AUTODESK UNIVERSITY 2013

2 Fast 2 Furious? Avoid Problems Caused by Rapid Energy Turnaround with Autodesk® GIS

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GS2855 This class demonstrates how ÜZ Lülsfeld, a regional German electric utility, is using Autodesk® AutoCAD® Map 3D software (on an Oracle® database) to meet the challenges of Germany's energy turnaround for utilities. No longer is it appropriate to use GIS only for as-built maps. Today's requirements include a flexible database with an open architecture, a programming interface, and easy-to-use (spatial) database functions. A modern GIS must also provide asset information and management with comprehensive reporting and analysis functions. AutoCAD Map 3D face all of these requests. We show examples of FDO and other database connections as well as integrating other applications, such as a network calculation program. We demonstrate how to create online as-built maps for third-party enterprises and mobile GIS (online and offline) to manage operational and breakdown services.

Learning Objectives

At the end of this class, you will be able to:

- Avoid problems caused by the rapid energy turnaround by using AutoCAD Map 3D and other applications
- Use Web-GIS both online and offline for operational and breakdown services
- Describe the practical interaction between AutoCAD Map 3D and other systems such as grid calculation or planning systems
- Explain how ÜZ creates interfaces to other enterprise applications, such as SAP®, IBM® Informix® databases

About the Speakers

Sebastian Kramer, sebastian.kramer@uez.de

I first came in touch with GIS and databases during my studies of Geography at the University of Bamberg/Germany. After finishing successfully my studies in 2009 I started my professional career at Autodesk´s Platinum Partner "Man and Machine" in Germany. As an Application Engineer I was particularly involved in different projects, especially in Germany and Switzerland, in the field of gas, water and electric utilities. In summer 2012 I changed my employer and became GIS Administrator at the "Unterfränkische Überlandzentrale eG Lülsfeld". My main duties are the administration of GIS and databases (especially Oracle and MySQL), programming of modules for our Client-, Web- and mobile GIS as well as providing technical support for the users. More than 50 employees in our company work with GIS data every day.

Artur Brei, artur.brei@uez.de

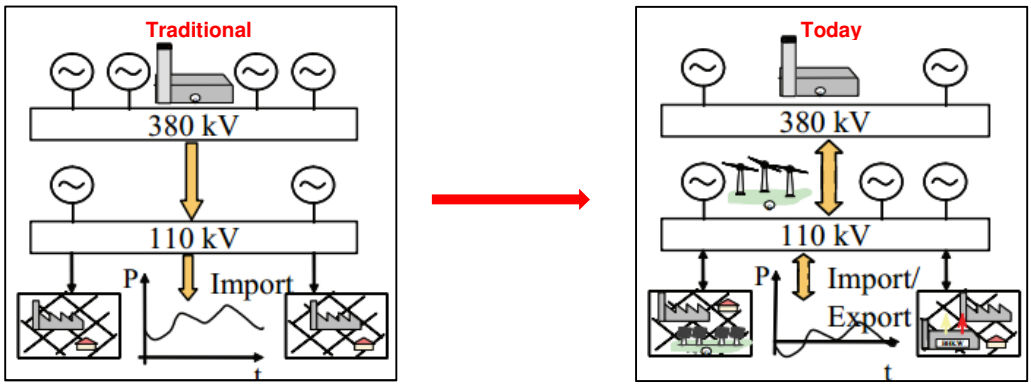
I hold a master's degree in engineering. My professional career started at an engineering company that dealt with surveying and civil engineering. Since 1999 I'm head of the graphic data processing at the ÜZ. My department includes 8 employees, responsible for documentation, quality management and IT processes concerning technical assets in GIS and all integrated database systems (ERP, Customer account data, CRM).Since 2005 I supervise the facility management of our company. I am also the president of the Autodesk® Geospatial User Group Germany e.V. (AGU Germany)

Avoid Problems caused by the rapid energy turnaround by using AutoCAD Map 3D and other applications

Energy Turnaround in Germany – Basics

The Fukushima disaster in 2011 initiated an intense discussion between German politicians about the use of nuclear energy. It culminated in a governmental decision to rapidly withdraw from nuclear energy and led to the establishment of different new laws. Eight out of 17 nuclear power plants lost their operation authorization in August 2011. The remaining ones are planned to go offline during the next nine years.

To compensate the loss of these power plants, a revolutionary change in the infrastructure of electrical networks took place. Supported by governmental subsidies, a huge amount of new decentralized renewable energy plants were created to use especially wind and solar power. While traditionally the electrical power supply meant the transportation of power from a centralized power generator (like a nuclear power plant) to the customer, today the situation changed due to the decentralized power generation.



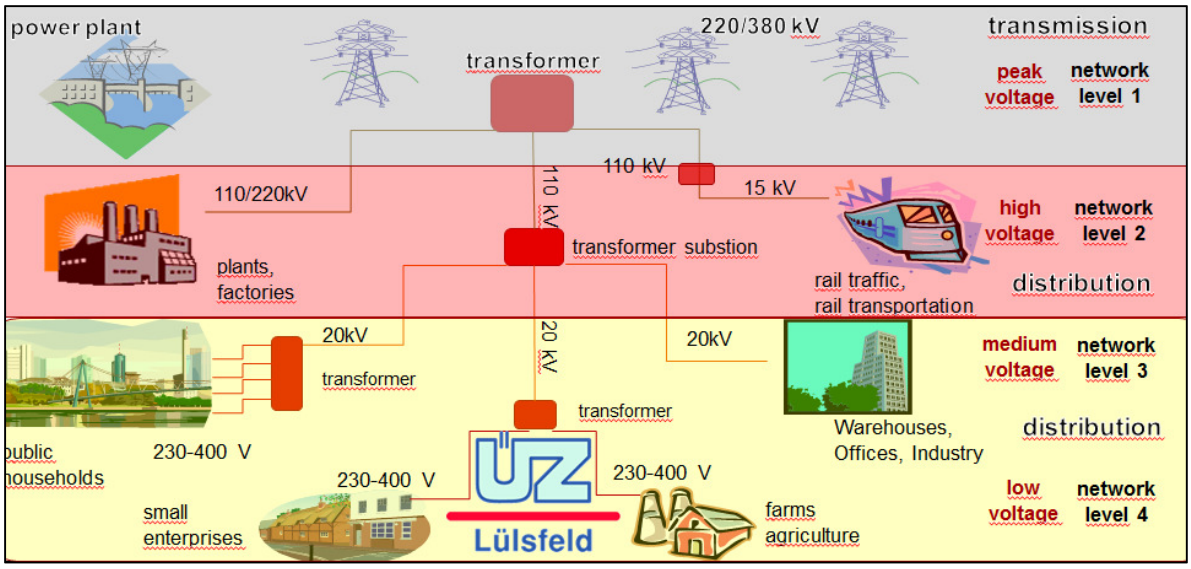
Source: Dezentrale Energieversorgung 2020 (VDE 2007)

This simultaneously led to an enormous increase in power generation on the (former) customer side.

The eye of the needle that was created by this evolution was the electrical network, which was not prepared good enough for this type of development.

Basically, the electrical network in Germany is divided into:

- Transmission grids for peak voltage (220-380 kV)
- Distribution grids for high voltage (15-220 kV)
- Distribution grids for medium and low voltage (0-20 kV)



One of the main challenges for the energy turnaround is to build an electrical network that can handle all of these new requirements.

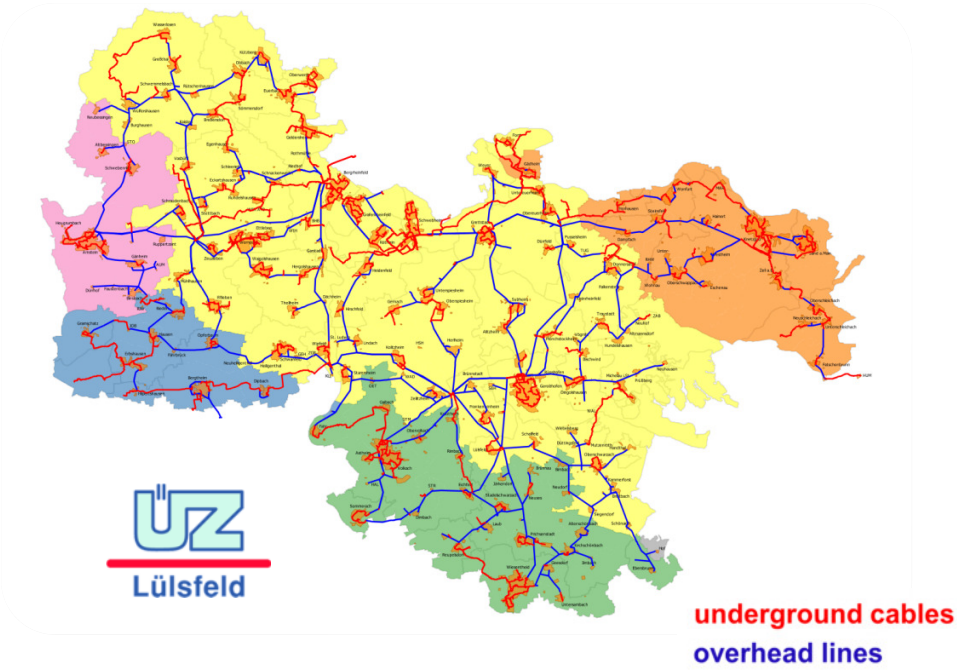
But this new and improved network not only needs to be built. It first needs to be properly planned. Afterwards it needs to be efficiently managed.

This is the place where Autodesk®-GIS can be very helpful to prevent and avoid problems but also to eliminate existing problems as fast as possible.

