

Building Rich GIS Solutions to Automate Network Statement Processes for Utilities

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In this class, we will focus on geospatial solutions for utilities based on enterprise industry models in Autodesk® Infrastructure Map Server and Autodesk AutoCAD® Map 3D software. In several steps, we will demonstrate all important aspects of building a rich GIS solution using as an example a project for a large water and wastewater group in the Czech Republic. We will cover the project from the migration of five different geospatial solutions into one Autodesk platform to actual activities in integration with external customer relations management (CRM) and maintenance systems. One of the top benefits of this solution is full or partial automation of network statement processes, starting with collecting electronic statement requests from a public site, automatically evaluating them in GIS, and responding in cooperation with CRM and internal processes. This process, as well as additional automation possibilities, will be described and demonstrated on a real example.

Learning Objectives

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

- Understand and evaluate general benefits of using Enterprise Industry Models in GIS systems for utilities
- Identify key implementation aspects of a GIS system for large utilities
- Describe important requirements and steps to automate network statement process
- Understand the benefits of network statement automation

About the Speaker

Jakub is a GIS implementation and software development manager in CAD Studio a.s., which is Autodesk Platinum Partner and major CAD/GIS company in the Czech Republic. He is actually responsible for group of 12 SW developers and GIS experts fully focused to GIS projects. Jakub takes part in building Autodesk Geospatial business in the country, having lectures and seminars on various conferences and making technical specifications and writing conceptual documents for new geospatial solutions. For this, Jakub is using the experience from 4 years in SW development companies and 3 years in academic where he has focused on image processing theory and applications, authored several papers and conference talks, and was giving university classes on Charles University in Prague.

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The key implementation aspects of a GIS system for large utilities

In this section, we'll list important steps and aspects related to enterprise GIS systems. We'll use experience from utility industry.

Data – the key feature of any implementation

Data is always the key feature of any GIS implementation. In fact, whole GIS solution can be seen only as a tool to handle and use the data. We have experience that in a well-formed GIS environment in large water and waste-water project, the software and implementation related costs were only up to 20% of overall costs. The rest were data-related costs.

From this point of view, the structure, completeness, and quality of migration from old data sources should be always the main concern of new implementation. Users will be easily refusing new solution as long as there are some data missing or being misinterpreted during migration into the new solution.

Compared to fact that the data is one of the most important things, the data migration activities are very difficult to estimate. In fact, the only reliable way is to do pilot migrations in order to have complete image of data complexity and possible issues that may arise during migration. On the other side, pilot migrations into partially prepared solution may be used to collect a very good customer feedback before or in the middle of the implementation process.

Bad data may be also a show-stopper for advanced functions and agenda:

- It is not possible to deploy any type of analytical automation on top of incomplete and/or inaccurate data. The results will be incomplete and inaccurate as well. Or even worse.
- It is not possible to turn on topologies or other functions on data that simply do not allow it.
- Bad data also discourages users, especially if they feel they've lost something.

Implementation steps and activities

Given in no particular order, here is the list of usual steps when implementing GIS system:

- Requirements specifications
- Analysis – solution proposal
- Deployment of system components and basic configuration
- Data model implementation
- Display model implementation
- Functions implementation
- Data migration
- User access and other configuration

Agile implementation principles

Agile techniques accommodated in software engineering as well as other fields. One of the benefits (and in fact, its nature) is quick and easy response to customer requirements, namely if the requirements are changing or adding-up in time as the customer is exploring functions and behavior of the new technology.

The same main principles may be applied to delivering GIS solutions on top of Autodesk products. The implementation may go through following phases:

1. Start with basic implementation
 - Cover only selected main agenda and main data
 - Give access to users as soon as possible
 - Let users and admins use, work and collect experience and feedback
2. Iterate
 - Get feedback
 - Validate the existing functions and other existing implementation artifacts
 - Use experience and feedback to design and implement next features
3. Iterate...

Addressing the “basic implementation” above, there are standard data models for Autodesk Industry Models, which can be used to quickly set-up initial system and let customer’s users and admins explore its possibilities. You should also build a set of standard modules on your own during time.

Project analysis

Regardless you are using agile iterative approach described above or not, there is always at least one analytical phase at the beginning of the project. It collects all important information for the implementation and lays out the target of the implementation including implementation steps to reach the target. In case of agile implementation, the analysis may be updated several times based on gradual experience and feedback.

Analysis steps:

- A. Map current situation
 - Describe all data sources
 - Describe all user interactions with current system
 - Describe all interfaces to other systems, data exchanges, etc.
 - Describe all additional requirements
- B. Layout the future: one-by-one, take each feature described in the first phase and describe its appearance in the new solution.

Reserve time for analyzing the current solutions of the customer you are going to replace. It is not a favorite activity but it brings a lot of useful information:

- Users can describe their current work only on top of the current experience and current solutions.
- Users, admins and managers have several real pains that force them to change the solution – track them carefully.

