How GDF SUEZ built a countrywide gas distribution system with AutoCAD® Map 3D Enterprise

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GDF SUEZ Energy Romania specializes in providing natural gas to over 1.4 million consumers, all through an immense and intricate pipeline network covering 17,300 kilometers. In 2007, GDF Romania embarked on creating a new and more efficient network for the natural gas pipeline. Initiated from scratch and managed with the company's internal resources and equipment, the collection of field data related to the pipeline distribution would take two years to complete and would be contained within a single, centralized database. The team made extensive use of AutoCAD Map 3D Enterprise software (formerly Topobase™) in regional offices, created a web platform on Autodesk® Infrastructure Map Server to share the information across the company (more than 600 users), and worked closely with Autodesk Consulting to create the best and safest asset management system possible. This class will help you to better understand the challenges and the key factors of this successful implementation.

Learning Objectives

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

- List the challenges and the key factors of success for a countrywide utility network

- Use AutoCAD Map 3D Enterprise to create and maintain a large network

- Share information through Autodesk Infrastructure Map Server

- Build bridges between the AutoCAD Map 3D Enterprise database and other systems, such as SAP or SCADA

About the Speaker

Radu Negoita

Senior project manager for GDF Suez Energy Romania, Radu has been a key contributor for the definition and implementation of the Gas Enterprise system for GDF Suez Romania.

Maxime Suing

Senior project manager with extensive experience in geospatial projects for Autodesk Consulting. After about 12 years of project management with a focus on the customer listening and satisfaction, Maxime is used to deliver successful projects in a wide range of industries and topics : utilities, telecom, government, local authorities, transportation, land management, geomarketing, environment, Facility Management.

GDF Suez Energy Romania, company profile

Before to tell the story of this system definition and implementation, we have to shape the profile of the main actor; GDF Suez energy Romania.

GDF Suez

- 1st group for gas transportation and distribution in Europe
- 2010 revenue : 84,5 billion €

GDF Suez Energy România / Distrigaz Sud Retele

- Belongs to GDF Suez group since 2009
- 1st gas operator in Romania
- 17.300 km distribution network managed
- 1,4 million customers
- 19 counties
- 34,8 TWh gas sold
- 2010 revenue : 810 million €
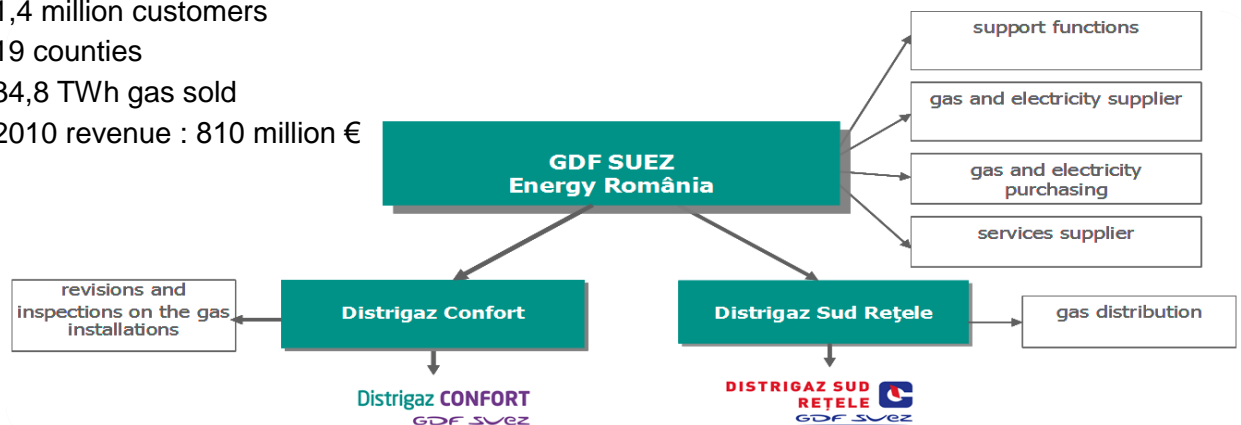
Business challenges

In 2007, GDF SUEZ Energy Romania embarked on the creation of a new and more efficient network for the natural gas pipeline.

