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Abstract

ArbIS hosts data on planned and current road works for the Bavarian network to, among others, enable harmonised planning for optimised traffic management and high quality traffic data for publication by traffic information and navigation service providers. The system is constantly updated according to requirements and was updated to version 2.0.

Beyond the mandatory application of the system in the realm of responsibility of the Bavarian State Ministry of Housing, Building and Transport, ArbIS invites interested districts to provide information or directly work with the system based on the directive to digitise and publicise available public information. Several parties joined the ArbIS user group and the data set of reported planned roadworks is growing constantly. This success is boosted by the growing user community of an already well introduced system for the collection of municipal and district data (Formularserver) which also feeds data into ArbIS.

ArbIS and Its Goals

ArbIS is the designated database of the Freestate of Bavaria, represented by the Bavarian State Ministry of Housing, Building and Transport, for hosting and managing information on planned, current and past roadworks on the Bavarian Road Network.

Figure 1: Bridge construction on major interurban road near Regensburg

ArbIS currently facilitates four main use cases, further ones pending:

- Generation of traffic information on current and future roadworks
- Harmonised planning of roadworks to avoid congestion due to non-optimised traffic management
- Documentation of execution of roadworks e in addition to planning dates
- Automated generation and management of the Legal Permission Document (LPD = German “Verkehrsrechtliche Anordnung – VRA / VAO”) for roadworks

As in many European regions, the responsibility for the construction and maintenance of the road network in Bavaria is shared between different actors including the Freestate of Bavaria, the Autobahn GmbH, municipalities and districts. In addition, the seven Bavarian counties who are responsible for a smooth traffic flow on the roads in their respective region of responsibility supervise the coordinated planning of roadworks.

This diverse setup of responsibilities and actors makes for a complex organisational system which, among others, results in different software solutions (if any) implemented with different organisations and no common quality assurance processes, documentation and databases. This is a clear challenge for the provision of high-quality traffic information via the national access point (NAP) to be consumed

by market participants like navigation providers. However, this is essential for public traffic management, as it provides a huge leverage by distributing trustworthy information and let the singular traffic participants decide themselves which route is optimised for their use case under the prevailing conditions.

Figure 2: Asphalt works on B286 near Schweinfurt

Even more gravely, it is essential to coordinate the planning of the roadworks in order to avoid leading traffic on a detour into another roadworks. Harmonised planning over all responsible partners is key to prime traffic management.

ArbIS Approach

In order to enable the comprehensive coordination of planned roadworks and at the same time provide a comprehensive publication of traffic information also on roadworks, the Bavarian State Ministry of Housing, Building and Transport thrives to incorporate existing digital data into the ArbIS data base or encourage the digitisation of analogue data currently produced by the processes in place.

The digitisation of relevant data from numerous districts and especially urban regions is currently commenced either by collecting information via a dedicated internet portal (“Formularserver”) of by collecting the legal permission documents (LPD) which must exist for every roadworks.

Those data are manually transferred into ArbIS mainly due to the huge variety of georeferencing techniques used. These range from verbal descriptions to detailed location references based on the official Bavarian location referencing system for

roads. Automated systems are (until now at least) unable to interpret these data and hence a manual transfer is necessary causing significant workload and costs which shall be reduced.

Also, if measures are received from external sources not the same quality management procedures apply meaning that if a district works with ArbIS, those data are fully covered by the quality management scheme.

Hence, ArbIS is opened up to public entities beyond the Ministry and districts are encouraged to either connect their existing systems to ArbIS via digital interface or, alternatively, directly utilise the ArbIS system to realise the full benefit of ArbIS. Several market participants providing software to districts have already developed interfaces, partially in the frame of dedicated regional projects under participation of the Freestate of Bavaria, but quality assurance procedures need still to be implemented within the respective public authorities concerned to be considered fully fledged production processes.

This approach, of course needs to be considered in the setup of the system architecture, especially as, due to IT related reasons, additional access mechanisms need to be utilised in order to facilitate system access by district personnel.