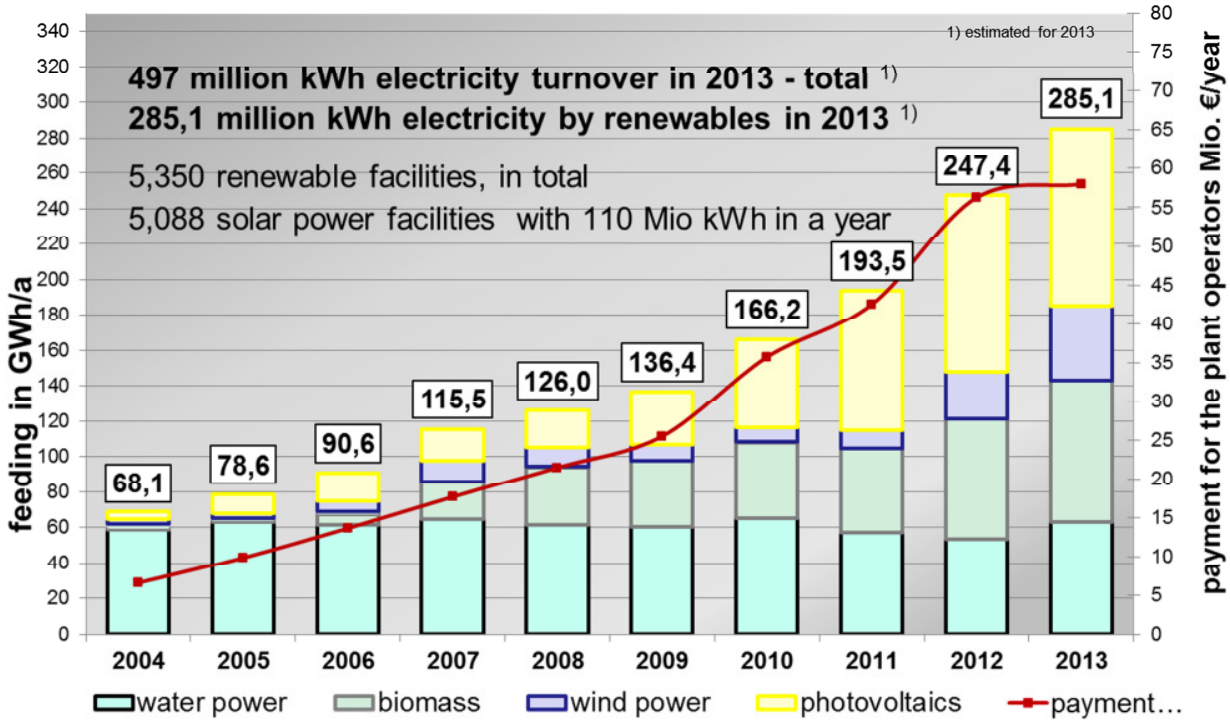
The Distribution Network of the ÜZ and how the energy turnaround affects the ÜZ grid

The ÜZ operates a low and medium voltage grid in the northwestern part of Bavaria/Germany. It's network area has a size of about 970 km². Here's some structural data of the ÜZ-grid:

- Medium voltage:
  - Aerial line: 230 miles
  - Cable: 341 miles
- Low Voltage:
  - Cable: 2355 miles
- Transformer Substations: 5
- Switching Stations: 18
- Transformer Stations: 962
- 62500 electrical meter at about 42000 connecting points



During the last ten years there was a huge amount of newly installed renewable facilities. As you can see in the next image, this development was even accelerated by the Fukushima event and its consequences.



This development made new investments necessary. So new transformer substations, switching stations, circuits etc. were built during the last decade to fulfill the needs of the new decentralized power generation and distribution.

Our GIS, based on Autodesk AutoCAD Map3D, plays a central role in handling and managing these numerous new objects and tasks.

GIS Infrastructure at the ÜZ – using all data in one single database by integrating other databases

GIS was introduced in the year 2003 at our company. One main goal was to abolish paper works dealing with maps and construction drawings.

We then began to gather all available data from Excel, Access etc. together in **self-developed applications** on GIS, for example:

- CRM-System including all contracts and correspondence with our customers
- BKZ: database for customer's electrical facilities and accounts like heating facilities, fusing or renewables

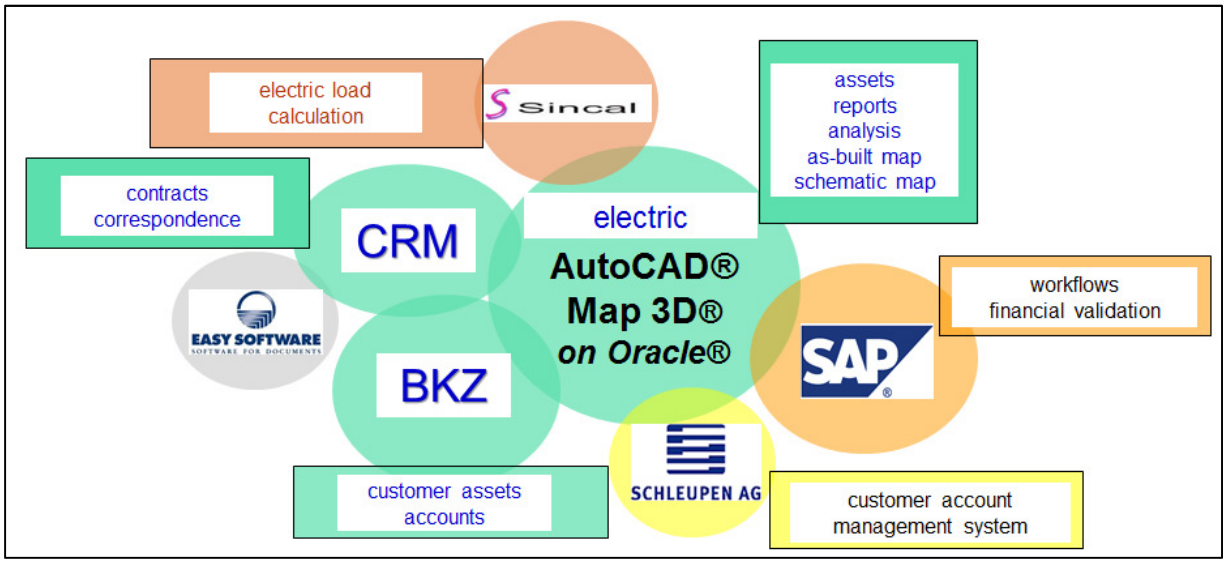
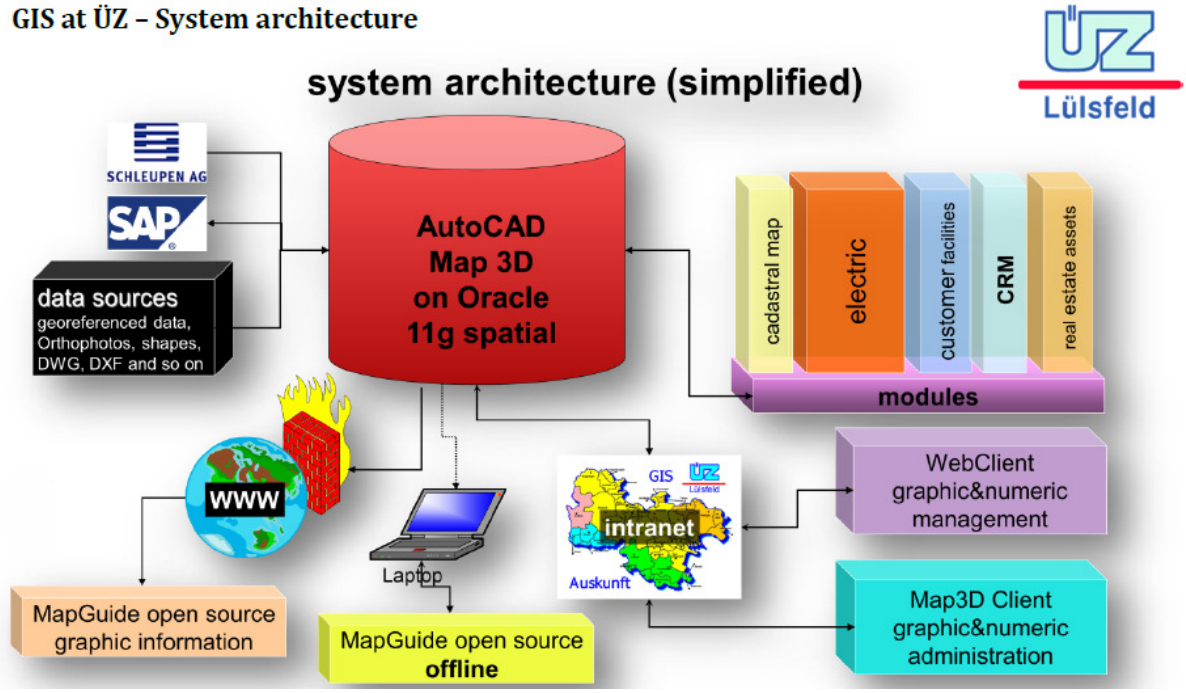


Image: Application Infrastructure at ÜZ

As you can see in the image above, AutoCAD Map 3D and the Oracle database in the background plays a central role for connecting all the different applications and databases due to its open and flexible GIS and database architecture which is shown in the next image.



As already mentioned, the Oracle® Database 11g is the center of our GIS infrastructure. It includes the five most important applications:

- real estate assets - about 13,000 parcels of land, which are assured by easements and contracts
- customer facilities for financial and technical issues like the technical house connecting equipment, data for the electric heating and all the important figures for the renewable power plants including all accounts back to the year 1960 (more than 200,000 data sets)
- CRM – a real costumer relation management system for administration, contracts, MS-Outlook-connection and the whole correspondence including contracts
- cadastral map – parcel numbers are connected to CRM- and customer data management systems
- Electric application with the complete utility data of our company for maintenance, error clearance, graphical and numeric analysis of all kinds of maps (as-built, schematic, overviews) – more than twelve gigabytes of data on Oracle®.