The outcome of the initial assessment could be summarize as follows :

- Heterogeneous data sources (paper, drawings…)
- Heterogeneous data quality and accuracy
- No centralized data
- Difficult to monitor the network and take decisions
- Difficult to get the most relevant data for field operations
- Difficult to maintain the network

And the first targets for the company were:

- To put the complete network in a centralized database
- To minimize the data conversions
- A secured and opened architecture (web)
- Easy data quality checks and improvements
- Easy updates on network information and maintenance
- Easy access to the right information for the field operations
- Easy access to a network status overview for a fast decision making
- Improve efficiency of client oriented services

The Map 3D Enterprise application

Project scope and history
Initiated from scratch and managed with the company's internal resources and equipment, the collection of field data related to the pipeline distribution would take two years to complete and would be contained within a single, centralized database.

The various phases of the project can be summarized as follows.

Data Collection

- started in 2007
- all the distribution network
- using internal resources, GPS and total stations
- 40 people involved, field measurement and GIS operators
- Using paper scanning, dwg's, separate databases

Solution definition

- Topobase 2010
- 30 Topobase client + 250 Topobase Web

Topobase 2010 implementation

- 10 months, live in January 2010
- 5 people involved from GDF
- 1 consultant from Autodesk Consulting and 3 consultant from a local partner
- Phases :
    - o Business requirements analysis
    - o Development of hardware and software architecture
    - o Customization of the gas network data model
    - o Installation of the application and data migration
    - o Testing and training

**AutoCAD Map Enterprise 2012 migration**

- 3 months, live in February 2012
- 8 people involved from GDF
- Autodesk Consulting
- Phases :
  - Assessment
  - Migration
  - Validation
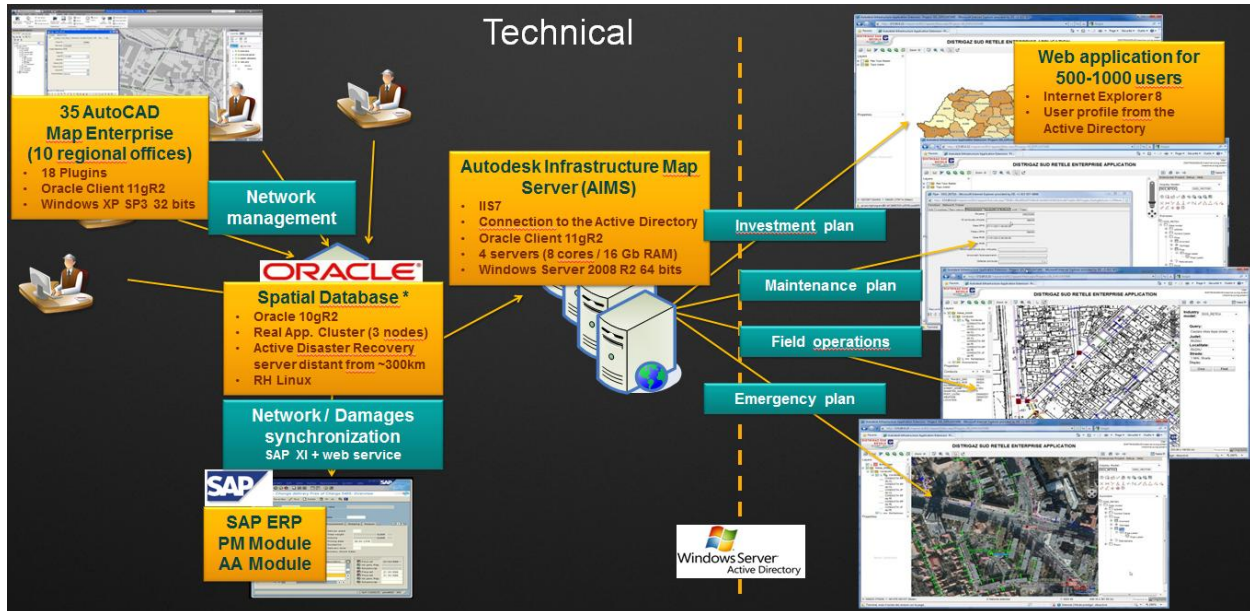 - Deployment
  - Tuning
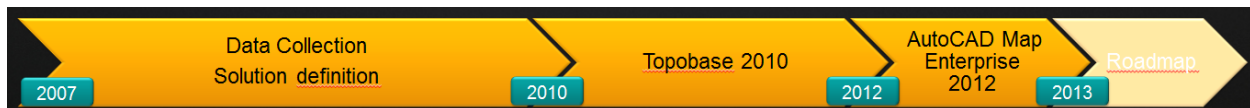
System architecture

