgently – and so nothing stands in the way of further advancing this gap closure

In the area of motorway expansion, the six-lane expansion of the A 3 between Aschaffenburg and Erlangen is currently taking on an outstanding position. The A 3 is one of the most important European east-west highways; it connects the Benelux countries with southern Europe, and within Germany, it connects Bavaria to the centres on the Rhine. However, traffic volumes have been on the capacity limits for a four-lane highway for many years already and are steadily increasing. Frequent accidents and congestion were and are still the consequence in the sections that have not yet been expanded.

The six-lane expansion of the approximately 94-kilometre section between Aschaffenburg and Biebelried has been underway since 1995 in a total of 16 individual subsections. Over 80 percent of the section has been completed already. At the end of 2017, around 16 kilometres between Marktheidenfeld and Helmstadt (including around six kilometres in Baden-Württemberg) were finally opened up to traffic. Until the planned completion by the end of 2021, three further construction phases with a total length

of 18 kilometres are to be implemented: on both sides of the Haseltalbrücke and near Würzburg. The total costs for the expansion area between Aschaffenburg and Biebelried amount to around 1.4 billion euros.

For the immediately eastern adjoining, approximately 80-kilometre-long section of the A 3 between the motorway junctions Biebelried and Fürth/Erlangen with construction costs of approximately one billion euros, the building permit has been granted throughout. The expansion is – similar to the A 94 – within the context of a PPP project. At present, the tender procedure is in progress. Construction is scheduled to start in 2019.

In addition to the classic expansions, so-called temporary hard shoulder releases have recently been used more and more frequently on heavily loaded routes at peak times to temporarily increase capacity. The main advantage of these measures is that they can be realised relatively quickly, as usually no land acquisition and at the same time complicated building permit procedures are necessary. Nevertheless, these are only temporary solutions until the route in question can be regularly extended. A current example of such a temporary hard shoulder release is the around 30-kilometre-long section of the A 9 between the motorway junctions Holledau and Neufahrn. Since the end of 2016, four lanes in each direction have been available on this very heavily loaded section at around 100,000 vehicles per day. In conjunction with an installed traffic control system, this has not only noticeably reduced traffic congestion, but also significantly

➤ A 3, Kauppen bridge at Waldaschaff; the new route has been moved up to 300 metres



➤ A 3, visualisation of the planned expansion between the motorway junctions Biebelried and Fürth/Erlangen



« A 9, construction work for the temporary opening of the hard shoulder

» A 9, opening up of the hard shoulder in operation



improved traffic safety. The investment volume amounted to – including the thorough renovation of the motorway section carried out in parallel – around 240 million euros.

In light of the steadily increasing volume of heavy traffic in recent years, the development and expansion of motorway service areas has also become increasingly important. Of course, more truck drivers need more parking space in order to be able to comply with their statutory driving and rest times which makes this subject highly relevant in terms of safety. Naturally, for the extension or new construction of resting facilities, routes with particularly high truck traffic volumes were in focus. Here it was necessary to counter some of the massive resistance from the population; the planning work here was correspondingly elaborate and tedious, especially in the case of large service stations.

An example of the measures adopted over the last few years is the extension of the managed Köschinger Forst and Fürholzen service stations on the A 9 between Munich and Nuremberg. The former was expanded bilaterally from 2012 to 2014 with an investment of around 20 million euros. Between 2015 and 2017, the further development of the Fürholzen East and West service stations was started. Investments into transport facilities (excluding ancillary businesses) amounted to approximately 35 million euros. The measures made it possible to create well over 100 new truck parking spaces on each side, along with numerous other parking spaces for buses and cars, as well as long-distance parking lanes for large-capacity and heavy-duty transports.

» A 9, Köschinger
Forst service station



The new service station Fürholzen West has a special feature: it was conceived by the Bavarian State Building Administration in cooperation with the Federal Ministry of Transport and Digital Infrastructure (BMVI) as a "service station of the future". For example, in addition to the "classic" fuels, the facility offers alternative fuels such as hydrogen or electricity, the latter by means of several powerful fast-charging stations. In addition, various innovative energy concepts were implemented in Fürholzen West, which enable the station to produce more energy than required by its operation – thus allowing it to represent an important role model as a lighthouse project within the context of the energy transition.

In the future, the improvement of the parking space situation remains an important goal of the Bavarian State

Building Administration. Following the successes so far, the expansion of new truck parking spaces along the motorways is to be continued over the next few years. In addition, the Bavarian Road Construction Administration relies on telematics solutions to increase the utilisation of the existing parking spaces. For this purpose, several pilot projects were implemented, including the "Truck Parking Guidance System" on the A 9 and the special parking procedures "compact parking" and "convoy parking".

The goal is the journey: projects on federal roads

In addition to the motorways, the Bavarian federal road network has also almost achieved its desired density.



↗ B 472,
 Hohenpeissenberg
 bypass; route
 in the area
 Hohenpeissenberg
 West interchange

Supplementary requirements by means of new connections therefore exist only sporadically, for example, in the case of the new B 15 from Landshut towards Rosenheim. For this reason, in the past years the focus has shifted towards relieving local thoroughfares through the construction of appropriate bypass roads. This development will continue in the near future against the background of the new demand plan for federal highways – whereby an increasing number of multi-lane extensions of existing federal roads are pending, which are reaching their performance limits because of continuously increasing traffic volumes.

This particularly applies to the B 472, which is the only high-capacity, long-distance east-west connection between the B 12 at Marktobendorf and the A 8 at Irschenberg in the foothills of the Bavarian Alps. After 1980, the plans for the so-called "pre-Alpine highway" were finally off the table, the B 472 would now be developed instead and the settlement priorities were to be relieved of through-traffic by the construction of bypasses. Another milestone on this route, which had already been successfully completed in the past, was the completion of the partially three-lane Hohenpeissenberg bypass at the end of 2017. From a technical point of view, there were a whole series of special challenges to master: on the one hand, several complex engineering structures (two viaducts and two railway overpasses), on the other hand, the existing subsoil conditions with contaminated slagheap. This ultimately required its own landfill construction to dispose of the excavated material. The investment costs for the approximately five-kilometre section amounted to around 43 million euros.

A similarly high priority in the Upper Palatinate is the upgrading of the B 20, Straubing – Cham – Furth im Wald, and the B 85, Amberg – Schwandorf – Cham, as a feeder road to the most heavily loaded Bavarian federal road border crossing to the Czech Republic. Here, the key project, the Furth im Wald bypass, was put into operation in the summer of 2013 after more than 40 years of planning. The reason for the long preparation period was partly strong resistance

from the population against the originally planned route in a deep cut through a ridge and dam in the immediate vicinity of the residential development. Finally, however, it was possible to reach an agreement with the federal government as the responsible building authority on the partial routing of the bypass in two approximately 750 and 200-metre-long tunnels. At a total cost of 77 million euros, the project was at the time the largest road construction project in the entire Upper Palatinate.

In Middle Franconia, the B 2 is gaining more and more importance. It not only functions as the most important trans-regional road link between the metropolitan areas of Nuremberg and Augsburg, but also serves as a feeder road for the adjoining towns and at the same time plays a major role for leisure traffic to the Franconian lakes. The aim is therefore to expand the B 2 between the A 6 and Wernsbach to four lanes, in the further course to Donauwörth to three lanes. So far, about half of the section has been improved; recently, the completion of the Dettenheim bypass with its southern extension of the existing section was successfully completed. The construction costs for this total

of 4.7 kilometre-long road construction project amounted to around 18 million euros.

An exciting detail of the associated planning work was the archaeological excavations that were carried out prior to the construction. Originally the expectation was to encounter remains of the Karlsgraben which Charlemagne had built in the years 792/793 AD and which was to form a continuous shipping route between the Rhine and the Danube. Instead, however, burial grounds and settlements from the Hallstatt and the La Tène periods were uncovered wholly unexpectedly under naturally deposited alluvial soils up to three metres deep. From the perspective of archaeologists, this was a real sensation, especially since the conservation condition of the objects proved to be very good. The findings thus enable researchers to gain an unprecedented, comprehensive view of the Hallstatt culture and the lives of the locally settled Celts.



« B 20, Furth im Wald bypass, entry to the Deschlberg tunnel with Furth-Mitte interchange

↷ B 2, Dettenheim
bypass, view from
the local connection
to the north



↷ B 2, Dettenheim
bypass, cremation
burial with pottery
vessels



In the service of the Free State: projects on state roads

In contrast to the motorways or federal roads, only a few comparable large-scale projects exist on the Bavarian state roads. This is not due to a subordinate importance of these roads for the road authorities – on the contrary: with regard to the required density of the road network in a large area like Bavaria, they make a significant contribution to the handling of trans-regional traffic. However, the average traffic volumes are usually much lower than on federal highways, which is why many smaller, but no less challenging, projects are usually carried out here.