Successes and further challenges

During the reporting period, several districts (Ansbach, Oberallgäu, Schweinfurt and others) started their direct work with ArbIS. Data on planned roadworks from those partners which are considered in the ongoing and annual harmonisation of the planned dates for the execution of roadworks as well as (for public data) publicised on websites, traffic information services and navigation providers can now directly be maintained by the responsible actors resulting, among others, in minimised delays between the occurrence of a changes and their digital reflection in the appropriate data sets and services.

Marketing strategies are deployed by ZVM which shall encourage further districts to participate in this deployment scheme. Within this frame, ArbIS is presented in dedicated working groups of districts and municipalities As these strategies employ existing personnel from ZVM, no external costs are generated.

As most districts already deploy software solutions on which their personnel is trained, it might be financially and organisationally unsound for those districts to switch to the direct operation of ArbIS. Also, the software deployed may provide functionalities specific to districts which might not be offered by ArbIS.

ArbIS is hence looking into means to offer a common interface based on industry standards to allow the data from those systems to be dumped to ArbIS and encourage software proprietors to connect to the ArbIS system by implementing the counterpart in their software. A DATEX II interface was developed implemented to connect to systems existing in multiple districts in southern Bavaria. Further technologies might be investigated to further ease access by market participants.

Finally, for those districts and especially municipalities with no access to IT personnel or infrastructure beyond standard internet, an internet service to manually describe planned roadworks is available. As mentioned above, those data need to be manually transferred into ArbIS which incurs a huge workload for the respective personnel. Especially due to the growing number of participants, measures must be devised for the future to electronically integrate said data, for example by offering a simplified version of ArbIS with geolocation capability.

The success of those activities can be seen on hands in the number of reported planned roadworks which is growing almost exponentially during the last years (see).

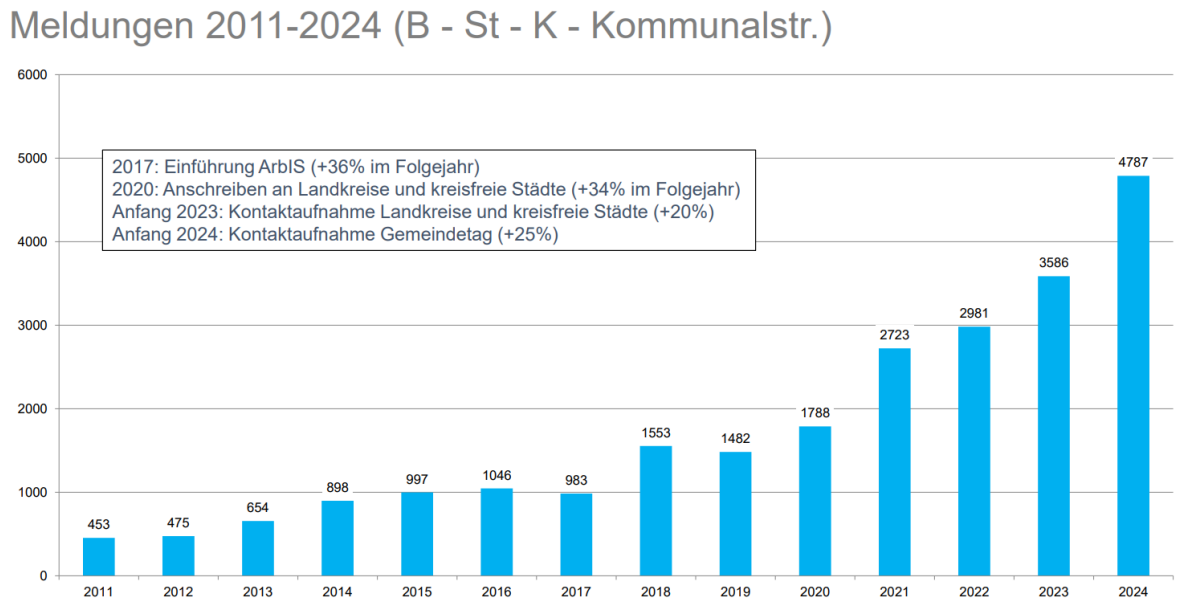

Figure 3: Total number of roadworks data sets on the Bavarian Road Network (BRN) reported per year