The team made extensive use of AutoCAD Map 3D Enterprise, created a web platform on Autodesk Infrastructure Map Server, and worked closely with Autodesk Consulting to create the best and safest asset management system possible.

The architecture now looks as follows.
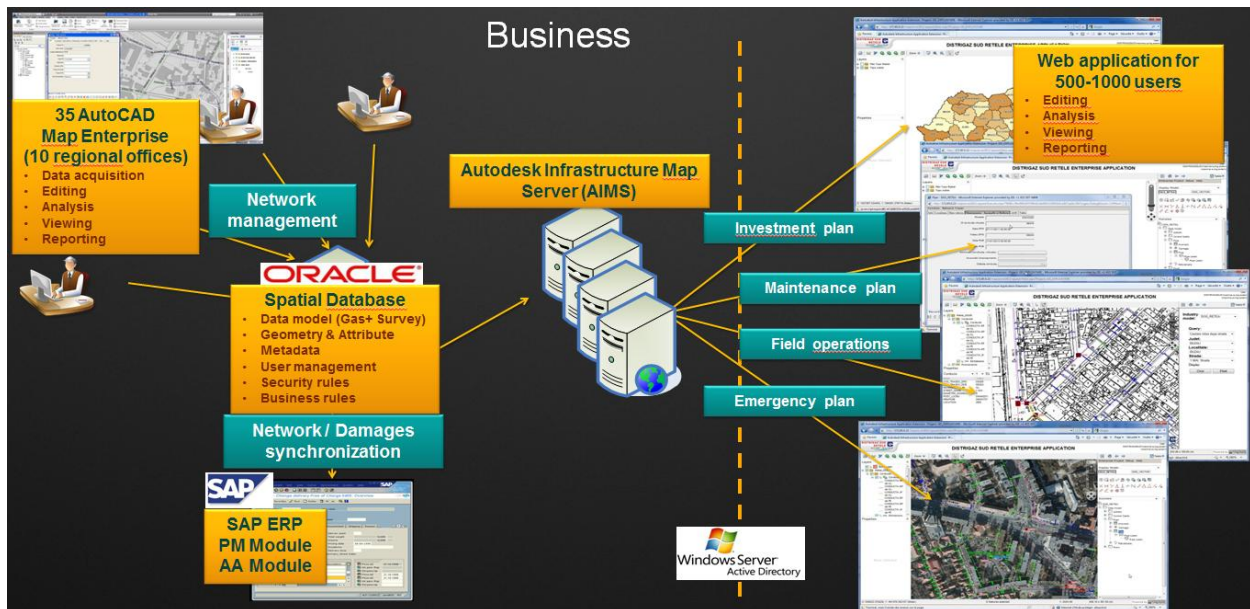
And to give a bit more technical details

Business processes

A necessarily highly regulated activity, natural gas distribution on such a large scale is a highly detailed and complex task. A pervasive network of gas pipes, residential connections, regulator stations, management systems, and sensors, the 17,000 kilometer network requires highest-level efficiency and automation of manual assets.