On the left side you can see our integrated data systems – SAP und our customer account system (Schleupen). And of course we use all the FDO-Provider connections, like web map/feature services, shapes, geo-referenced data and so on in order to use all available data from all kinds of data sources. **This highly connected infrastructure helps us on a daily base to manage the flood of new data and new objects from different sources easily.**

Easier Management of Grid Data – Extending the Standard Functionality of AutoCAD Map 3D

Because of the new requirements that the rapid energy turnaround brought along for data and asset management, the standard data model and functionality especially of the electric module of AutoCAD Map 3D on Oracle needed to be extended. Data modeling was easy. The powerful Infrastructure Administrator contains in combination with the SQL Sheet all the data modeling functionality. Together with the Client-API we were able to extend the electric module and add functions that we needed to manage these new tasks more efficient. We developed our own application called “FAB” that contains all the extra functionality we needed.

Here are some examples of added functionality:

- **Extended Data Model and Functionality:** Based on the data-model “Electric for Central Europe with the German Country-Kit“ from Autodesk we created our own data- and display model. The fundamental idea of our data-model is the hierarchic structure of the graphical and numeric data into five levels:
  - **Structural (EL-STRUCTURE):** for as built-plans (segments with cross sections)
  - **Electrical (EL_DEVICE):** for as built-plans (segments with cross sections)
  - **Electric Distribution (*_V_TABLES):** For schematic plans (Electric Management Plan)
  - **Electric Feeder:** For schematic plans (Electric Management Plan)
  - **Internals:** For internal plans
- **Interface to iReport:** PDF-reports are an essential tool for operation scheduling and facility management of the ÜZ. We use the open source tool iReport by Jaspersoft as report generator which we connected to Map 3D with the application programming interface

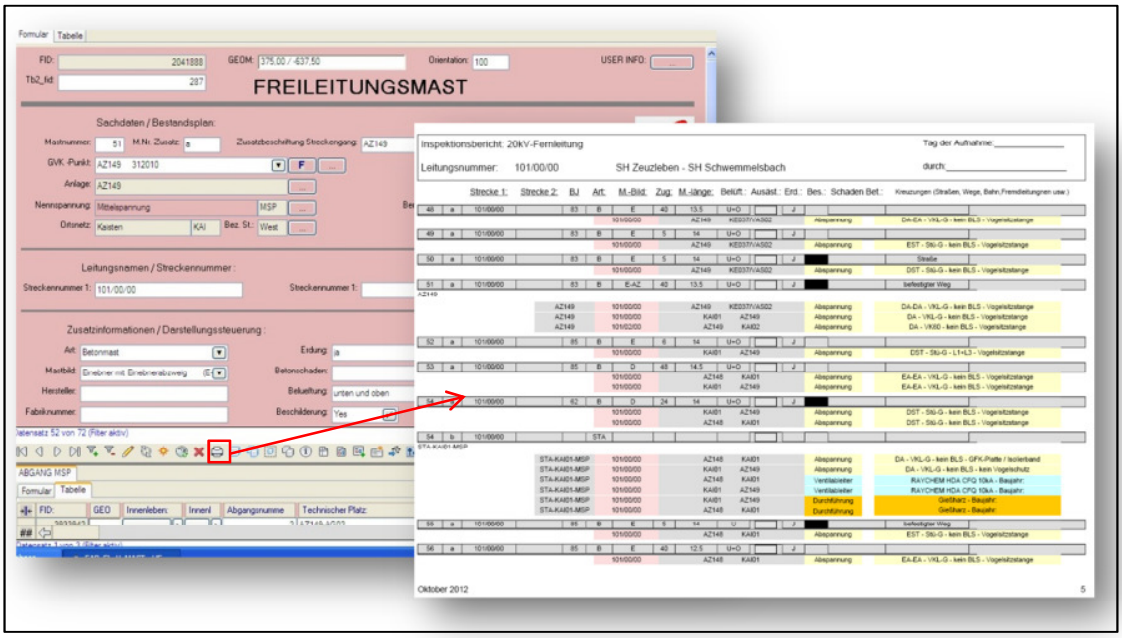


Image: Interface Map3D-Client → iReport

- **TabPages:** TabPages controls the look of our data forms based on different data attributes. We use it to change for example the look of the data forms according to the voltage level of the object. So it is possible to display the same form with different form controls, different colors and/or a different detail table according to the specified attribute. This helps for example in the case of a transformer station with three distribution voltage levels. We integrated them into one master detail dialog. So all the attributes are handled in one single dialog, but they are displayed differently according to the voltage level

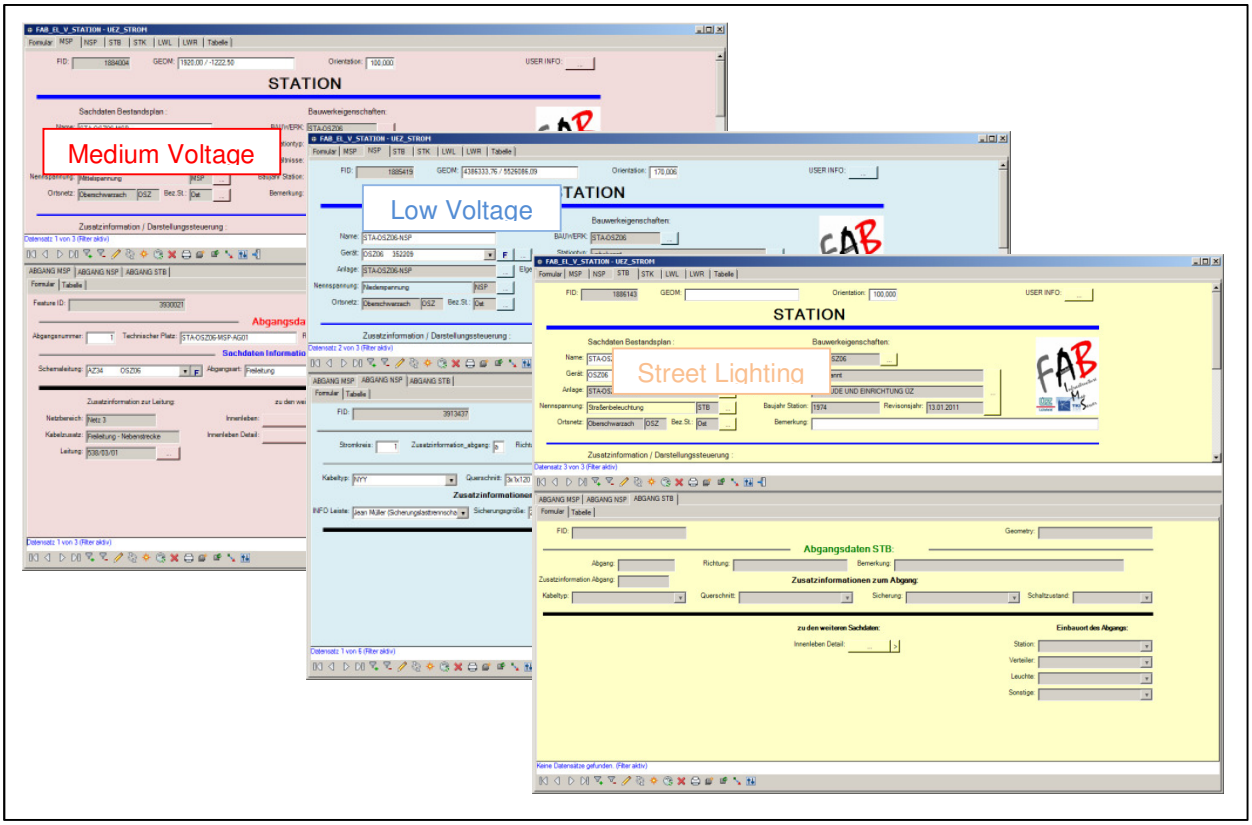


Image: Example for TabPages

- **Extended Form Functionality:** To manage for example duct and/or conductors in segments the form functionality was extended via API-Buttons; we can manage, as an example, all segment related objects in the segment form now