The currently largest state road project in Bavaria, with a cost of around 50 million euros, is the construction of the bypass around Plattling in the course of the St2124. The aim of the measure is to strengthen the function of the state road as a feeder to the A 92 and the B 8, relieving the city centre of Plattling, which is currently polluted by up to 20,000 vehicles per day, of through traffic. The highlight of the project is the planned arch bridge over the Isar with a total length of over 600 metres. Almost half of the total project costs go into this demanding engineering structure alone. Completion of the bypass is scheduled for 2021.

Looking at the past (and probably also the coming) decades, the new construction of the 30 kilometre-long

State Road 2580 represents probably the largest unrivalled state road construction project in Bavaria. The so-called “Flughafentangente Ost”, or FTO for short, should serve as an additional connection axis in conjunction with the construction of the new Munich airport in Erdinger Moos. Its primary task was and is to handle the traffic of the thriving airport region in and from the south-east direction efficiently and at the same time as compatibly as possible with the population and the location by bundling it on the FTO, which is free of local thoroughfares.

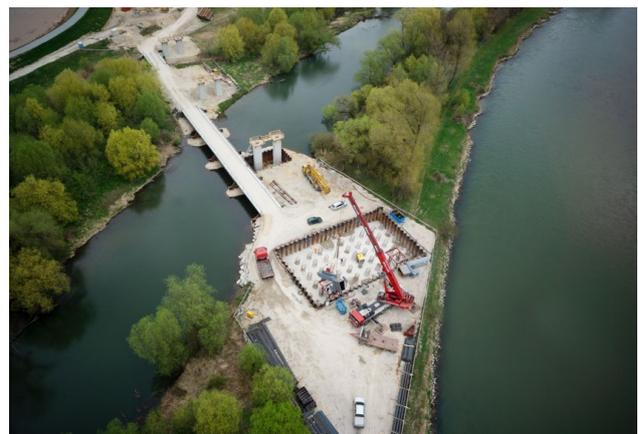
The first regional planning procedure took place in 1975, just six years after the airport was chosen as the location. Construction for the airport then started in 1985, so too did work on the FTO. Only two years later, finally, the first 6.6 kilometres between Oberding and Eitting were put into operation. Coinciding with the opening of the airport in 1992, the two northern sections between the A 92 and the B 388 went into operation. The remaining sections followed, after some very difficult planning procedures and legal disputes, finally in the years 2007, 2009 and 2010.

From the current point of view, one can justifiably call the ultimately 110 million euro FTO an out-and-out success story. It was very well received by traffic from the beginning; today, for example, more than 20,000 vehicles are on the road every day in the northern area. As pleasing as this fact is, the volume of traffic is already pushing the road to its

☞ St 2580, airport tangent east in construction phase V; aerial view looking north (Erding)

limits. Therefore, the four- and three-lane development of the FTO between the A 92 and Neufinsing are already in planning. According to the latest cost estimate, a further 28 million euros will be invested in these state roads, which are so important for the future development of the entire airport region.

Whether motorway, federal road or state road: ultimately, it must be stated that the efforts made to date to upgrade roads in line with demand need to be rigorously pursued so that the roads in Bavaria can cope with the ever increasing volume of traffic. On the one hand, the State Building Administration is facing particular challenges due to growing scepticism on the part of the population vis-à-vis infrastructure projects; on the other hand, the specialist planners and engineers must take ever stricter environmental protection guidelines into consideration. These two facts must be met with with equal levels of competence, sensitivity and foresight.



☞ St 2124, Plattling roundabout, new construction of the Isar bridge with lifting of the first steel parts at the abutment



CLEAR ROADS – EVEN IN WINTER

The road maintenance service in Bavaria



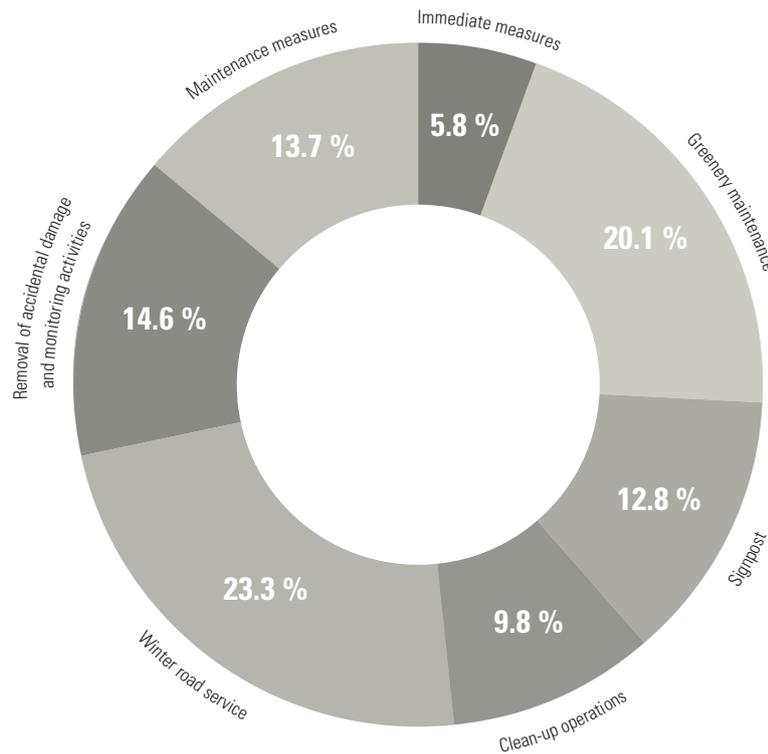
« Clearing in the Bavarian forest

Author **Dr.-Ing. Heinz Dirnhofer**

A modern, efficient and secure transport infrastructure is the prerequisite for the mobility of our citizens and at the same time makes an indispensable contribution to securing Bavaria's role as a competitive business location in the heart of Europe. The road maintenance service in Bavaria makes every effort to ensure that the important traffic axes are always available for safe use without restrictions.

Well-organised

The road maintenance service in Bavaria is responsible for around 2,500 kilometres of motorways, 6,000 kilometres of federal roads and 14,500 kilometres of state roads. In addition, there are around 3,000 kilometres of county roads, which are also looked after by the Free State on behalf of 19 counties. Altogether, the employees of 29 motorway and 64 road maintenance depots of the Bavarian State Building Administration permanently monitor the condition of these roads and, if necessary, immediately undertake the necessary repairs to maintain road safety. The wide range of tasks extends from the maintenance of green areas through the maintenance of traffic signs as well as the cleaning of roads and ancillary areas to the elimination of accident damage or minor repairs. In the winter months, the timely clearing and spreading of salt on the road is top on the road service's agenda.



☞ Removal of unwanted wood with remote-controlled forestry mulcher

The figure above shows the average distribution of services provided by our motorway and road maintenance departments in the individual service areas in recent years.

Accordingly, the greenery maintenance and the winter service together make up almost half of the activities of the motorway and road maintenance depots.

here are of crucial importance. In addition, however, the landscaping functions of the green spaces alongside the roads must be preserved. In addition to ecological aspects, economic aspects must also be considered here. The motorway and road maintenance depots either maintain the roadside greenery with well-trained specialists themselves or outsource the maintenance work to specialised companies.

Greenery beside the road

The grey edge of the roads is fringed in the open landscape mostly by greenbelts of grass and woodland areas. In addition to the integration of the technical structure of the road into the countryside, these green areas also make a contribution to nature conservation, especially as they are often the only structurally rich elements, especially within structurally poor agricultural landscapes.

Greenery maintenance works, above all, help to ensure road safety and to maintain the existence of the road embankments by protecting against erosion. The clearing of the required clearance gauge as well as the visible surfaces





» Mowing on the
A 93

In the case of woodland maintenance, nature conservation regulations have become firmly established, which is why the corresponding maintenance work takes place primarily during the winter half of the year.

The maintenance depots cultivate single trees and rows of trees as well as mixed hedges by regular clearing or erecting in order to preserve their diverse constructional, traffic and landscaping functions in the long term.