The moment of implementation of new GIS system is always a very rare situation. To get the maximum benefit, it is always necessary to try to **re-design functions and agenda**. No-one should ever agree to just re-implement current solution using the new technology. Instead, current agenda related to GIS should be analyzed and the target functions designed with respect to Industry Models technology. Such change will always be a problem to users as they have to get used to a different tool, but it brings several major benefits:

- Optimal utilization of the technology
- Optimization of functions and implementations gradually accumulated during longer period

- Lower implementation costs (due to higher usage of standard tools and lower custom plugins and modules)
- Maximum benefit from product subscription

General benefits of using Enterprise Industry Models in GIS systems for utilities

With respect to the above key aspects, Enterprise Industry Models in AutoCAD Map 3D and Infrastructure Map Server bring these benefits:

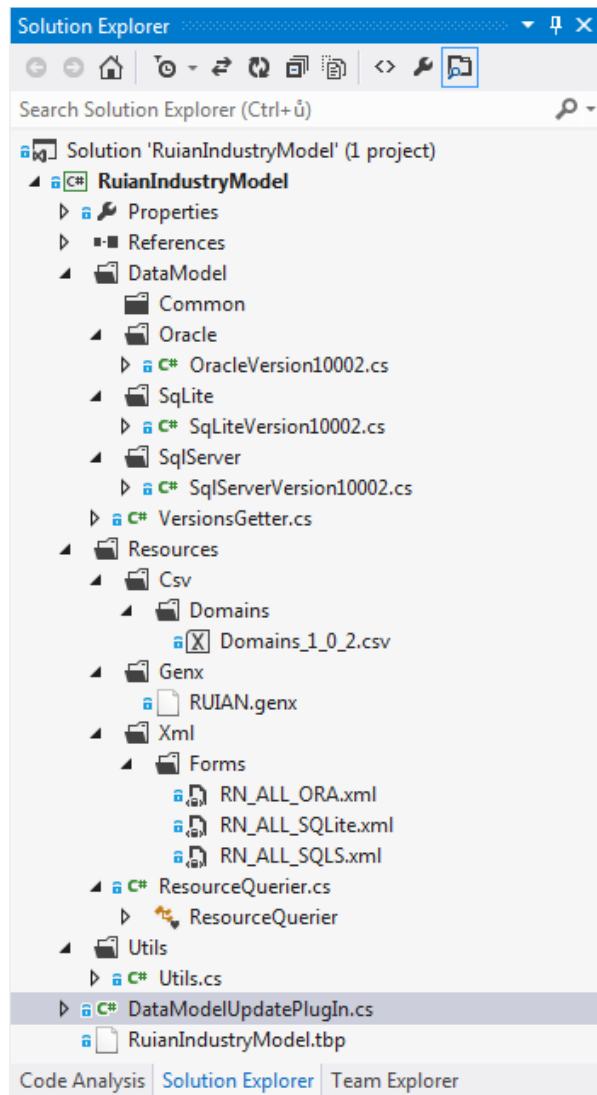
- A. Easy administration:** The admin tools are available and it is easy for customer's admins to perform necessary changes into the system themselves. Also for the implementer, the administration is a handful tool during project implementation.
- B. On-the-go changes in data model:** once the project is deployed, it is possible to make further changes in data model and functions. This means that the system may easily adjust to new user requirements during time. The fact also enables the agile implementation principle.
- C. Closely tied CAD and GIS:** for customers already working with CAD data or having to communicate with CAD partners, this is one of the major benefits.
- D. Operationally oriented solution:** let it run and focus on your business.
- E. New data import tools in 2013 release** (originally project Parsec)
- F. Open solutions based on open technologies:** There are no proprietary data formats or interfaces. Server technology is based in open source.

Efficient data model management

Actual Industry Model technology tools enable efficient management of data model in multiple environments and change distribution. For example, if there are Development, Testing and Production environments, the change propagation from one to another can get quite laborious and error-sensitive. On the other hand, the solution proposed here is more error-prone and may be automated in continuous integration environments.

Key features: It is possible to use Structure Editor to create data model and make changes in it. As a result, there is GENX file (XML structure) describing the data model structure. It is also possible to export Industry Model dialogs into XML file in Infrastructure Administrator.

Both sources can be integrated into `XmIBasedDocumentStructureUpdatePlugIn` and distributed as Infrastructure Administrator plugin. The plugin's structure is very simple. It needs to have above mentioned GENX and XML definitions as resources and few lines of code inside plugin itself and inside `DocumentStructureUpdateVersionBase` implementations for target platforms (Oracle, MS SQL, SQL Lite). It is also helpful to include CSV file with domains content. See the example structure of plugin's project in Microsoft Visual Studio in following picture.



Plugin usage

Anytime there is a change in data model, forms, etc., the change should be done directly in Structure Editor if possible, or transferred into GENX file. In case of changes in forms or other configuration artifacts, the change is exported from Infrastructure Administrator or directly implemented in the plugin's source in Visual Studio.