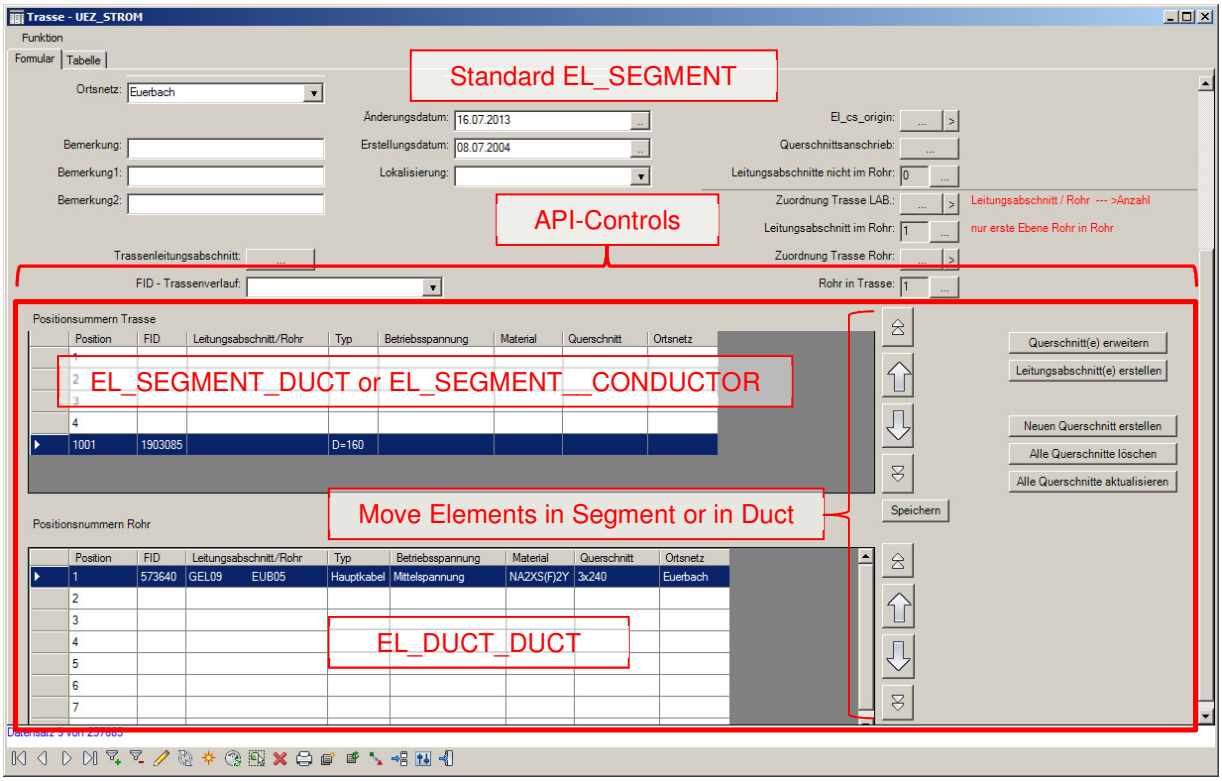


Image: Extended Functionality in EL_SEGMENT dialog to manage segment-internal objects

Use Web-GIS both online and offline for operational and breakdown services of the ÜZ and for third party users

To make the grid data available for every employee in our company we use a highly customized Java application called **RIWA** as Web-GIS-Clients. It is based on the “Java Unified Mapping Platform” (JUMP) and a great tool for viewing and processing of spatial data in the intranet. The data gets delivered to the clients via an Apache Webserver. It can also be set up offline for our breakdown services on laptops.

The RIWA application is also connected to all kinds of data sources we use in our company (ERP, CRM etc.). For Raster data like Orthophotos we use an UMN Map Server which is set up as a WMS-Server, so we can easily integrate this kind of data into our Web-GIS. Most of our own developments that we made Client-Side work on the Web-Side as well, like Tab-Pages, the interface to iReport etc.

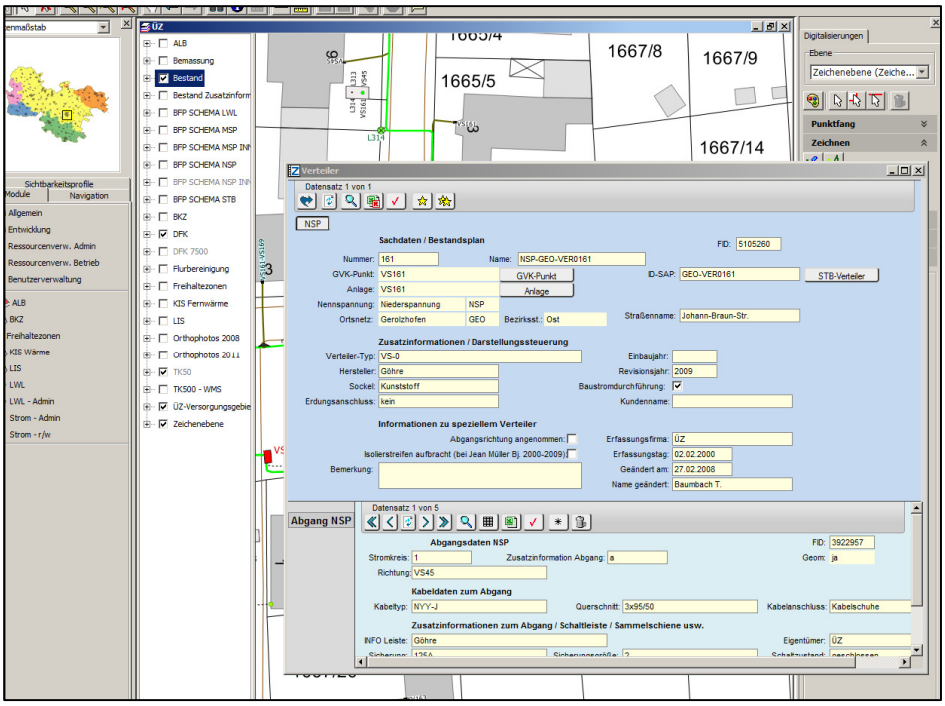


Image: ÜZ Web-GIS-Client (RIWA Client)

A fine grained user administration that RIWA offers makes sure that every employee gets access to all the necessary data he or she needs to fulfill his daily tasks, but also that every employee gets only access to data he or she is allowed to use.

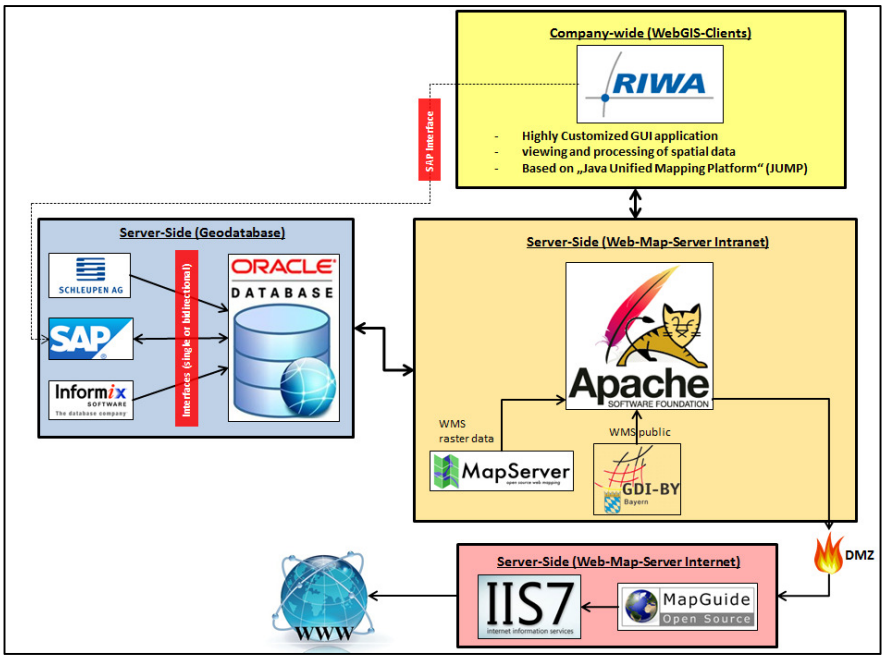


Image: ÜZ Web-GIS Infrastructure

For third party users like construction companies we use a special Internet-GIS which is based on MapGuide Open Source and IIS7. Each registered company is able to use this tool 24/7 and gets up-to-date plans for planning their constructional measures.

The approach of how this works is shown in the image below. Each night the necessary data is written out of the Oracle-DB to SDF-Files which are then copied on to the internet-server in the DMZ (demilitarized zone) via Batch-Processing. On the internet-server we set up a MapGuide Open Source Server together with an IIS 7 which provides the data for our Internet-GIS.

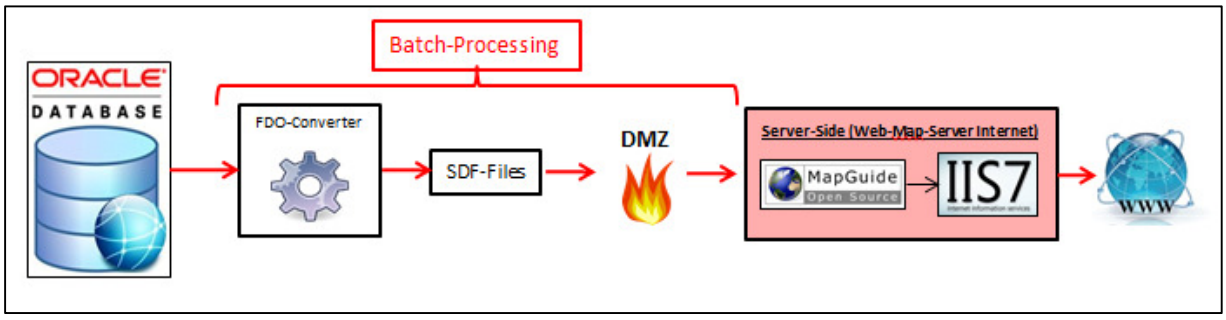


Image: Processing of SDF-Files for the Internet GIS of the ÜZ

Third party users log into the internet tool via our ÜZ-Homepage.

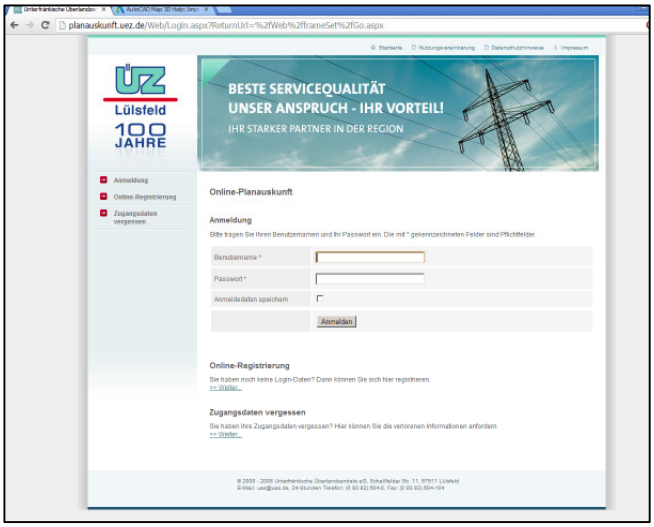


Image: Login-Screen for the Internet-GIS of the ÜZ

This is where they can create the necessary plans for their construction measures. What is important to know is that third party users get to see our network data for legal reasons only in the resulting plan (a PDF-file is generated in the end). The navigation to the area of interest is done either by searching for a street or by navigating with Open Street Map data.