In the case of closed woodland areas, multi-level hedges and woodland strips, continuous, basic woodland maintenance is required every ten to a maximum of 15 years, in order to secure long-term stable and traffic-safe stocks. Bushes and shrubs are pruned, however, only in sections, to a maximum of 100 metres in length, taking into account ecological concerns and species protection. As a result, it is not only the intervention in the familiar landscape that is less pronounced; even the animals are thus allowed to escape to adjacent areas which in turn ensures the ecological function of roadside woodland areas. In the vicinity of settlements, the widespread preservation of visual shielding by means of woodland plantings is of particular importance. For this

reason, tree preservation here selectively takes place either scattered or diagonally offset.

In the course of woodland preservation, large quantities of clippings – and thus a valuable energy resource – are regularly produced. The wood chips extracted from the clippings are then used in our own workshops as CO₂-neutral heating material or sold to local dealers.

In the summer months, the lawns along the motorways and highways must be mowed regularly. Of high relevance for traffic safety is the so-called intensive area, which includes the hard shoulder, drainage depression, separation and median strips as well as the parking areas. Since traffic safety alone determines the frequency and time of maintenance actions, these areas are mowed two to three times a year – ecological concerns play a minor role here. The grass cuttings always remain on the surface; the only exceptions are areas where there is a risk of clogging of the drainage facilities or the cuttings ending up on the road.

➤ Ragweed on the
A 92



All other green spaces along roads are assigned to the extensive area where greenery preservation has no direct impact on traffic safety. Accordingly, the ecological functions can come to the fore in the maintenance of these areas, which is why mowing takes place there in the early or late summer. This ensures that the stock-forming plant species have been extensively sowed and remain available to animals as habitat and food at least until the developmental cycle of the next animal generation is completed. The mowed materials remain mostly in the extensive area as a mulch on the surface and must not be disposed of. In addition, the selected cutting time of a thatching of the vegetation scar can be prevented since there is still sufficient time left for the decomposition of the mowed material.

Ragweed, Hogweed and Co.

The occurrence of plants that pose a health risk or that displace the native plant world due to uncontrolled spread also poses new challenges to the preservation of greenery.

Particularly noteworthy here is the Bavarian abundance of ragweed (*Ambrosia artemisiifolia*) whose pollen is one of the strongest known allergy triggers. In addition, the late flowering period (July to October) of this species migrated

from North America leads to an extension of the pollen season for allergy sufferers.

The operating service in Bavaria pursues a two-pronged strategy in dealing with the highly allergenic plant which is to be found preferentially on lean areas such as beside the hard shoulder. On the one hand, this includes occupational safety measures with the purpose of protecting the operating personnel of the maintenance depots against health hazards due to the pollen count. In addition, there are various control measures, with the help of which both larger ragweed stocks are to be reduced and a continued spread of the plant prevented.

In addition to Ambrosia, the operational service also faces other problematic plants such as the genus of groundsel (*Senecio*), giant hogweed (*Heracleum giganteum*) or even individual species such as the oak processionary moth (*Thaumetopoea processionea*). These plants and animals must also – in accordance with legal regulations – be reasonably regulated and further propagation both along the road and in neighbouring areas must be prevented.

» Winter service on a state highway



Winter service

The winter service is still the leading operation for the road service in Bavaria. The calculation of personnel and vehicles but also of the depots takes place primarily on the basis of the respective requirements of the winter service and taking into account an allocation share of 30 percent for motorway maintenance depots and 50 percent for road maintenance depots. Although the winter service according to the legal regulations is largely a voluntary service of the administration, it is nevertheless an indispensable part of the public service due to the requirements of our present mobile society. Nonetheless, the demands for a road infrastructure that can be driven on at any time without restrictions are in principle subject to financial viability. For example, the winter service looks after roads with outstanding transport functions such as motorways or certain federal and state roads around the clock, while most federal and state roads are kept in a passable condition between 6:00 and 22:00. To enable road users to drive over cleared and gritted roads from the onset of rush hour, work usually begins between 3:00 am and 4:00 am. To accomplish this task, the road maintenance service in Bavaria uses around 600 internal and 700 private large trucks.

In order to be able to carry out the winter service as effectively and economically as possible, reliable information

on the forecast weather conditions and the expected road conditions is essential. For this purpose, a new digital winter service management system (WDMS) has been developed in recent years, which collates, analyses and graphically displays a large quantity of relevant data from different sources.

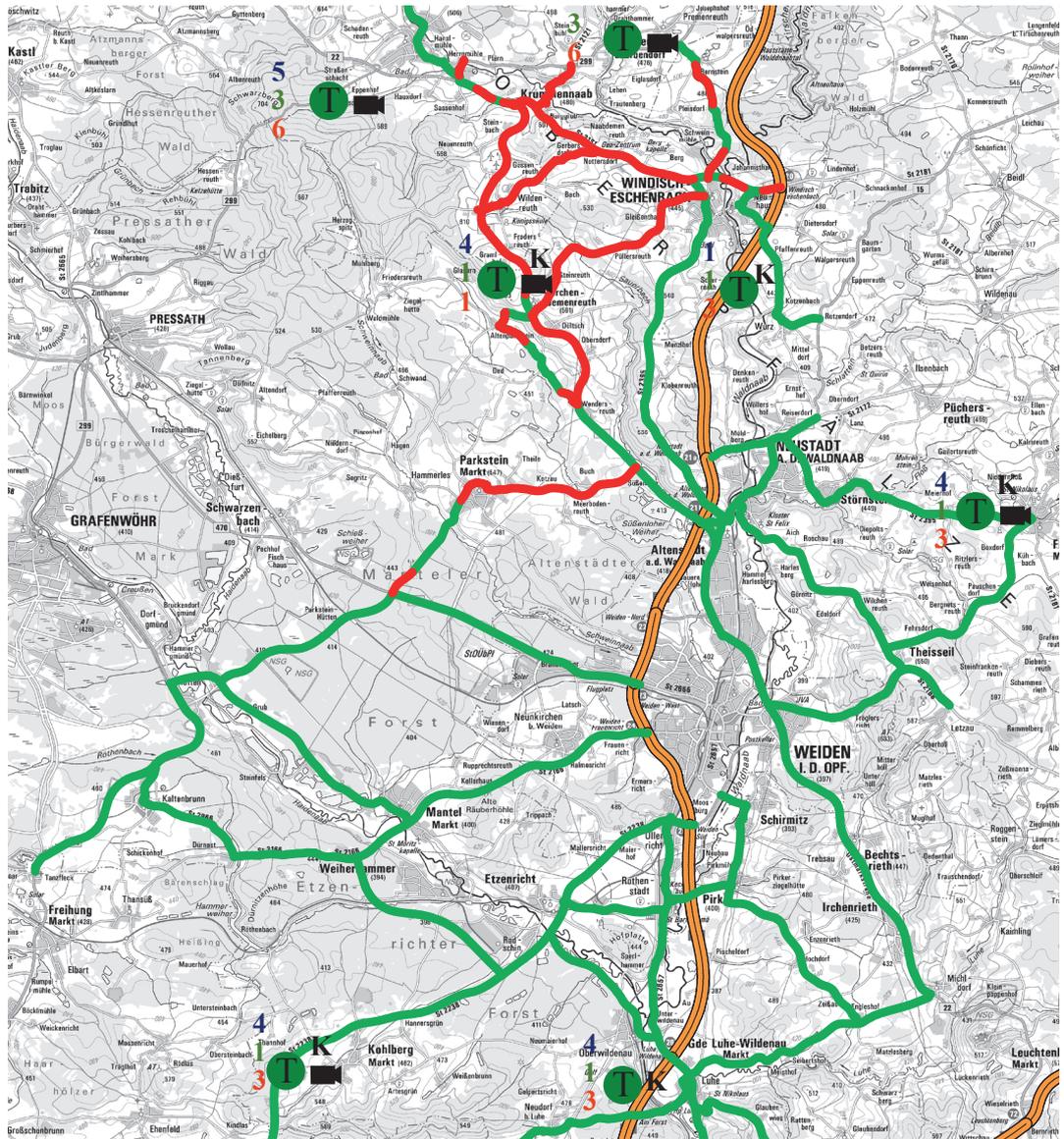
The WDMS consists of two modules that can be used independently of one another: the forecasting module and the deployment module.