To deliver the change, it is also necessary to increase the version number in the visual studio, build the plugin and update DLL in the Infrastructure Administrator. After connecting to a project, Infrastructure Administrator can promote the changes in the project.

Important requirements and steps to automate network statement process

Network Statement Provisioning is an important agenda for any company or institution related to utility business. Its purpose is to give information about the real and accurate position of the utility network and conditions for any activity related to network and areas around the network. The situation in every country

may vary from obligation for every utility operator given by law, over management of the agenda by local municipality, to completely unregulated situation with soft responsibilities. However, building activities, emergency and other situations near utility networks are continuously occurring, and network statement provisioning helps to ease every situation even if it is not real obligation.

Hence, most utility operators or responsible institutions have to solve the situation. For them, the activity is in fact a non-business activity in one hand, but the ease and flexibility of getting network statement impacts appearance of the utility operator in public and partners.

Steps in Network Statement provisioning automation

The provisioning process may be easily automated. Usually, there is rather organizational and legal barrier rather than technical. The fully automated process has several steps:

1. Get digital statement request in structured form, including all necessary data.
2. Push request into geospatial database to evaluate region of interest against network documentation data.
3. Evaluate request, collect network statement response data.
4. Generate network statement document and attachments.
5. Employ result verification or authorization procedure
6. Send the result

To really start with at least partial automation, it is necessary to make the requests digital. This phase also saves the first costs. Instead of letting people come to office or write snail-mail requests, let them enter their request into web form AND do not forget to let them draw the area into map. The experience is that unless people cannot draw the area themselves, they do not accept the digital requesting on the web.

The only two compulsory fields are:

- the identification of the applicant,
- the region of interest.

The other useful fields may be:

- reason of the request (type of building activity, etc.),
- address of the applicant to send the standard or electronic response to.

As soon as the requests are electronic, it is possible to automate further phases as noted above. Without the first phase, none of the following phases could work efficiently.

Automation of region evaluation in the geospatial database can have several sub-phases as well. The actual procedure may differ according to internal requirements, organizational and legal possibilities and quality of data. As the first step, it is possible to at least markup locations where the networks are not present and automate statements “without network collision”. In case the data is complete and accurate, it is possible to automate it directly, otherwise it is necessary to increase protection zones along network which data’s precision is low or mark location where the network is but data is missing.

One of the efficient approaches is to quickly draw “approximate network routes”, e.g. street axes, with low accuracy just to establish initial information, that the network is probably present. In such case, the statement has to contain request to order additional network demarcation in the field.

With increasing quality of data in time, it is possible to automate evaluation of more and more various situations.

Once the result evaluation is automated, the following phases depend much on internal possibilities at every company or institution. It is necessary to incorporate the possibility to handle cases which cannot be fully automated and resolve sending the final result.

Request gathering portal solution

For gathering digital network statement requests, it is necessary to build web portal solution as a front-end of the whole automation pipeline.

The key feature is: *keep it simple*. This applies especially to the area of interest drawing tool. The map should be as simple as possible, without many options (e.g. without selectable layers). A good experience is general street map for the higher scales, replaced by orthophoto images combined with cadastral map when the user gets closer. Very helpful is also full-text address and cadastral data search to be able to quickly navigate the requested area.

When selecting data sources for maps on which will users draw their regions, be careful with the data precision. The image below shows a situation of location where is only old cadastral map available. Compared to up-to-date orthophoto image, it is possible to see the possible error that may be introduced by drawing polygons on top of inaccurate data.



Data provisioning

As a part of network statement response, there may be a vector data file exported in selected format. Such data may be useful e.g. for planners and architects.

As one of the benefits, it is possible to use the same infrastructure for data provisioning as for network statements. The principle is same, but instead of evaluation of the region against network data, the data is directly exported from geospatial database and sent to the applicant.

Partner integration

To support cooperation on local basis and ease the position of the public even more, it is possible to integrate network statement requests portal solutions of several utility operators in the same region. The applicants do not need to visit or request each operator, fill in the same information again and again, but only select which operators he needs.

There are basically two options:

- Several network operators share common solution.
- Each operator has private solution but all the solutions are interconnected to share the requests.

The benefits of network statement automation

These are the main benefits a company or institution may get from network statement automation:

- Ease and accelerate the process for public as well as the network operator (or network statement provider)
 - Automate hundreds to thousands of network statements each month
 - Reduce costs on both sides
 - Reduce non-business activities
- Increase the operator's (provider's) value for public and local municipality – service for voters
- Make decisions based on real data, perform qualified management of the process
- Reach automation percentage: 98%
- Decrease average response time from days to hours
- Decrease total costs by millions of EUR per year
- Eliminate employees and departments with useless agenda and tools
- Qualified personnel can be focused on qualified work (not printing maps)