Key implementation steps and related milestones

As scheduled, ZVM started to approach the districts in 2022 in an ongoing endeavour to persuade those partners to join the ArbIS user community. The respective marketing scheme comprises direct presentations to target groups as well as repeated information offensives via suitable organisations and directly.

Until now, the integration of a separate map base (HERE) was not commenced according to the original schedule for the reasons of lack of requirement as district roads are covered by the network already represented in ArbIS. While the addition of a navigation map) paired with a highly dynamic development schedule for ArbIS. With the integration of municipalities, a HERE map would be somewhat required as the municipal road networks are not yet represented in ArbIS. Today, roadworks on these roads can be entered by using the free hand drawing tool on the map which is sufficiently exact but might slightly decrease user convenience for municipalities. It needs to be investigated if, before those partners can be approached, the integration of the additional map data base might be required. However, it was shown not to be

essential for the project goal of integrating Bavarian districts and hence was postponed to mid 2025.

ArbIS 2.0 was released in autumn of 2023 and is constantly improved based on the user communities response. It features a new user interface and improved workflows to support an enriched set of use cases.

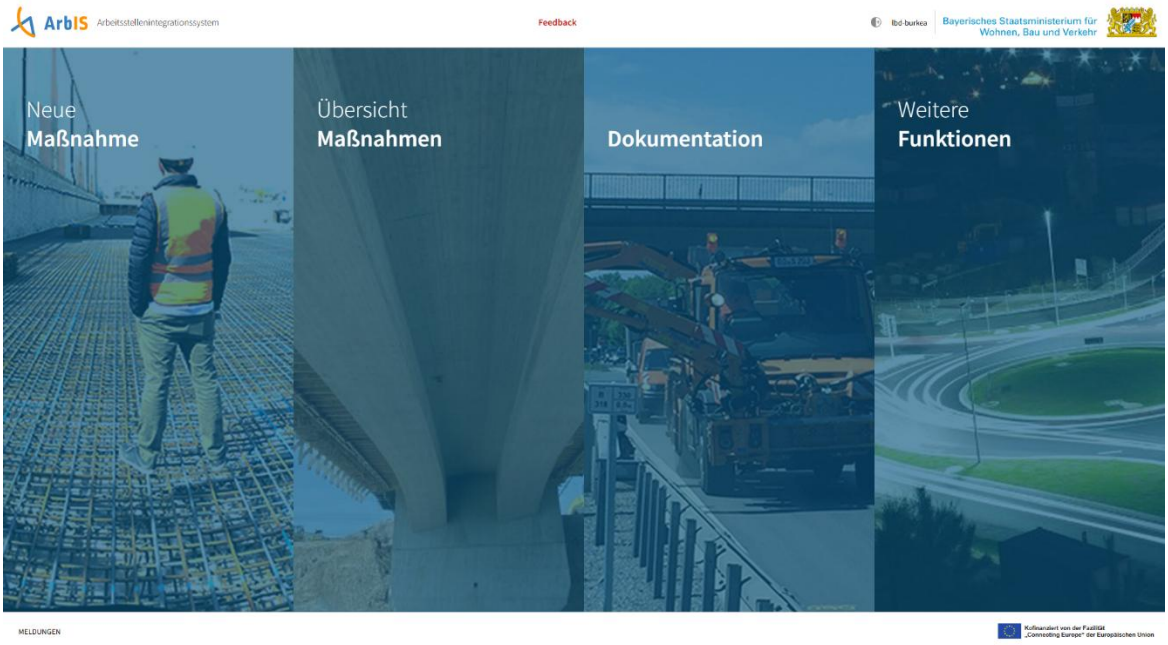

Figure 4: ArbIS 2.0 Frontpage

From early 2025 onwards, the generation of the legal permission document (LPD or *VRA -Verkehrsrechtliche Anordnung*) has to be mandatorily commenced with ArbIS for all significant roadworks.