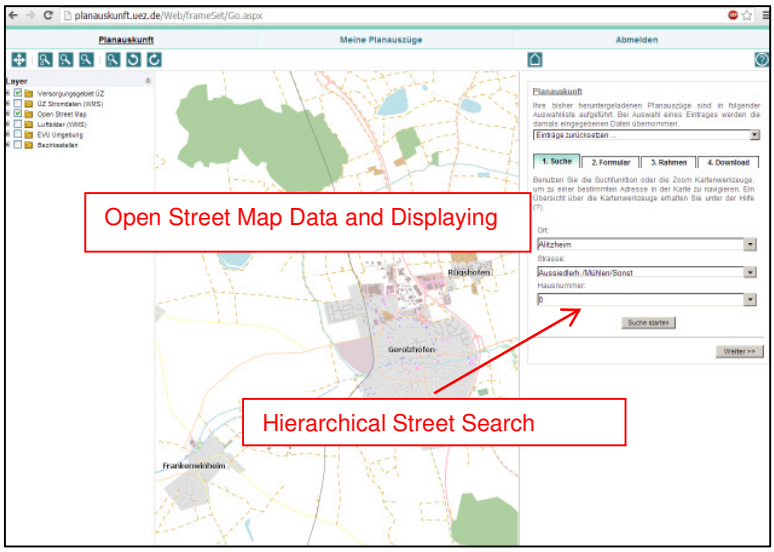


Image: GUI of the Internet-GIS of the ÜZ based on MapGuide Open Source

In the end a PDF-File is created which contains the requested plans with some additional information sheets (legend, safety data sheets, contact information etc.).

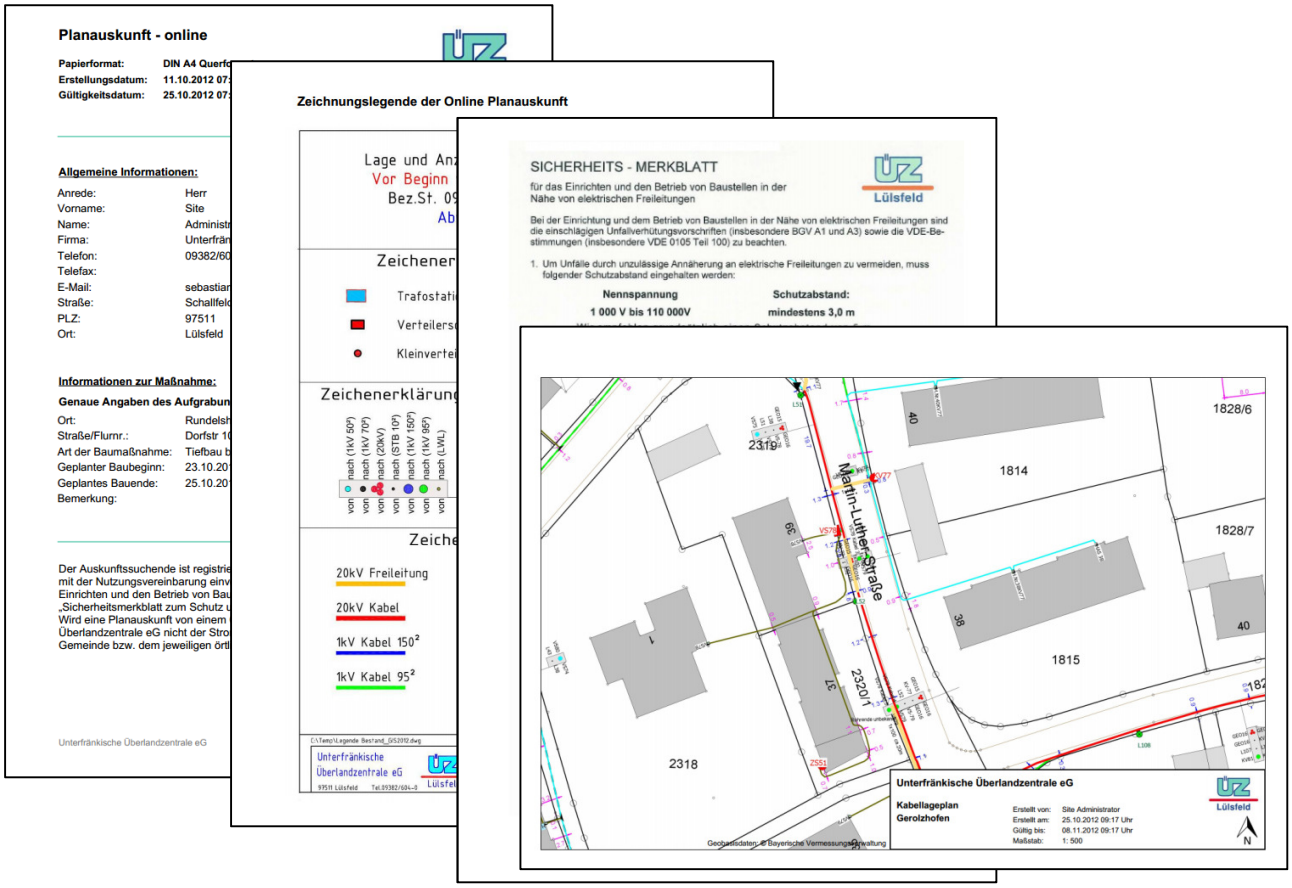


Image: Plans for third party companies (construction companies) generated by the Internet GIS of the ÜZ

Getting AutoCAD Map 3D based data into other systems such as grid calculation or planning systems

Since we use a lot of different systems and applications in our company, it is absolutely necessary to be able to exchange data between those systems without any big effort. Since we see this interaction as a basic thing, almost everybody in our company should be able to do it (as opposed to the interface examples we show you in the next chapters, which are more complex and should be done only by more experienced users). We will now give you two examples of how the ÜZ gets data, that basically comes from AutoCAD Map 3D (or respectively from its underlying Oracle database), into other applications to be further processed.

Since we only have nine full AutoCAD Map 3D workstations at our company, but about 150 employees, we needed to find an alternative, that was able to take over these exchange tasks. This is the place, where our Web-GIS-Client (RIWA) comes into play again as you will see.

Getting AutoCAD Map 3D data into the grid calculation system SINCAL

For grid calculation tasks we use PSS®SINCAL. We mainly use it for load flow and short circuit calculations. In the background of each SINCAL-projects there is an MS Access database. So we basically needed to get the data from our Oracle database into an MS Access database. As already mentioned, “normal” users need to be able to perform the exchange whenever necessary. Since our Web-GIS Client offers functionality to export data to Excel, and since SINCAL vice versa offers an Excel import, we decided to use Excel as exchange platform. What we had to adjust, was the Web-GIS Excel export. The data needed to be exported in a way SINCAL can import the data easily on the other side. This is the way we set this up:

- Display area and objects that have to be exported to SINCAL in Web-GIS-Client

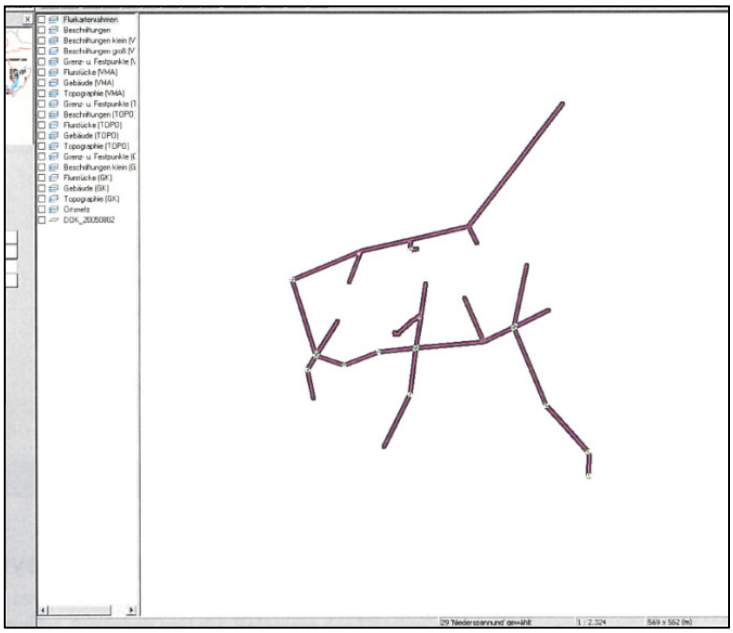


Image: Conductors in the Web-GIS Client that need to be displayed in PSS®SINCAL

- Execute SINCAL Excel export and choose the according export → the data gets exported to Excel exactly how the Excel Import of SINCAL can read it so no other formatting of the exported data is needed

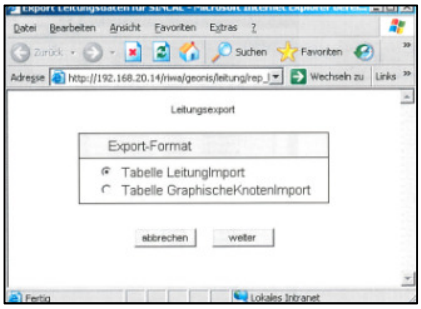


Image: SINCAL Excel Export in Web-GIS Client

- Open SINCAL and open Excel Import Tool; what you need to do before is to create a allocation file, which is an XML-File that SINCAL needs for the import