The forecasting module provides the most important weather data with a two-hour review and provides current readings as well as a forecast for the next 18 hours. The precipitation radar of the German Weather Service (DWD) and the following measurement and forecast values of the road weather stations are shown:

- › Road, air and dew point temperature
- › Precipitation type and quantity
- › Road condition (dry, damp, wet)
- › Wind strength and wind direction

By adding and removing different layers, users can decide themselves which information is relevant for them. For example, in addition to clearing and gritting plans,

» WDMS, route-related alerting



information about the assigned vehicles, route lengths, salt requirements and circulation period can be retrieved in just a few clicks. Freely-configurable diagram and webcam galleries also offer users the opportunity to conveniently view the relevant data and images for their area at the click of a mouse.

With the route forecast, a completely new function for the WDMS was implemented. On the basis of the measured values of road weather stations and detailed forecasts of the DWD, the system calculates the hourly black ice risk of the routes being serviced. Depending on requirements, the alarms can then be displayed either in a table or on a map. In addition, the Winter Service Operations Manager can rely on a time slider to always retrieve the most accurate information on which sections can expect black ice over the next 18 hours.

The second WDMS module, the so-called deployment module, maps the winter service deployments in real time. For this purpose, the locations and activities of the winter maintenance vehicles are transmitted continuously every two minutes to central servers and displayed on the map of the WDMS as a symbol image. The Winter Service Operation Manager receives the following information about the pictogram used:

- » Activity of the vehicle (clearing, spreading, empty run)
- » Direction of the vehicle on its route
- » Route sections that have already been maintained

For about 25 years, the road maintenance service in Bavaria uses moist salt FS 30 (30 percent salt brine, 70 percent dry salt), which has meanwhile established itself as the

Preventive brine spreading on the A 9



standard. By moistening the dry salt, significantly less swirling arises during spreading and the scattering pattern is much more uniform. In addition, the moistened salt adheres better to the road, which in turn reduces slipping by the traffic.

Despite the advantages mentioned above, FS 30 also causes large salt losses due to traffic – and so it makes sense to increase the proportion of brine to up to 100 percent, in particular with dry roads and temperatures just below 0 ° C. In Bavaria, therefore, the use of pure brine (FS 100) on motorways was already tested in 2008. Here, it was found that with the same thawing effect is possible with less salt and the salt also remains on the road for longer. This makes FS 100 particularly suitable for efficient preventive spreading as soon as the weather forecast or WDMS predicts a risk of freezing.

However, pure brine spreading is also subject to physical limits. Due to the lower amount of salt applied, the FS 100 can only be used down to about -6° C. In addition, the previously used FS 30 proves to be much more effective when it comes to keeping the snow clear in heavy snowfall. For this reason, all Bavarian motorway maintenance depots are already equipped with combined spreaders which can deploy both FS 30 and FS 100. They can be used for both curative and preventative spreading and are therefore indispensable for an effective winter service.

In the area of federal and state roads, FS 100 is used primarily for preventive spreading, especially on the outskirts, while FS 30 is particularly successful in urban areas. Accordingly, within the next few years, the Bavarian road maintenance depots will be equipped with combined spreaders.



« Women and men in orange: hausham road maintenance depot

Our women and men in orange

In order to best meet the numerous and responsible tasks in operational service, the state building administration must be able to rely on dedicated and motivated employees in the service depots.

Here, the two organisational concepts AM 21 and SM 21 from the years 2004 and 2007 respectively come into play: thanks to them, the road maintenance service is prepared for the future and has improved significantly both in terms of quality and cost-effectiveness. For example, the cooperation between neighbouring service depots or the assumption of motorway tasks by nearby road maintenance depots has given rise to larger organisational units which make it possible to use existing staff, vehicles and equipment more flexibly and efficiently. At the same time, however, the closure of individual sites was largely abandoned so as not leave rural areas high and dry.

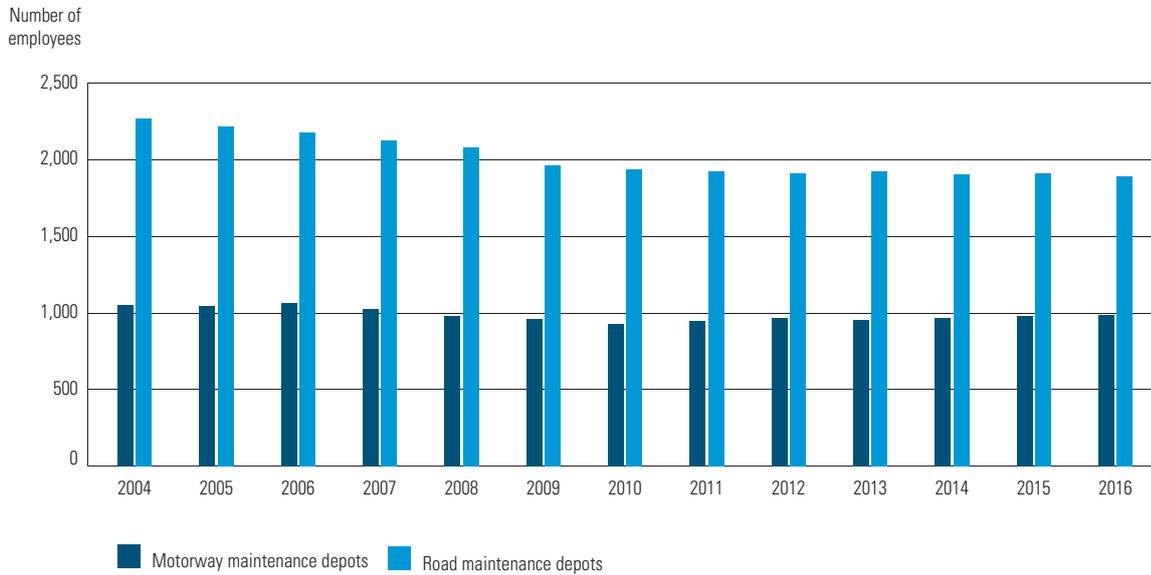
Although the number of people employed in the operating service has fallen by almost one fifth since 2004, the following additional tasks had to be taken over during the same period:

- › 24-hour winter service on federal and state roads with outstanding traffic function
- › Shortening the circulation times in winter service on particularly critical motorway sections
- › Preventive spreading operations on the rise
- › 24-hour on-call service in the road service depots.

This enhanced agenda can only be tackled by increasing the use of private companies for operating services. In the meantime, especially in winter service, around half of the clearing and spreading work is carried out by private service providers at the road maintenance depots. In the case of the motorways, the proportion of contracts in winter service is currently around 20 percent.

Another consequence of the now completed staff reductions is the age structure of employees in the maintenance depots. Since the average age in the operating service is now over 48, employees are increasingly no longer able to cope with the high mental and physical strain of their profession and can therefore no longer be deployed to their full capacity. For this reason, in 2011, a health promotion programme specifically tailored to the employees of the

Number of employees in maintenance depots over time



maintenance depots was introduced. Among other things, it envisages the increased use of special equipment such as remote-controlled mowers which greatly reduce the physically demanding work. Improvements are also planned in winter service; for example, the operation of ploughs and spreaders from different manufacturers should be made simpler and as uniform as possible.

In the next few years, many members of the operating service will leave due to age. All the more important is the timely search for junior staff, which we are already tackling through increased activities – in schools, at vocational training fairs or through trial internships.

Despite these challenges, the Bavarian road maintenance service is well prepared for future tasks thanks to its motivated and committed employees, modern fleet and intelligent software solutions!