Keeping in mind the 2 main objectives of the system, knowing to manage the complete equipment life cycle and to standardizing and secure the business processes, here is a short list of the processes that this system covers:

- Locate an area of interest
- Import field measurements
- View technical geometry and attributes
- Concurrent edition
- Network Topology
  - Increase data integrity
  - Minimize update errors
- Graphic and tabular reports
- Distance / buffers
- Sketch drawing / redlining
  - submit a draft proposal for the supplier
- Completion status
  - Work progress
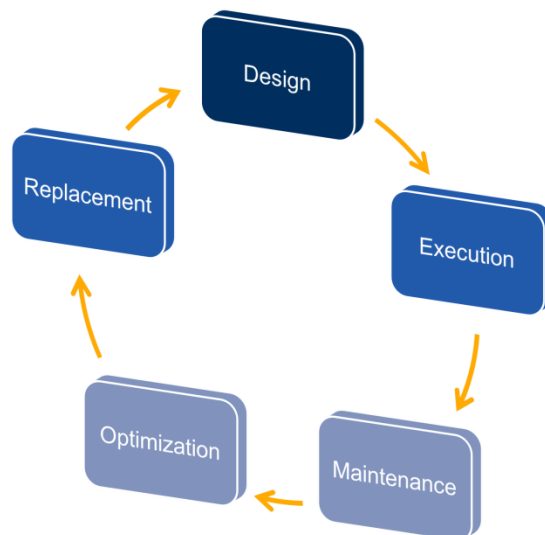
- Multi criteria analysis
  - Used for investment plans
- Cost of network deployment estimation
  - For new areas
- Network status reports
  - For any user-defined area