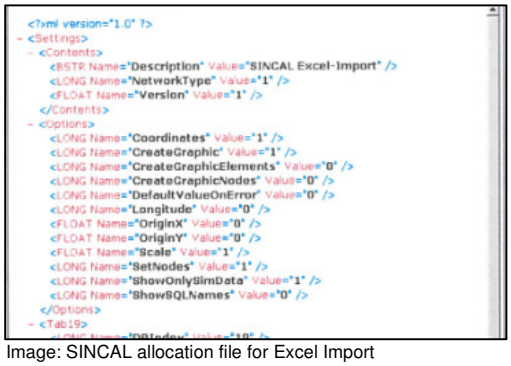


Image: SINCAL allocation file for Excel Import

- After successful import you get the following message

Image: SINCAL successful Import Message

- Now the data can be processed in PSS®SINCAL

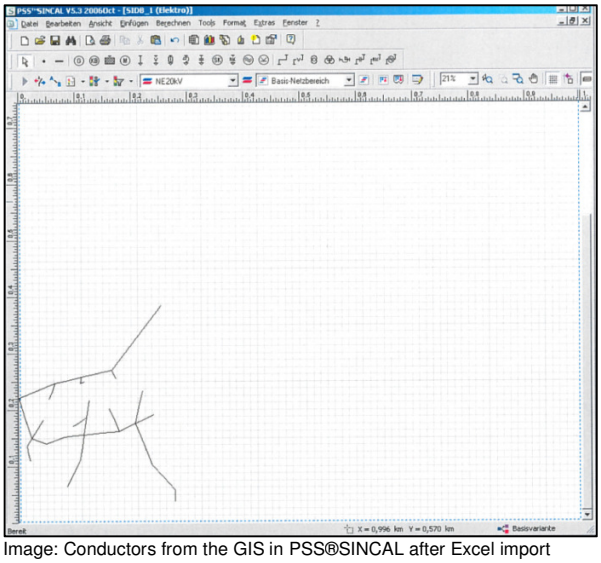


Image: Conductors from the GIS in PSS®SINCAL after Excel import

Edit AutoCAD Map 3D (Oracle-) data for the Planning Department

Our planning department constantly needs the latest graphical data from our GIS. But they need the data in a special way, which made some AutoLISP routines necessary that we programmed by ourselves. The colleagues use standard AutoCAD Map 3D 2008 (without Oracle!!) to plan the utilities for example for new residential areas. The basic steps are as follows:

- DXF-Export from the Web-GIS Client

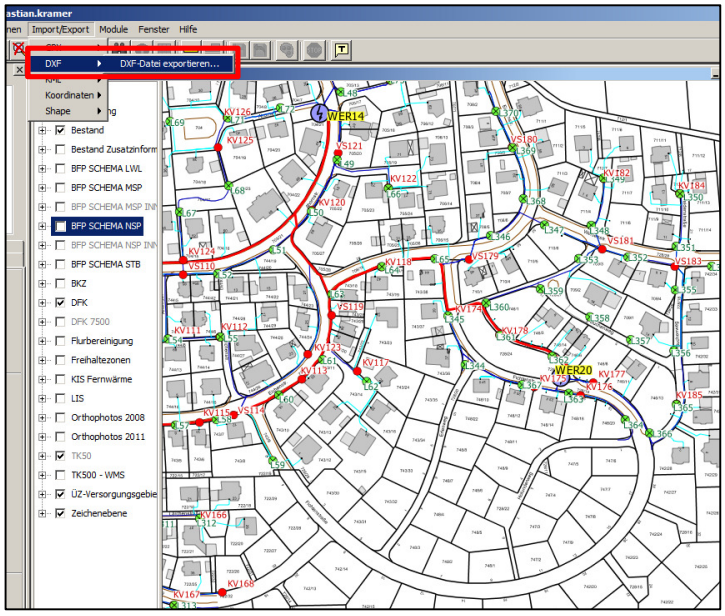


Image: DXF Export Web-GIS Client

- Open DXF in AutoCAD Map; this is what it looks like after the export from the Web-GIS-Client

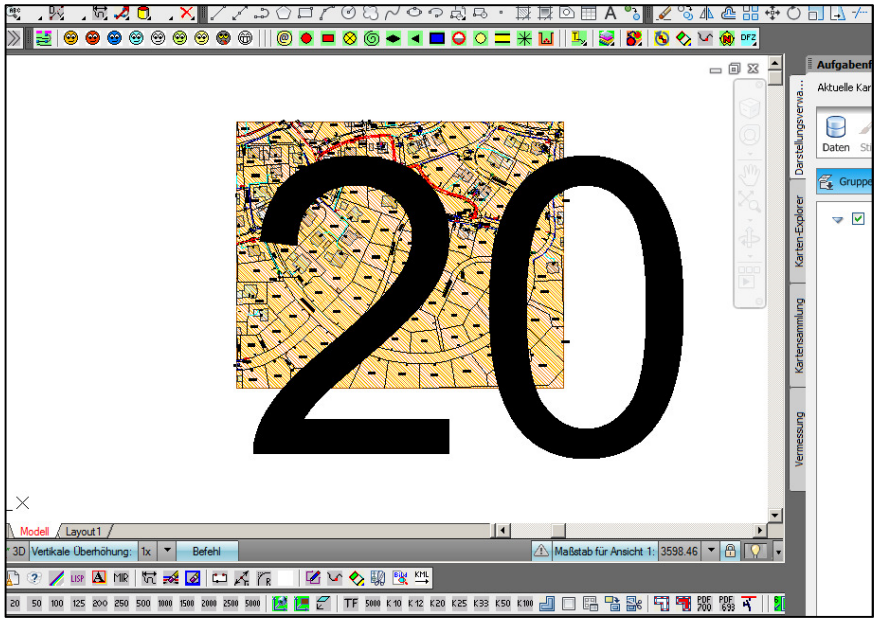


Image: DXF data from Web-GIS Client in AutoCAD Map3D; not edited yet

- Now the data needs to be edited to fit the needs of the planning department → execution of some LISP routines

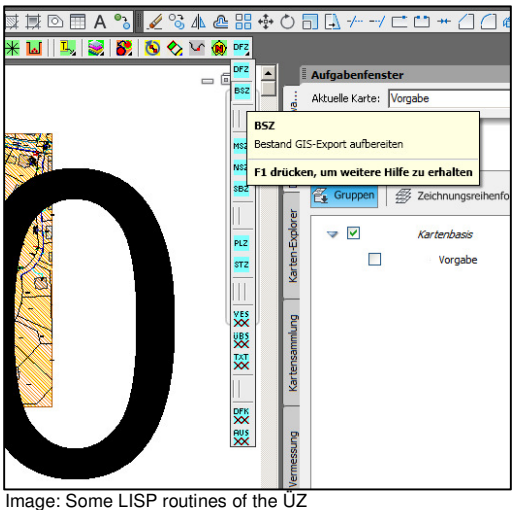


Image: Some LISP routines of the UZ

- Now the data looks ok for the further planning

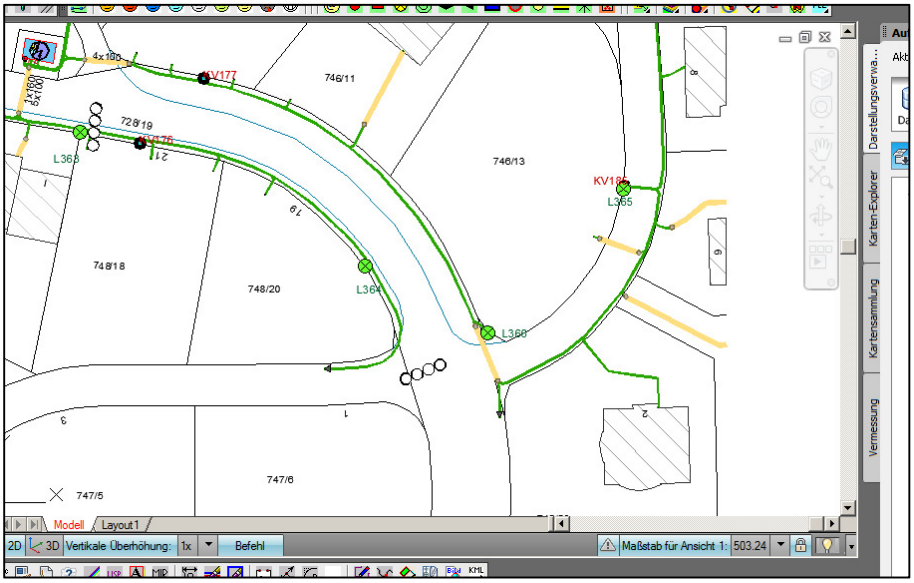


Image: DXF data from Web-GIS Client in AutoCAD Map3D after running the LISP routines

How the ÜZ realizes interfaces to other enterprise applications such as SAP® and IBM® Informix®

In order to make our GIS and the users more efficient, the different enterprise applications and databases in our company needed to connected. So we had to create a couple of interfaces to these systems. Some of them use very basic functions, others are structured in a more complex way. We will show two examples of connecting other systems to our Autodesk-GIS.