SAFE JOURNEY – ON SAFE ROADS

Traffic safety today and in the future

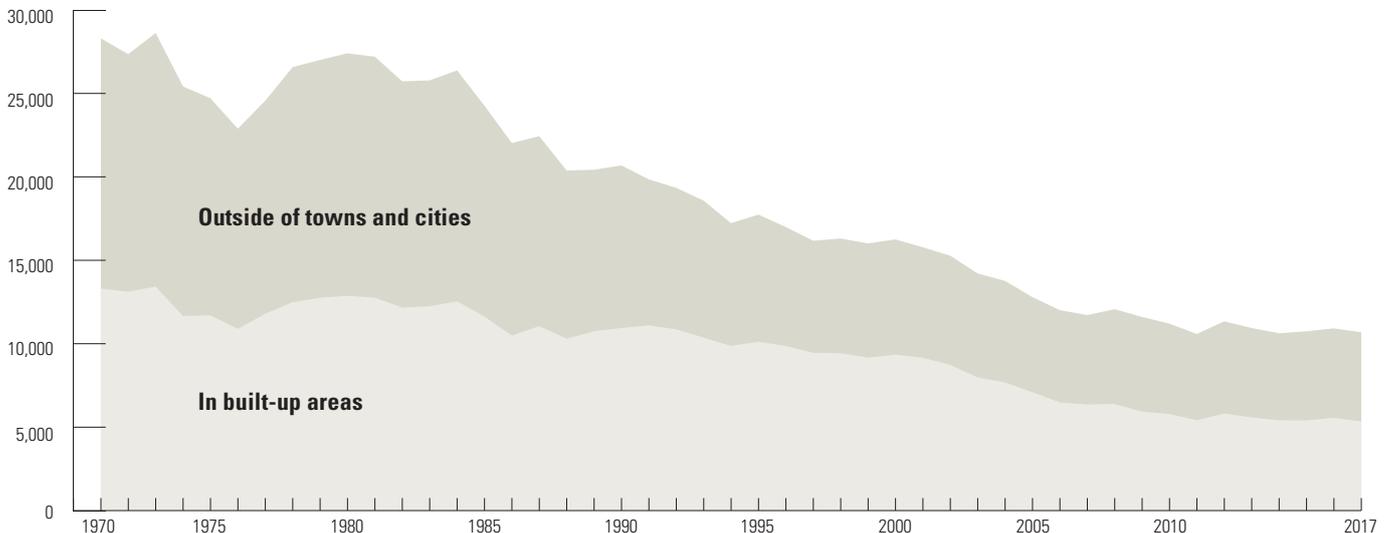
↗ Country road with good safety level

Author **Dr.-Ing. Volker Spahn**

Roads make a considerable contribution to handling the ever-increasing volume of traffic – and thus constitute an important factor for the economic development of our federal state. At the same time, however, no other mode of transport has similarly high accident rates: in Bavaria alone, one road user is injured on average every seven minutes; every 14 hours, a person succumbs to their injuries. If one looks within this context at the accident statistics of other modes of transport – such as the railway – it quickly becomes clear what comparatively great dangers for life and limb exist on roads. Nevertheless, the successes of the efforts made in recent decades to reduce the risk of accidents on the roads are obvious: since the early 1970s, when the number of people killed and severely injured reached its peak, the number of serious traffic accidents on Bavaria's roads has declined almost continuously. This development is all the more remarkable since the annual mileage has increased many times since then. The causes for the

Serious accidents 1970 – 2017 in Bavaria

(Accidents with fatal or severe injuries)



pleasing decline in major accidents are extremely varied: they range from regulatory intervention by lawmakers, such as the introduction of mandatory seatbelts and helmets, alcohol limits, improvements in rescue services, to technical advances in vehicle safety. Driver assistance systems, including in particular the Anti-lock Braking System and Electronic Stability Program are now standard features in motor vehicles and help the driver retain control of his/her vehicle even in critical situations.

In addition to these factors, road construction has also been shown to make a significant contribution to the decline in accident numbers since the 1970s. Worth mentioning here are above all

- the structural separation of the types of traffic
- the installation of passive protective devices
- the creation of non-slip road surfaces according to dynamic driving requirements
- the construction of safe intersection solutions
- the expansion of the motorway network (motorways are the safest roads after adjusting for mileage)
- as well as operational optimisations such as winter service.

Tackling the risk of accidents – the Central Office for Road Safety (ZVS)

Nevertheless, according to expert opinion, the potential for further increasing road safety – above all in the area of road infrastructure – is far from exhausted. This is reflected in the fact that many, and in particular heavy, traffic accidents continue to be concentrated at certain points, regardless of local mileage. Accordingly, one focus of road safety work in future is to identify and restructure obvious areas of road traffic that are at risk of accidents so that accidents are significantly reduced and serious accidents avoided as much as possible. This is where the Central Office for Road Safety comes into play. For more than 25 years, it has coordinated the clean-up of those particularly accident-prone areas for all roads that are managed by the Free State of Bavaria. In order to identify them, the ZVS first presents the traffic accidents recorded by the Bavarian police using geoinformation systems and specially developed programmes in digital maps; subsequently, the ZVS staff accompanies the implementation of the appropriate remedial measures. Almost all traffic accidents on classified roads in Bavaria are accurately recorded on the digital maps created by ZVS today. They thus form an extremely useful basis for road-related local accident investigations in Bavaria. The most important tool here is the Bavarian Road Information System BAYSIS. It not only allows the selection of traffic accidents for any time and section, but also, depending on the task,



their combination with other specialist content such as the number of traffic data and speed data, data of the road construction and data of the road construction detection plus geodata services from neighbouring administrative departments.

Standardised before-and-after comparisons, which have now been carried out by the ZVS at more than 3,000 examined sites and routes, show clearly that the measures taken have had a positive effect on accident-prone areas. All associated examination results including analyses and remedial measures are stored in a web application and are available to the Bavarian authorities in a justifiable, comprehensible and practical form. Since the web application provides predictions on the usefulness of planned measures, it offers valuable assistance in selecting particularly suitable measures. As a result, the online tool ensures the deployment of highly recommended remedies in similarly located accident-prone areas. If, for example, accidents were based primarily on driving faults at certain spots, the corresponding expansion or new construction of longer country roads or the straightening of narrow curves turned out to be the most effective solution.

The effectiveness analysis of remedial measures at identified accident sites clearly demonstrates the importance of compliance with the technical road safety regulations. Due to various boundary conditions, the planning of new roads occasionally compromises safety-

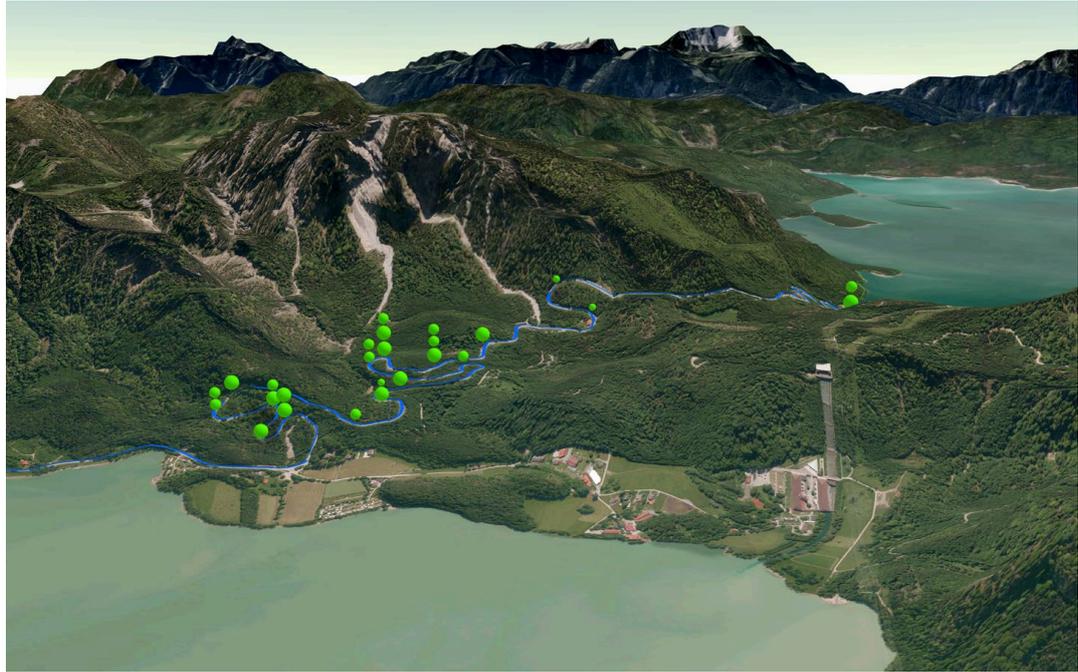
relevant parameters and underestimates its effects. As a result, planning deficits are possible that increase the risk of traffic accidents. This should be prevented by so-called safety audits; they are carried out by auditors who not only have extensive experience in planning roads, but also take part in regular nationally recognised training courses on current safety research. In order to find an acceptable and traffic-safe solution for all road users, experts examine road planning for possible safety deficits; once these have been identified, builders decide how to best eliminate the corresponding vulnerabilities. Overall, around 50 percent of all deficits identified in the safety audit lead to changes in planning; where, due to local conditions, costly rescheduling is economically unjustifiable, traffic restrictions and instructions must provide for the highest possible level of safety. Since, only a limited part of the road network is expanded, extended or renovated each year, the impact of these measures on national accident statistics is limited. For this reason, safety auditors will also increasingly be devoted to existing roads.