To give a better idea of what have been proposed within this application, here is the description of the system from the user point of view.
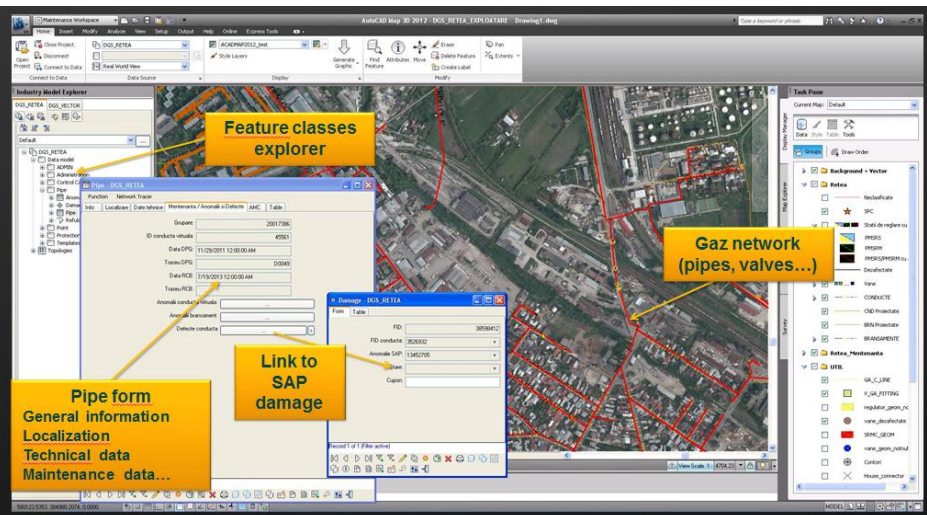
Desktop application for the GIS experts
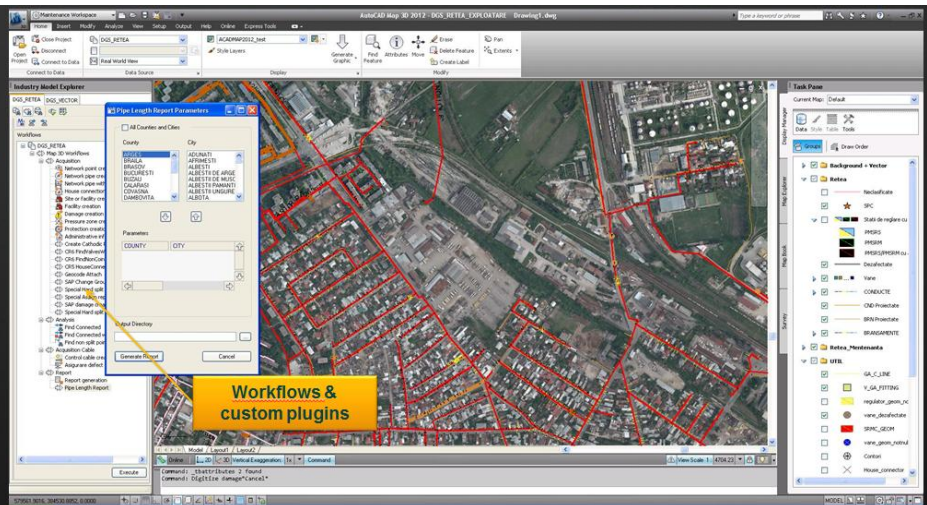
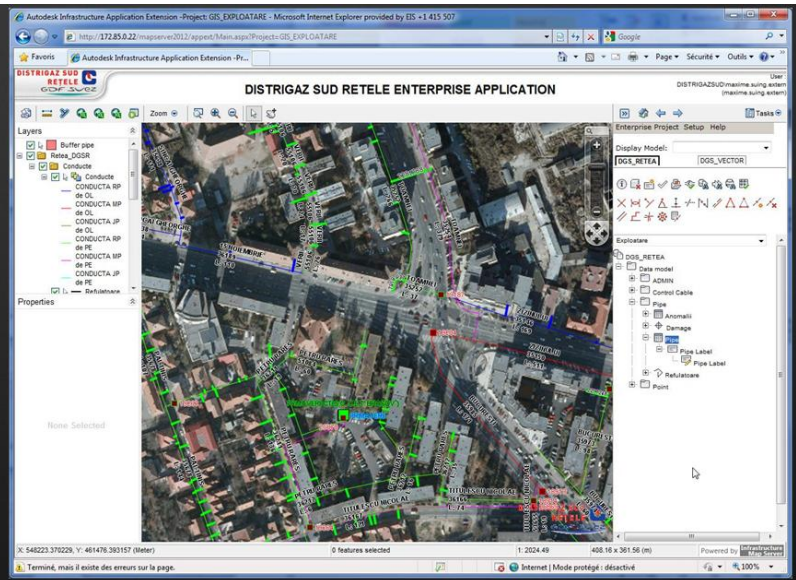Web application for a wide distribution of the information

Web Application (AIMS)

Users :
- 600 / 1000 users
- 200 / 300 simultaneous
- Anyone in the company

Technical constraints :
- Internet Explorer 8 and above
- Works on Firefox and Chrome but not deployed

Web Application (AIMS)

Application credential :
- No password required
- Any user belongs to 1 or many groups in the Active Directory
- Any group in the AD is linked to 1 workspace / project :
  - Field work
  - Investment plan
  - Maintenance plan
  - Emergency plan
  - Hydraulic calculation
  - Cathodic protection
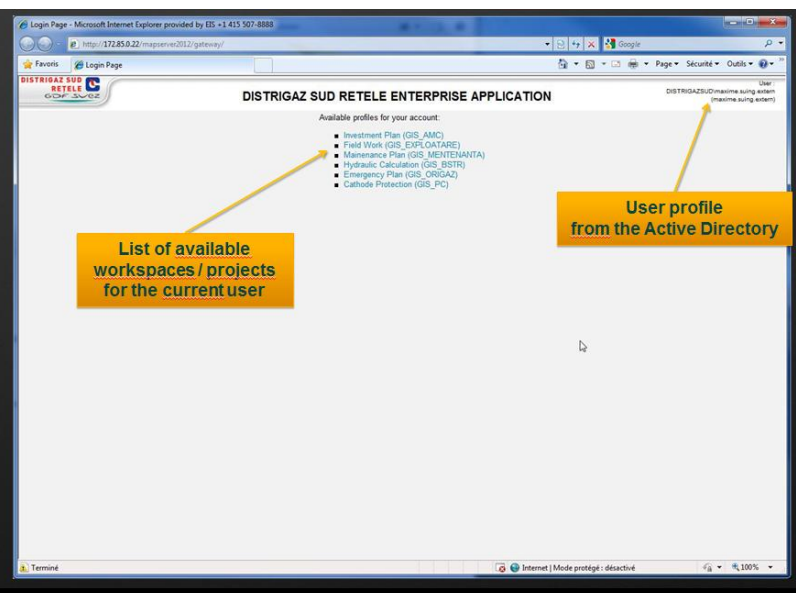
Web Application (AIMS)