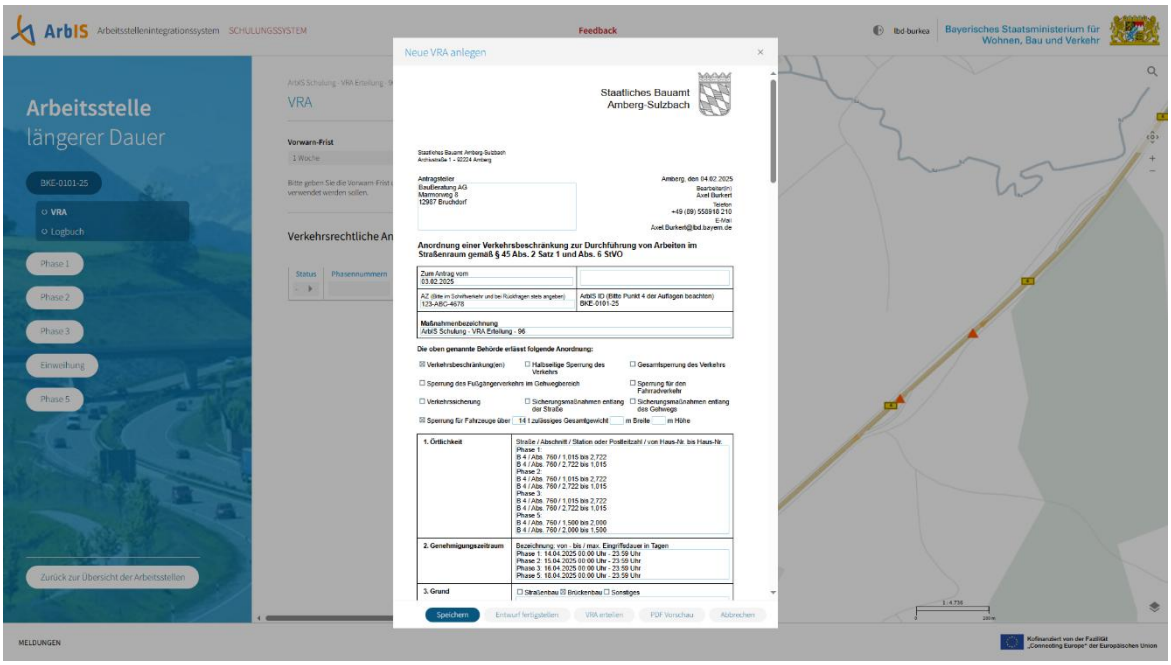

Figure 5: Automated Legal Permission Document (LPD) in ArbIS

This requirement is expected to further boost the completeness and exactness of the data sets contained in ArbIS as the LPD has to be correct at all times. Delayed entry of changes in planned dates and other details are relevant to the LPD and the update of the related data sets is hence legally mandatory to be timely and accurate. The expectedly improved data quality procreates though all ArbIS use cases including traffic information.

Future developments

As ArbIS holds the best available data on roadworks planning and execution. While use cases are developed according to the actual requirements set by the working group ArbIS, the governing body for the ArbIS development, multiple use cases are envisaged for the short-, medium- and long-term future.

Already planned but, due to lack of current requirement, not yet implemented is a map featuring minor roads which are operated under responsibility of external authorities such as municipalities. If those partners wish to join the ArbIS community, the addition of a dedicated map would ease data input as the geographical locations would not have to be entered by free hand sketch but, more conveniently, along digitised road stretches. This would also increase the convenience for the input of road stretches over longer distances as the current map data base requires the input of each road stretch between intersections separately. Boosted by another related use case, namely the automatic addition of a detour map to the LPD, this feature could become a reality in 2025.