Danger zone country road: approaches of construction solutions

The official accident statistics reveal that most fatal road accidents occur on rural roads – in Bavaria, this figure is approximately two thirds of all fatal accidents. Especially when vehicles stray from the road, the risk of serious

« Country road with formerly accident-prone bend

» Three-dimensional map with driving accidents (green)



injuries remains particularly high in this respect. Survival of vehicle occupants then depends essentially on two factors: the nature of the area to the side of the road and the effectiveness of the vehicle's protection systems. While the automotive industry is constantly optimising the latter by using state-of-the-art technology, there are still many solid obstacles alongside the road on our country roads; these become a fatal risk even with a lateral impact at speeds of 50 to 60 km/h, because then even the most modern vehicle technology cannot prevent accidents from resulting in death or serious injuries. It is therefore essential to consistently minimise these dangers – for example, by shielding or, if possible, eliminating dangerous obstacles close to the road, such as trees, pipe outlets and masts with protective equipment. Fortified verges, in turn, can help guide a slightly off-the-road vehicle back onto the road.

A further significant gain in safety are crash barriers. These are aimed primarily at the protection of car occupants. For motorcyclists however, these barriers can be life-threatening in certain cases due to their sharp-edged metal posts to which they are attached. In Bavaria, the existing crash barriers are retrofitted by an underrun protection along routes preferred by motorcyclists in order to reduce this risk expediently. In addition, especially the popular motorcycle routes have to meet the specific safety needs of motorcyclists, since single-track vehicles pose particularly high physical requirements on the road

surface and are often perceived by other road users to be worse than cars, trucks and the like. All these aspects are to take particular account of the road condition, the design of intersections and the routing of motorcycle routes.

Many serious accidents occur at junctions and intersections, which do not meet the requirements of the applicable technical regulations in every respect. For this reason, the safety optimisation of junctions has great potential for reducing the severity of accidents. Where the structural redesign of a junction, for example, by replacing it with a roundabout or by adding traffic lights is not feasible for the foreseeable future, "smaller" solutions can also offer some relief: thus, at least the recognisability and comprehensibility through high-quality equipment can often be improved there, for example, by means of appropriate signage and/or markings.

Urgent action continues to be revealed in front-on collisions in oncoming traffic, as most road deaths on rural roads are to be lamented here. Such accidents are very often triggered by risky overtaking manoeuvres along two-lane roads. In order to minimise this risk of accidents, visibility improvements or the examination of overtaking bans are recommended on particularly striking routes. On very busy routes, safe overtaking opportunities can be created by building sectional overtaking lanes adapted to suit the local boundary conditions.

➤ Bend with retrofitted underrun protection



⤴ Crossing aid in a built-up area

Within built-up areas, the protection of more vulnerable road users is the main priority. This inevitably involves a well-developed and consistently usable cycling infrastructure, with the help of which, especially at junctions, the number of bicycle accidents can be reduced – despite the equally desired and expected significant increase in cycling. For pedestrians, on the other hand, the focus is always on easily recognisable, safe and user-friendly crossing aids. They should ensure that both our youngest road users and elderly pedestrians are able to reach the other side of the road at any time safely.

High-quality road infrastructure as a sustainable investment

Roads have to meet the needs of their users at all times. A huge challenge, considering that road users are such a heterogeneous group: they move at different speeds, have different physical and mental conditions, perspectives and perception and reaction skills. Even with all due care, they still make mistakes because they are subject to misperceptions, get distracted, or misjudge their driving skills. It is true that futurologists like to assert here that "human vulnerability" is no longer relevant in the future world of autonomously-acting vehicles, since no accidents caused by humans could then occur. It should be noted, however, that even autonomous driving requires a high-quality infrastructure, since a considerable part of the "driver-adverse reactions" cannot be ruled out in the future due to inadequate hazard detection, even with the help of state-of-the-art technology. For this reason alone, the improvement of the safety-related condition and the equipment of our conventional road infrastructure must be consistently driven forward – apart from the fact that it already benefits road users today.

As mentioned above, the number of serious accidents (with fatalities or serious injuries) has been declining for quite some time, Bavaria has seen a certain stagnation in recent years. In order to achieve the ambitious targets set by Bavaria, Germany and the European Union for the reduction of fatalities and serious injuries in road traffic, it will be necessary in future to pay even greater attention to the improvement of the existing road network. All those involved face major challenges which can certainly be mastered confidently with respect to the road infrastructure. The prerequisite for this, however, is to understand traffic safety



as a cross-sectional task; all administrative departments, private engineering firms, universities research institutes, construction industry and lobby groups must orient themselves to the well-being of road users..

PAVE THE WAY

How we work together towards a future without barriers





Authors **Dr.-Ing. Alfred Kühn, Thomas Hölzl**

M

Mobility is the basic prerequisite for any participation in life in society – this is especially true with regard to working life, but ultimately affects all areas of our community. Of course, people with mobility impairments also want to be able to make their way as far as possible without outside help. Therefore, the entire journey must be optimally aligned to their needs. An essential prerequisite for this is the barrier-free design of the transport infrastructure.

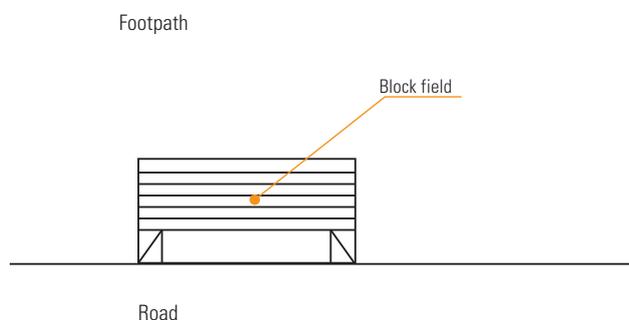
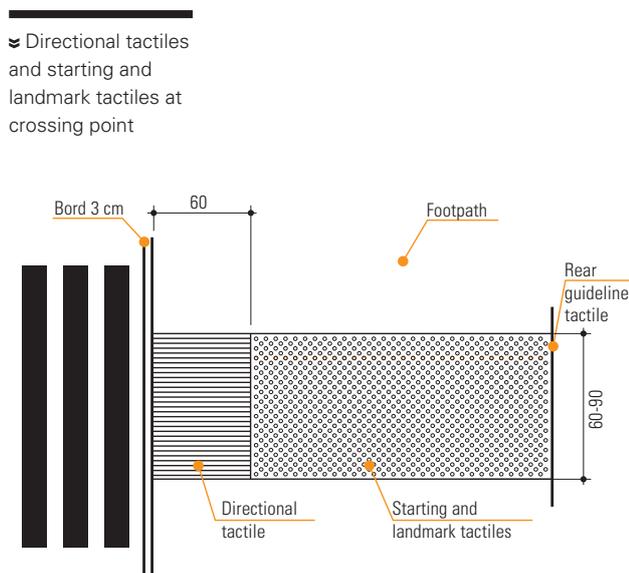
The Federal Highway Law (FStrG) stipulates that the responsible road authority is required under the legislative road requirements to "(...) take into account the interests of (...) disabled and other people with mobility impairments with the aim of achieving as far-reaching accessibility as possible". The Bavarian highway code (BayStrWG) also requires consideration of the needs of people with disabilities and people with other mobility impairments, "(...) provided other predominant public interests, especially traffic safety, are not in opposition. This precludes making a single issue, such as that of persons with disabilities, absolutely binding.

For the implementation of accessibility, the Bavarian State Building Administration has an extensive set of guidelines and DIN standards available. We have developed a working

aid for our planners. Within this context, control solutions or standards are defined for the area of accessibility, which take into account the necessary planning "leeway" for the respectively appropriate solutions.

Diverse claims from the demographic change

As life expectancy increases, so too does the number of people living with mobility impairments who are getting older and continuing to actively participate in road traffic. Accordingly, the subject of accessible mobility in road construction is becoming increasingly important. According to the German Traffic Safety Council (DVR), even today 30 percent of Germans are restricted in their mobility; along with this, mobility needs and actual mobility in the public transport sphere will change significantly in the future. Accessibility must meet the needs of the visually impaired and the blind as well as those with reduced mobility, such as wheelchair users, people with rollators, people with pushchairs or heavy luggage, and children who have no previous experience in public transport. The need for action extends in particular to the inner-city transport network; it must ensure that the routes from the place of residence to shops, doctors' surgeries, pharmacies, schools, retirement homes, but also to facilities of cultural life are designed to be barrier-free. It is very important for us to combine the needs of the "more vulnerable" road users with the concerns of traffic safety.