View graphic data on the map :
- Background layers
  - Using MapGuide tiling capability
  - Tiles served directly through IIS
  - Include many raster files (900 Gb ecw/sid)
    - Aerial photographs
    - Cadaster scans
    - Satellite image
- "Dynamic" layers
  - Equipment (pipes, valves…)
  - Events (damages, anomalies…)
  - Thematic layers
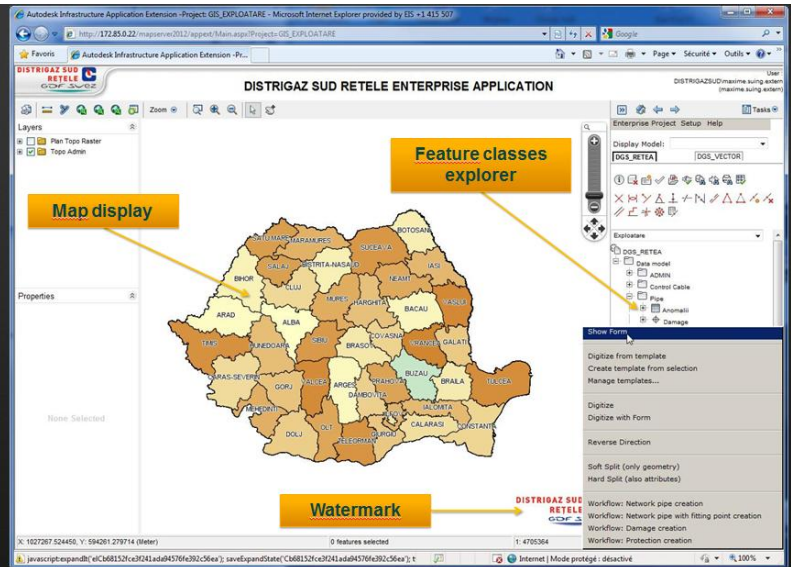
Web Application (AIMS)

View attributes in the forms :
- General information
- Location (city, street…)
- Technical data (material, length…)
- Maintenance data (defects, anomalies…)
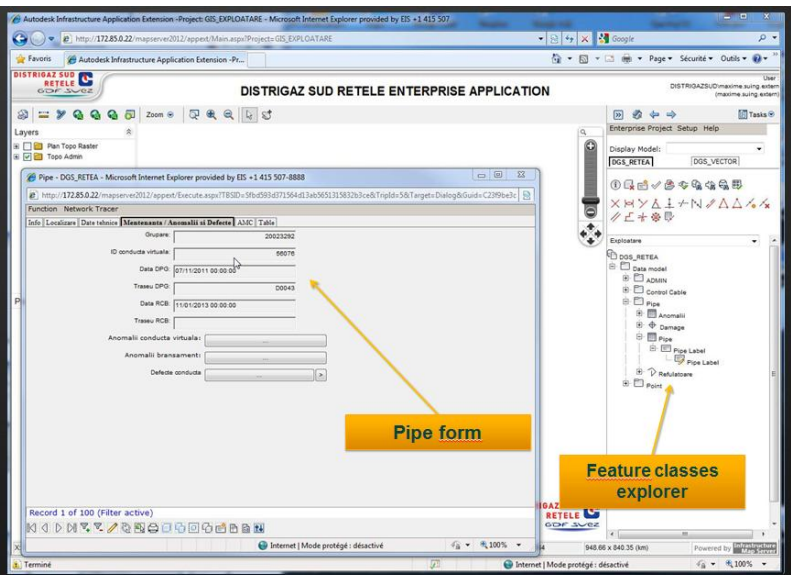
Web Application (AIMS)