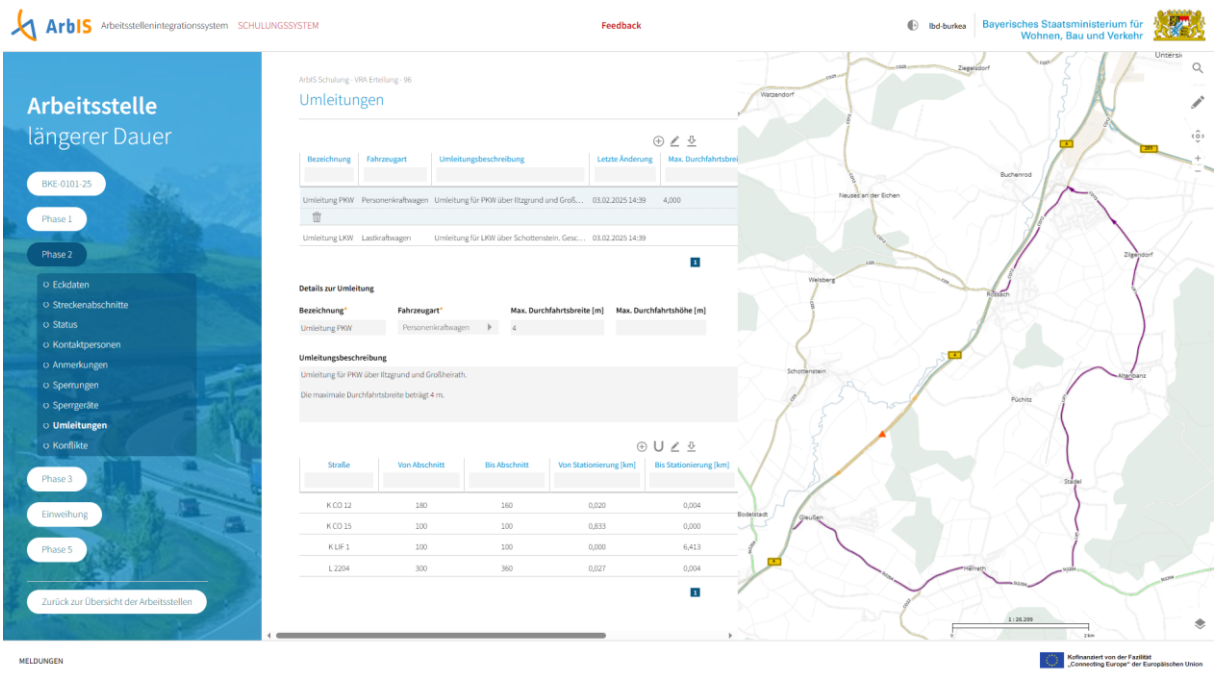

Figure 6: Example for multiple Detours of a planned roadworks in ArbIS

Also, as ArbIS allows for the definition of the exact point of time of the publication of a roadworks via different formats such as the NAP, navigation devices but also traditional and electronic news papers and social media, ArbIS could provide standards assets for a press release generated on basis of the Bayern KI (Bavarian

AI, dedicated AI system for the internal use cases of the Freestate of Bavaria) at the perfect time without the risk for miscommunication.

While certainly human staff cannot be substituted, such a feature has the potential to ease the workload especially for authorities without dedicated staff for the generation of press releases.

Thirdly, roadworks of temporary nature should be included in the future for documentation purposes. This should include the erection of dedicated C-ITS infrastructure for warning trailers (traditional technology is not C-ITS capable) and the connection of the cooperative centre, which is to be implemented, to the ArbIS system.

Other use cases and features will pop up during operation and the continuous extension and optimisation of the feature set is expected to continue.