Forschungsvorhaben FE-Nr. 02.0354/2012/ARB

Definition of methods and proof-of-concept for a converter software to produce OKSTRA objects for the road asset documentation out of road design data sets

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Problem in Question

The „Objektkatalog für das Straßen- und Verkehrswesen (OKSTRA)" – the German data structuring standard for road and transport IT applications – was created with the objective to allow data transport in and between the road and transport business processes without media discontinuity. This goal has in the meantime been met within the two important workflows for road design on one hand and asset documentation on the other. There is however no practical solution for the data transport between these workflows.

The research project was to show pathways to transport road design data to asset documentation without media discontinuities. The expected benefits of closing the IT gap between the workflows from road design to asset management in the near future are reduced cost of acquisition and qualification of asset data, higher timeliness of data when manual processes can be avoided or reduced, and better data quality when error-prone steps of the present workflow can be avoided or replaced.

Method of Analysis

At first, the results of the former research project „Verfahren zur Harmonisierung gleichartiger Objekte in den Bereichen Planung/Entwurf und Bestandsdokumentation, Untersuchung der Machbarkeit und Wirtschaftlichkeit des Informationsflusses in der Prozesskette Entwurfsplanung bis zur Bestandsdokumentation nach ASB-Netz und –Bestand" (FE 04.222/2008/ARB) were subject to a critical review and partial update. Involved were the specific subdomains and object classes considered, the technical regulations, the target business process defined, and the methodology, e.g. concerning alternatives.

In the next step, the present situation regarding the transport of data from the design process to the asset documentation was analyzed in order to find out to what extent is realized a continuous data transport of digital design data to digital asset data in different road specific domains, and why this fails in others. A precise definition of the terms „design data" and „asset data" was worked out. Starting from the rich set of resources available (technical regulations, internal guidelines of road and transport authorities, exemplary project records etc.), suitable themes were identified for further analysis. A theme comprises bundled information for a particular aspect of the real world road, independent of its IT representations. For the different themes, the present situation for the data transport from design to asset documentation was exemplified, especially when and why it is not implemented. In the latter case, data are lost and must be acquired afresh, i.e. there exists a media discontinuity. This can be avoided either by optimizing workflows (e.g. capturing data specified in the procurement process before they get lost), by the harmonization of data structures and rules for data acquisition (requires modification of software applications and maybe technical regulations), or by the digital conversion of the data objects without modification of existing data structures or guidelines.

All three approaches were analysed in detail thereafter. They are not strict alternatives but complementary methods.

One possibility to modify the workflow is Building Information Modeling (BIM). A further one is to extract data relevant for asset documentation at the end of the design process („proto asset data“). Requirements for this method were identified that guarantee a continuous data transport. Additional techniques for data acquisition were discussed, as well as the usage of data models that already guarantee the required data continuity.

Regarding the harmonization of data structures and technical regulations, at first it was analyzed which regulations concern themselves with IT applications. For those found, the possibilities for harmonization were regarded in technical and organizational respect.

Another possibility are data conversion methods. Ways of creating asset data out of constructive design data (e.g. alignment) and „general geometric objects“ (i.e. essentially CAD data) were described. A data transport process including conversion was defined. Necessary modifications of OKSTRA® and IT applications were described. The possibility of the feedback of asset data into the design process was discussed.

As the usage of data conversion had been shown to be theoretically feasible, this approach was verified by a proof-of-concept. A commercial CAD-System was slightly modified to produce proto asset data. The conversion software itself was implemented as plug-in for the OKSTRA toolbox (available from the OKSTRA web site). The interface of the OKSTRA class library („OKLABI“) was also slightly modified to demonstrate a standard approach to write conversion software. Finally, the ETL-Tool FME was employed to transform the converted OKSTRA data set into the format accepted by the target system. Test data from a real world road planning project could be obtained, as well as a suitable centerline from an asset data base and example data for the target format and for road side facilities.

In the final step of the research project, the cost effectiveness of the proposed measures were considered.

The active and effective support of Straßen.NRW in all steps of the research projects accounts significantly for the success of the project.

Results

The main technical obstacle for the continuous data transport was shown to be that design data produced by the design applications according to the simple data model „geometry plus object denotation“ cannot transport asset relevant information without media discontinuity. This data model is sufficient for the transport of visual information in drawings, it does however not allow the transport of object-structured data needed by the data base oriented applications used for the asset documentation. Furthermore, data added in the procurement phase are lost, e.g. specifications for materials and dimensions. The data transport from design to asset documentation must mandatorily include the building phase. Frequent changes compared to the planned state must be documented in order to get reliable asset data. The change management process needed for this task needs only consider those data actually needed for the asset documentation. Mobile techniques for data acquisition are probably of value here for their faster data transmission avoiding unnecessary delays. The use of conversion software is helpful for constructive design data. However, conversion algorithms tend to get complex. The prof-of-concept identified and documented various problems that must be resolved to allow reliable operation. A better match of the data structures would help, this must cooperatively be advanced by experts from the design and asset domains.

Implications for Future Practical Work

The present analysis shows that the implementation of a continuous data transfer from road planning to asset documentation has a realistic prospect. Some preconditions however are necessary, which are formulated in the following recommendations:

1. Overall goal: Life Cycle Management
2. Usage of existing data models allowing continuous data flow in some domains right now
3. Definition and implementation of an easily extendible, standardized attribute model as replacement of the current practice of the „general geometric objects“
4. Production of data structures in the design IT applications that are better able to be imported into the asset documentation (directly of after processing by stable conversion algorithms)
5. Reliable, standard compliant OKSTRA®-interfaces in all systems involved in the data flow.
6. Object level return of procurement-based information into the design applications
7. Reliable conversion software of sufficient precision where necessary
8. Rules for the coordinate reference systems used, maybe a standardized system for road construction valid in all of Germany
9. Description and implementation of a defined data transport process from planning via construction to asset documentation with quality assurance
10. Change management for asset relevant data in order to document deviations from the original planning during the construction phase
11. Increased usage of mobile data acquisition
12. Standardization of parametric models for constructive objects where possible
13. Better coordination of the version managements of the IT relevant guide lines and applications to provide standardized and stable data structures for the data transport
14. Consideration of the recommendations for data transport given by the current activities in Germany concerning Building Information Modeling/Management