Connection between IBM® Informix® (Schleupen) and AutoCAD Map 3D

The customer account system (Schleupen) of the ÜZ is based on an IBM® Informix® database and contains important data of the customers electric meters which are also needed for special operations in the GIS. So the data needs to be transferred into the GIS on a daily base. We achieve this by a couple of tools, that we programmed for this use and that perform the following steps:

- Delphi-based Tool (self-developed) to export the data out of the Informix database into a CSV-file, that already contains the necessary insert-statements for the Oracle Database
- The exported CSV-file must be edited, to contain Oracle-conform Insert-Statements; therefore we wrote a Java Program, that for example replaces certain digits by other ones that Oracle can “understand” while inserting the relevant data
- The inserted datasets must be connected to the as-built datasets in our electric module; this is easy because each meter or service point in our GIS-database has a specific key which again consists of other keys that it can be separated into like:
    - Location
    - Street
    - House Number
- This key from the address data can be compared to the “metering code” from the Schleupen datasets which contain the same information; in the end these codes can be connected automatically via SQL scripts
- All these steps are executed each night in the specific order by a simple batch-file

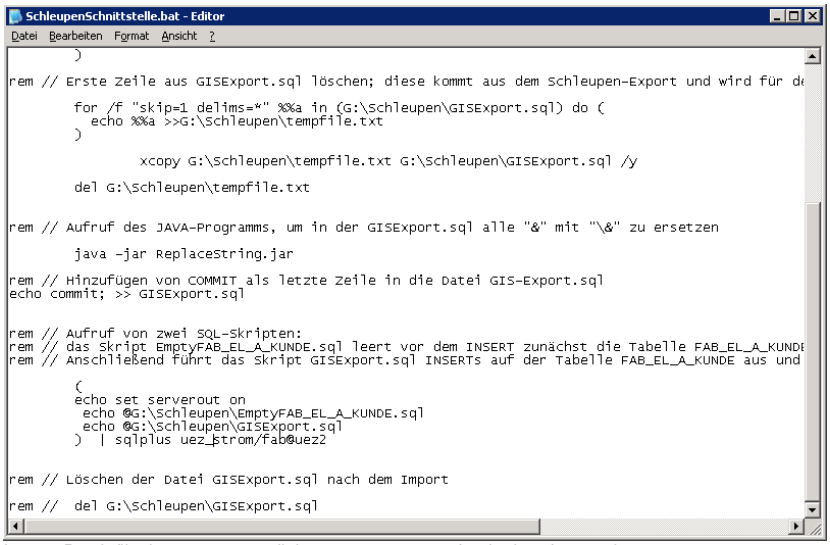


Image: Batch file that processes all the necessary steps for the interface to the customer account system (Schleupen)

Here's an example how this looks like in the customer account system "Schleupen":

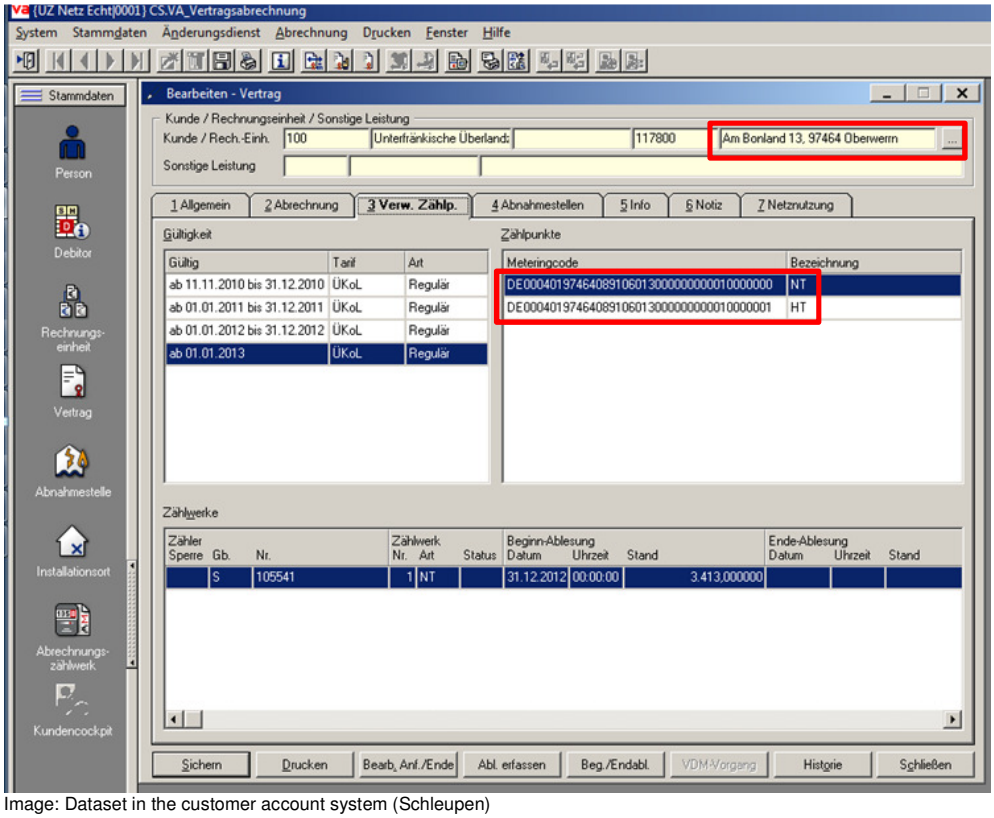
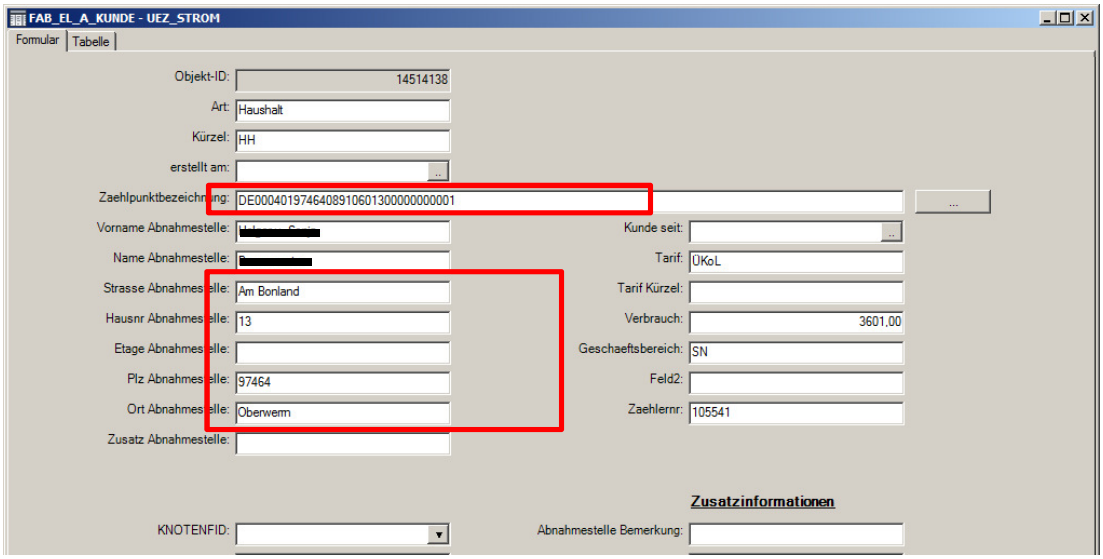


Image: Dataset in the customer account system (Schleupen)

And the according dataset in the Map3D dialog:



Connection between AutoCAD Map3D and SAP-PM

We use SAP mainly for maintenance tasks. The connection between AutoCAD Map3D and SAP is bidirectional. We read data from SAP and display it in specific dialogs (for example for transformer stations or medium voltage circuits) and on the other hand write data to SAP. Here are two examples on how the ÜZ uses this interface between SAP and AutoCAD Map3D.

Writing information from a GIS object to SAP

The communication between SAP and AutoCAD Map3D takes place in a subsystem developed by a German SAP Partner. This subsystem constantly monitors communication between SAP and other systems, like our GIS, and automatically handles the communication and conversion between those relevant systems. The subsystem supports all of the common exchange formats like XML, ANSI X.12, EDIFACT or other formats.

For the writing process, the subsystem monitors a specific table in the Oracle-Database, which was setup to log any changes on elements that need to have a connection to SAP. The logging is done by a couple of database triggers. As soon as a change has been made for example to the EL_CIRCUIT table, it is written out by a trigger to the Change-Log table which is monitored every 5 seconds by the SAP-subsystem. If a change was detected, the subsystem takes over the further processing according to a couple of parameters. When processing in SAP is finished, the subsystem marks the dataset in the Oracle table as “processed”. The steps that are performed by the SAP-subsystem after detecting a change in the Change-Log table are shown in the next graphic.