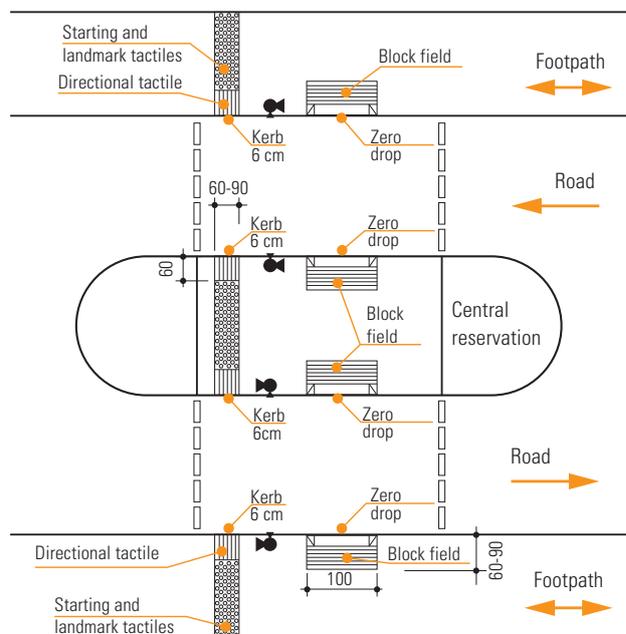
☞ Block field for zero drop at separate crossing point

Built accessibility

From a structural point of view, the implementation of accessibility extends from the construction and design of sufficiently wide pavements, through crossing points for carriageways, to solutions for junctions and bus stops. There has also been an increase in the supply of sufficiently-wide parking spaces. Also, the road equipment must be adapted to the changing needs, for example, in the form of longer green phases and acoustic signals at traffic lights or the font size on traffic and information signs.

Another aspect concerns tactile guidance systems with corresponding ground indicators. With elements such as

Separate crossing point with kerb and zero drop; tactile floor elements in picture and sketch



starting and landmark tactiles or directional tactiles and block fields (see diagrams), visually impaired and blind people are to be allowed a largely independent mobility in the public traffic sphere. A special focus in the design of such control systems is on the implementation of closed journeys instead of singular isolated solutions. For this reason, we recommend that the municipalities involved in the conversion and expansion measures of our local thoroughfares, if necessary, also redesign the barrier-free onward walkway areas contained in their building obligations. Here, always "naturally" existing structures with guiding element functions should be included, such as house walls, fences or lawn enclosures. Finally, it is necessary to comply with the requirements of general urban planning through the sparing use of additional tactile elements. An important detail here is the optimal design of the height of kerbs at crossings; these must act as a tactile edge for the visually impaired and at the same time must not be an insurmountable obstacle for persons in wheelchairs or with rollators. As a control solution, we see here the so-called separate crossing point, which provides separate crossing points with kerbs lowered to road level as well

as sufficient kerb height for white sticks. Alternatively, a continuous kerb height lowered to three centimetres can be considered as a suitable solution. At bus stops, we see the "Kasseler Sonderbord" as standard, which ensures the lowest possible entry level into buses. However, it is also crucial to look beyond the bus stop into the surroundings, where barrier-free accessibility must be ensured by means of any necessary crossing points and ramps. An equally important role in this context is played by the barrier-free design of the traffic routes, when construction sites require temporary routing.

Things are better together

The requirements for barrier-free construction must already be taken into account in the planning process. That is why we have established an appropriate audit process for quality assurance, ensuring that the issues of accessibility are incorporated into all essential planning phases. The review is carried out by specially trained auditors. Deviations from the regulations are only permissible in justified and tenable exceptional cases, whereby accessibility therefore



« Bus stop with Kasseler Hochbord and tactile floor elements

represents the general case. Furthermore, we attach great importance to integrating the affected people on site with regard to the structural design of the accessibility. By openly sharing suggestions and discussing different approaches together, we not only find it easier to find the best possible individual case solution, but also ensure a high degree of acceptance. The municipal disability representatives of the districts and municipalities, who we regularly involve in the planning process and from whom we receive valuable suggestions, provide a great deal of support.

In addition, the Bavarian State Building Administration contributed to the establishment of the "Construction and Transport" module for the "barrier-free Bavaria 2023" programme of the Bavarian State Government for its area of responsibility. Its declared goal is "(...) to finance additional structural measures for the creation of accessibility in the area of responsibility of the Bavarian State Building Administration over the next ten years and, in particular, to financially support municipalities and public transport operators. Accordingly, accessibility should be able to be established in particular "where high frequencies and a lack of options for using other services are present and the removal of barriers to meet everyday needs is imperative". Between 2015 and 2017, we already invested around

€2.2 million per year in retroactive measures to improve accessibility on federal and state roads; in the future, too, we want to use appropriate programmes to best meet our extensive responsibility in this area.

Recognise and use requirements

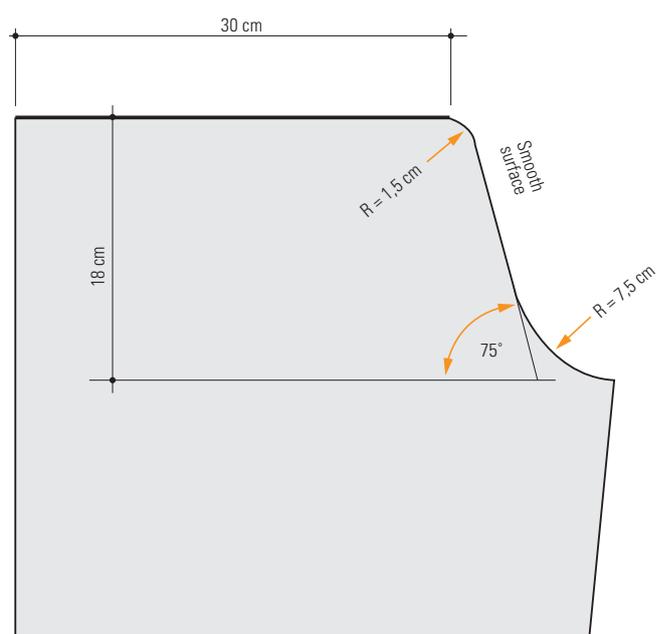
According to the guideline "The Accessible Community", it is incumbent on municipalities in particular to identify existing accessibility deficits and to remedy them together with the responsible authorities. Good practice is therefore that the municipalities, bus line operators or representatives of the disabled in these cases directly approach the state building authorities as public authorities responsible for federal and state roads. Step by step, existing bus bays, crossing aids, traffic light systems at intersections and pedestrian traffic lights are redesigned to be barrier-free within the limits of available funds and prioritisation or equipped with acoustic signal transmitters. There is increased coordination effort purely in the case of bus bays: on the basis of the local traffic plans and depending on the local conditions, it is necessary for road construction authorities, municipalities and public transport authorities to determine at which points, for example, structural measures are required or

accessibility can be achieved, for example, by the use of public buses with lifts. In the future, the current state of accessibility at bus stops in the Bavarian federal and state road network will also be detailed in the Bavarian Road Information System (BAYSIS).

Expedient funding

For district and municipal roads, in turn, the municipal authorities must ensure the provision of accessibility. In doing so, the municipal authorities or the respective transport company may have recourse to subsidies from the Bavarian Municipal Transport Financing Act (BayGVFG) and the Financial Equalisation Act (FAG). The basis for this are the guidelines for grants of the Free State of Bavaria for road and bridge construction projects of municipal construction authorities (RZStra) and the guidelines for the awarding of grants from the Free State of Bavaria for local public transport (RZÖPNV). The condition for such state support is the widest possible consideration of the needs of people with disabilities or mobility restrictions; in addition, discussions must be held with the responsible local disability officer.

☞ Kasseler
Sonderbord at
bus stop



CYCLING

Bavaria en route towards becoming the number one cycling state



Authors **Martin Singer, Johannes Ziegler**



T

Two wheels – and lots of advantages: cycling is healthy, protects the environment and improves the quality of life in cities. Apart from the great popularity in sports and leisure, cycling on short to medium distances usually represents the fastest and cheapest way of travel. Above all, electric bikes open up completely new opportunities to establish the bicycle as a means of transport for everyday use. More and more people go by bike to work or school, use it for shopping or even for delivery and transport purposes. Especially in urban areas, the bicycle can thus make a significant contribution towards relieving traffic on the roads and reducing noise pollution and exhaust emissions.

More than a tenth of the trips in Bavaria today are already covered by bicycle. Through targeted and comprehensive support measures, the great potential of the bicycle will be better exploited in the coming years and the share of journeys across Bavaria will increase to 20 percent. In addition to a comprehensive network of cycle paths with high-quality construction, this requires clear, uniform and consistent signage, safe and convenient parking facilities and improved combination options with public transport. At the same time, it is important to increase road safety in cycling despite the desired increase in the portion of journeys made on bicycles and to reduce the number of accidents.