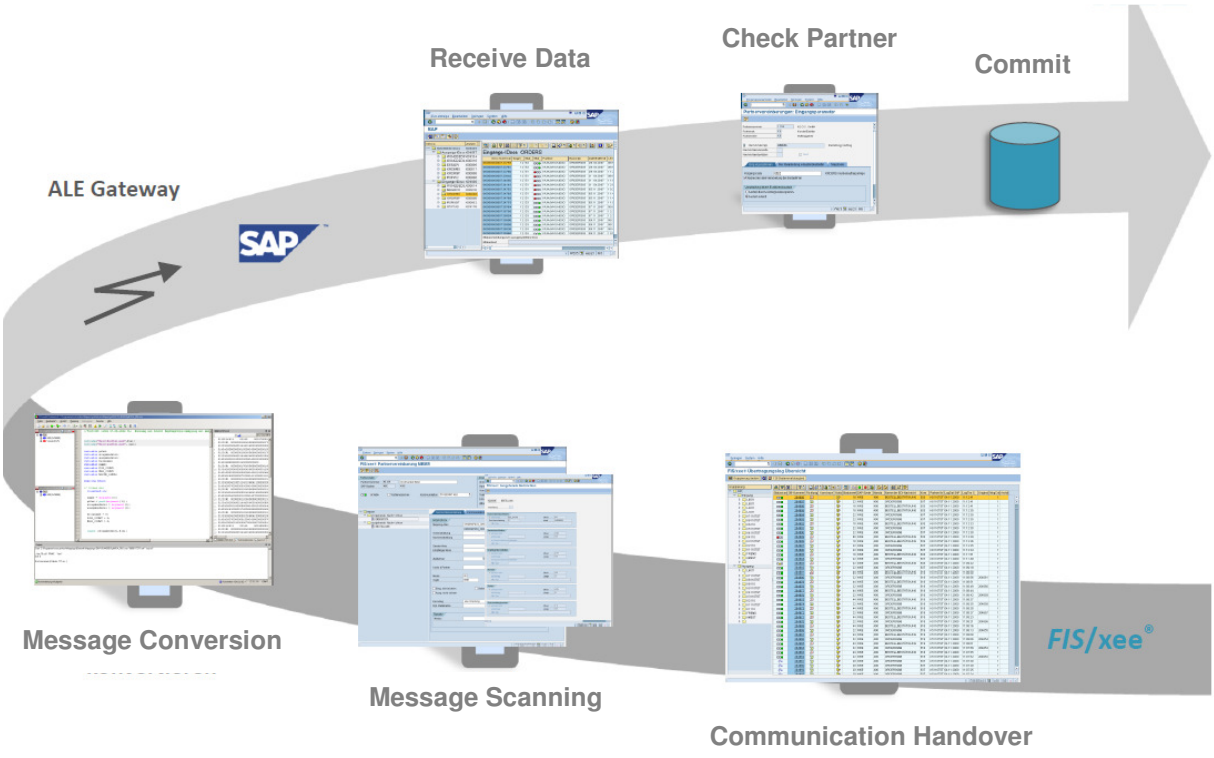


Image: SAP subsystem

Jumping from AutoCAD Map3D into SAP-GUI

If we just want to jump from a GIS object like a transformer station to the functional location in SAP, we simply use a VB Script Button in the Map3D dialog.

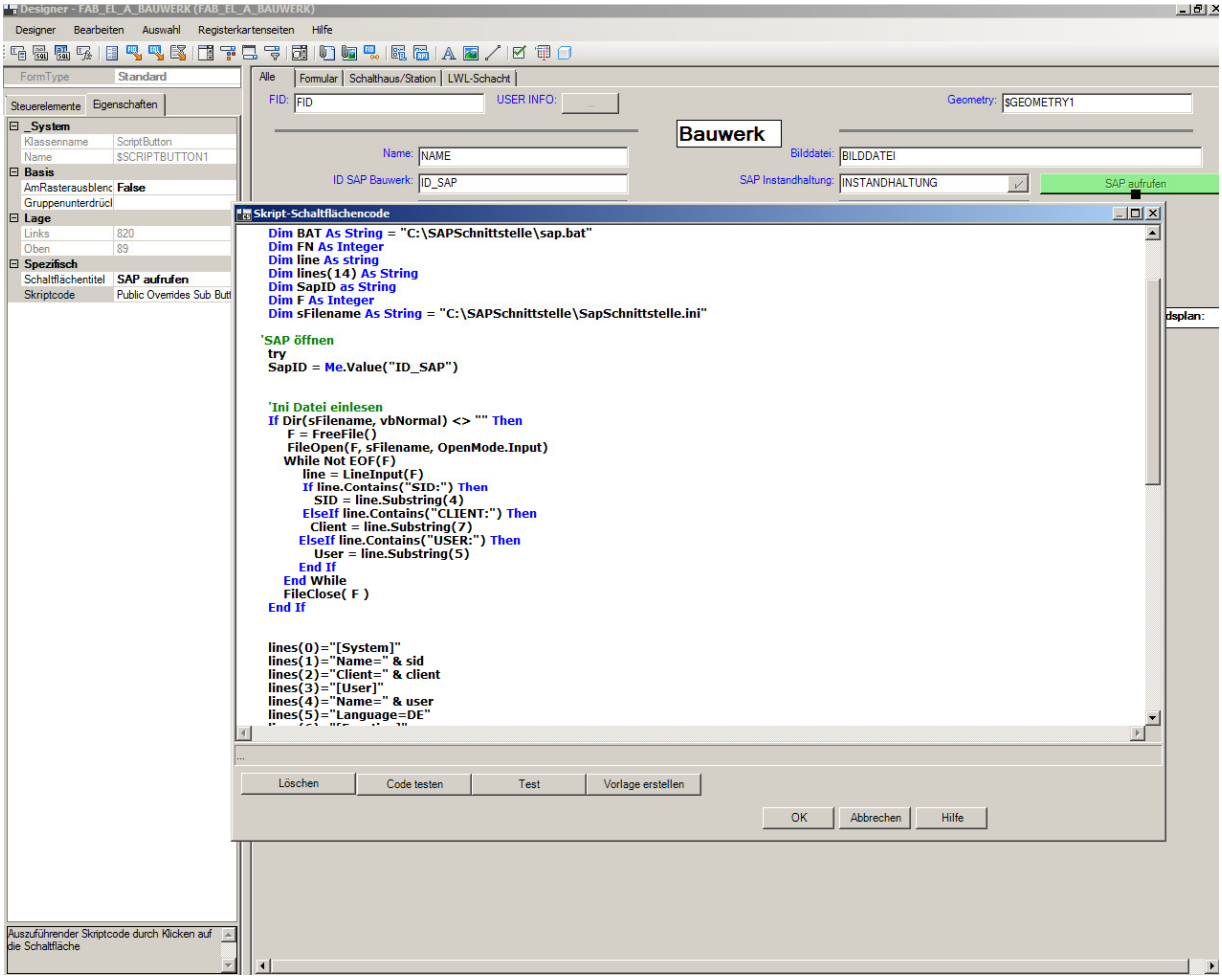


Image: Configuring the VB Scipt Button to call SAP-GUI in the Map3D Form Designer

The steps that are being performed after clicking the Script Button are the following:

- Get the ID_SAP (connection key for the link to the SAP object) from the active dataset of the dialog
- Get the required transaction code for SAP
- Get the SAP-Client ID
- Write this data out together with other parameters to a *.sap-file
- Call the *.sap-file via another Batch-file

The SAP-GUI is opened were the user needs to enter the login data and then is directly forwarded to the functional location of the object in SAP.

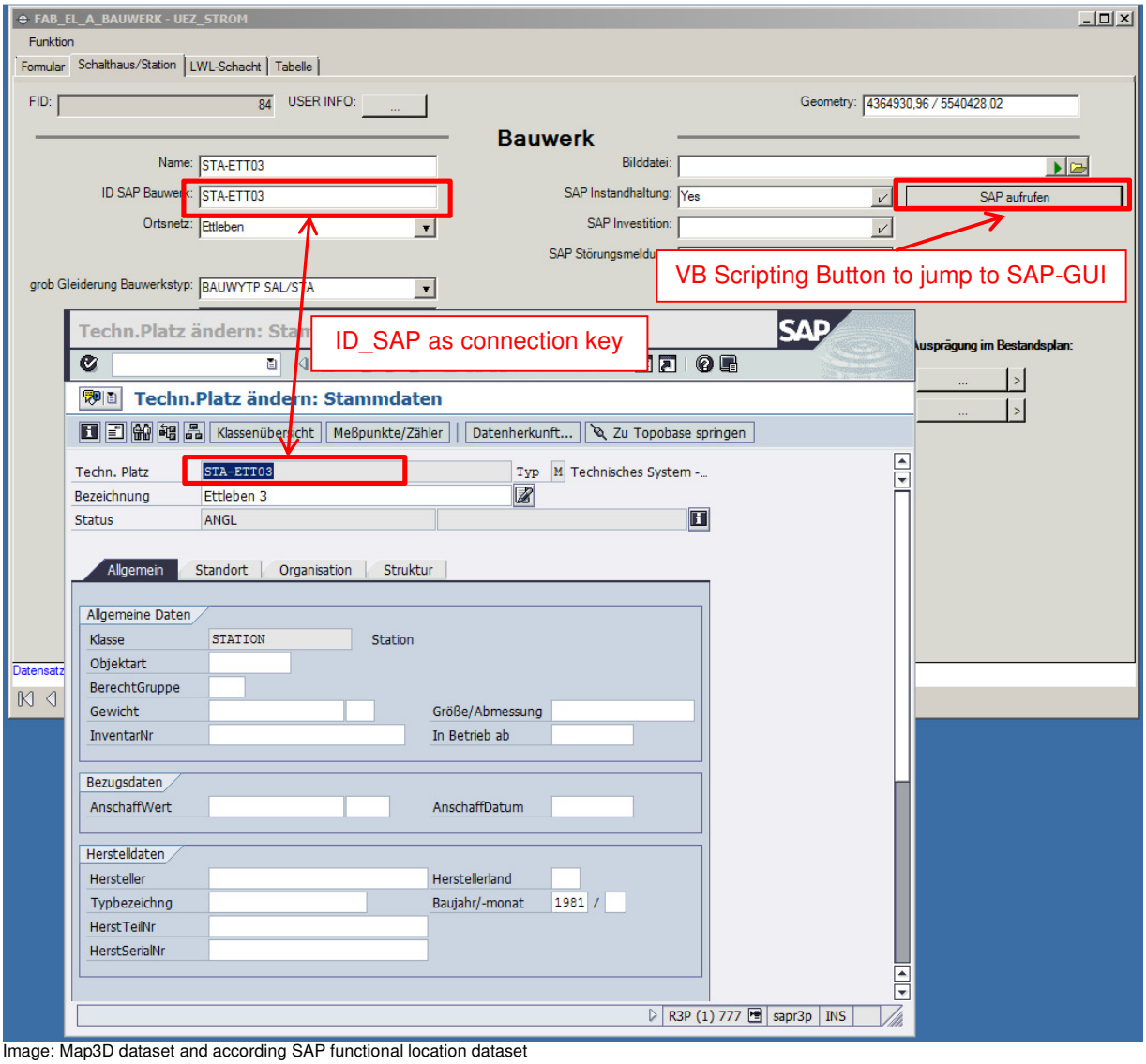


Image: Map3D dataset and according SAP functional location dataset