Close to the citizen: Bavaria 2025 Cycling Programm

In early 2017, the Bavarian state government published the cycling programme Bayern 2025; it sets the thematic priorities on the road towards making Bavaria the number one cycling state. An important basis for this were the results of an Internet survey in which the participants expressed their wishes for attractive cycling. The most



Bayerisches Staatsministerium für
Wohnen, Bau und Verkehr




**Radverkehrsprogramm
Bayern 2025**

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« Measures package of the Free State of Bavaria: Bavaria 2025 Cycling Programm

frequently mentioned aspects were cycle paths and cycle path networks (86.6 percent), bike stands (74.7 percent), paved cycle paths (68.4 percent), signposting (68.2 percent) and being allowed to take bicycles on public transport (66.6 percent).

Investing in the future

The Bavaria cycling network represents a focus of the Bayern 2025 cycling programme. Within the next few years, this network will be designed for everyday cycle traffic and equipped with the corresponding signage. The aim is to connect all of the cities and communities in the free state of Bavaria to each other in a way that is suitable for cycling. At the same time, counties, cities and communities are called upon to develop their own network plans for further consolidation. A decisive role in the development of Bavaria's cycle traffic network will be played by the cycle paths on federal and state roads. Between 2015 and 2019, around 200 million euros will flow into their new construction and refurbishment. This high

level of investment, averaging 40 million euros per year, is to be continued beyond 2019. Indirectly positive effects for cycling also arise from the construction of bypasses; thus relieving the inner-city roads of through-traffic and heavy traffic not only provides more space for cyclists, but also opens up the possibility of redesigning wider road cross-sections in terms of construction or traffic law in favour of cycling.

New impetus for faster journeys

Cycling will continue to become more attractive in the coming years as electrification increases. With electric bicycles, longer distances can be covered without much physical effort, which benefits above all less athletic cyclists and elderly people. For example, inclines can be overcome more easily, allowing users to arrive at their destination much more quickly than with conventional bicycles. All this makes the bicycle an interesting alternative to the car in the long term – especially on routes up to 15 kilometres in length.



The term "electric bicycle"

In recent years, the electric motor has made its way into the bicycle. There are three types. On Pedelecs (Pedal Electric Cycle), an electric motor assists the cyclist up to 25 km/h when he/she is actively pedalling. Other variants are S-Pedelecs, which can go up to 45 km/h, and e-bikes that go up to 25 km/h and do not have to be pedalled at all. Only the Pedelec is legally considered a bicycle. This book uses the term "electric bicycle" for Pedelec.

According to the results of the "Mobility in Germany" study (2017), the average journey travelled by bicycles is 3.9 kilometres. By contrast, not only is the bicycle used much more frequently in the Netherlands, it is also used as a means of transport on longer journeys. Various studies show that even in German metropolitan areas, certain routes have potentials of more than 2,000 cyclists per day. In order to exploit this potential, speedy and pedestrian-friendly cycle paths are required. The latter, for example, must guarantee safe two-way traffic and overtaking by appropriate routing and sufficient width; in addition, they should be routed grade-separated or preferentially at intersections, in order to avoid excessive travel time losses. Current feasibility studies on the metropolitan areas of Munich and Nuremberg show that such rapid cycle connections are very cost-intensive and that there are numerous sections in the construction responsibility of the cities and municipalities. In order to support the municipalities in financing, funding options are being designed and set up both at the federal and state levels.

A perfect tandem: cycling and public transport

In order to further increase the attractiveness of cycling in the future, ideal networking with public transport is also required. Therefore, stations and stops for cyclists must be easily accessible and provide sufficient quantities of safe, convenient parking. With the cycling programme Bayern 2025, up to 4,000 modern bicycle parking spaces are to be built or improved in quality each year through improved funding. The increasing number of high-quality bicycles and Pedelecs requires theft-proof systems, for example, by lockable bicycle boxes or bike stations with service offerings. It is just as important to make the taking of bicycles on trains financially attractive and as uncomplicated as possible – for which, in turn, appropriate capacities in public transport must be created. Already in recent years, the Free State has therefore significantly increased the requirements for the dimensioning of multi-purpose areas in which bicycles can be transported in the tendering of rail transport services in the area of the Bavarian major regional centres.



« Interconnected traffic: bicycle station at the Augsburg central station

Experience diversity: bicycle tourism in Bavaria

Cycling tourism is a significant economic factor for Bavaria, especially since the Free State of Bavaria is one of the most popular cycling regions in Germany. A correspondingly large role is played by the further promotion and the consistent development of existing cycle tourism offers. The "Bavarian Network for Cyclists", which has existed since 1997, comprises numerous attractive long-distance cycling routes for recreational traffic – with more than 120 cycle routes and a length of around 9,000 kilometres. It is available as a free map and can also be downloaded online at www.bayerninfo.de/rad with lots of additional information. In addition to all the routes, there are also altitude profiles, which showcase attractions and service offers along the route. In addition, the web portal includes a cycle route planner, with public transport services and regional cycle routes integrated into the route search function. For some years, the offer also exists as an app for Android or iOS.

Financially secure in the saddle: building cycle lanes on federal and state roads

Already in 1981, according to the former road construction report of the federation, already a quarter of the federal road network (approximately 32,600 kilometres) was equipped with cycle paths. In order to set further energy policy accents within transport policy, a cycle path construction

programme was set up for the first time for the period from 1981 to 1985. This provided for both the subsequent cultivation and the construction of new cycle paths within the context of construction on federal roads. For cycle paths on state roads, construction programmes have been set up since 1985 and updated to this day together with the federal road programmes.

Currently, the cycle path construction programmes 2015 to 2019 are being implemented for federal and state roads. The basis for this was an analysis of existing gaps in the cycling infrastructure network, which also considered existing connections via parallel roads or routes. In addition, planning requirements were included, for example, the creation of inter-city cycle paths, the elimination of the frequency of accidents involving cyclists, and making school routes safe.

Especially in the area of state roads, there is still a great need for cycle paths; here, investigations showed gaps of around 1,400 kilometres in total. Based on the budgetary resources expected during the programme period, programme volumes were set, assuming a surplus of about one third. The calculated surplus ensures that the budget can be completely used up even in the event of project delays, for example, due to difficulties in land acquisition or coordination with nature conservation issues. Projects were selected after being classified in terms of urgency.

The programme for the subsequent addition of cycle paths to federal roads involves a total of 186 projects with costs

"It is important that we don't just invest in construction measures, but also in people's minds."

Matthias Dießl, district administrator of the Fuerth district and Chairman of AGFK Bayern

of around 100 million euros and a length of around 360 kilometres. The programme for retrofitting on state roads includes 117 projects costing 67 million euros and covering 220 kilometres. In addition, cycle paths will be built on federal and state roads in connection with road construction or renewed as part of conservation measures.

Municipalities can undertake the construction of cycle paths on state roads themselves and resort to state subsidies from the "Staatsstraßenumfahrungen in gemeindlicher Sonderbaulast" (state road bypasses in municipal special construction) funding programme. As a result, dependent cycle paths on state roads have been eligible for funding since 2009. The municipalities thus have the opportunity to prioritise cycle paths that are not included in the current cycle lane construction programme, but which have great importance from a municipal perspective. Between 2009 and 2017, 317 projects with a total cost of around 195 million euros and a total funding volume of 127 million euros were included in the funding programme.

All aboard, please!

Socially speaking, the promotion of cycling requires the active participation of various actors: only if the Free State, districts, cities and municipalities, cycling associations, public transport operators, transport authorities, schools and, last but not least, cyclists all "pedal together" can significant progress be achieved. The cycling programme Bayern 2025 therefore includes a comprehensive

catalogue of measures, the contents of which are aimed at various target groups. In the long term, a cycle-friendly climate is to be created throughout the Free State of Bavaria. This also includes extensive communication and information measures. The Free State of Bavaria, in close cooperation with associations, institutions and organisations, promotes campaigns such as "cycling to work" or "city cycling". In addition, Bavaria organises conventions, congresses and conferences on cycling and supports the "Committee of Cycle-Friendly Municipalities in Bavaria, Registered Association" (Arbeitsgemeinschaft fahrradfreundliche Kommunen in Bayern e. V. – AGFK Bavaria), whose member municipalities themselves are actively engaged in cycling.

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