Search area of interest :
- Use the map toolbar
- Position finder
  - Locate an equipment in a street
  - Locate an equipment by id
  - Locate an maintenance route
  - Identify equipments planned for maintenance in next months
  - Locate an incident
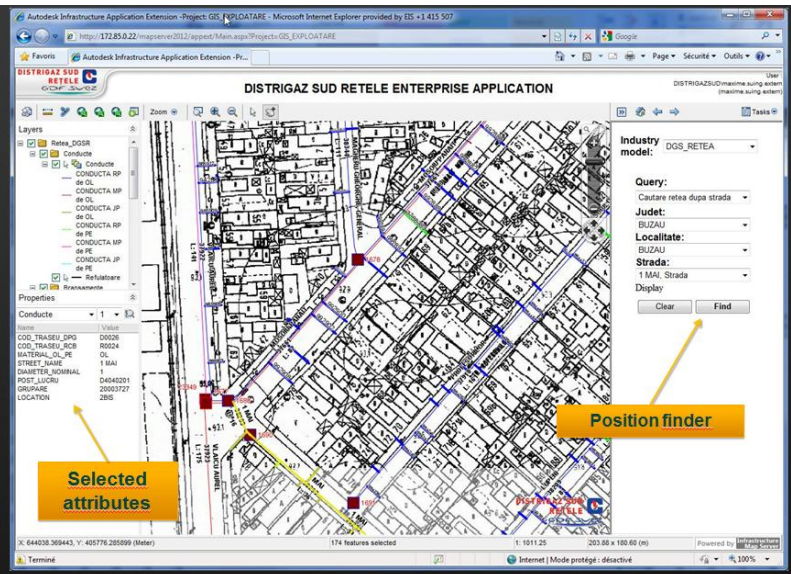
Web Application (AIMS)

Analyze data :
- Thematic maps
- Measure / buffers

Web Application (AIMS)

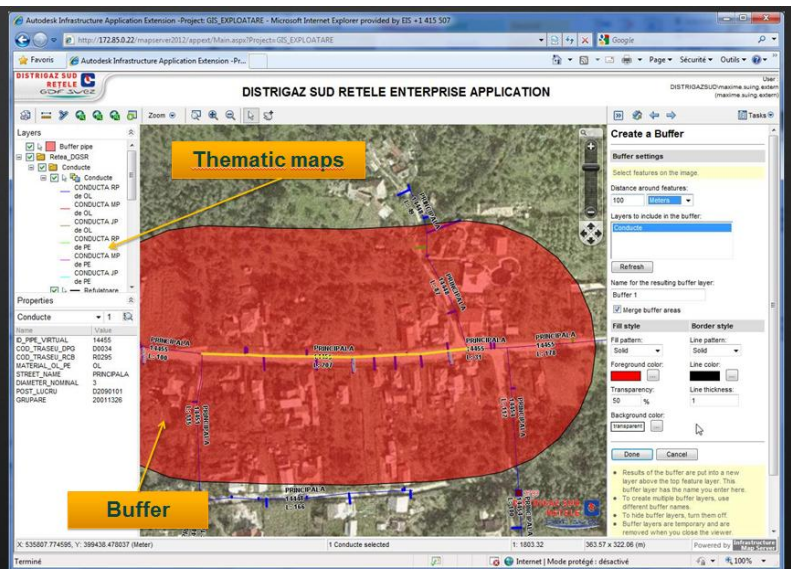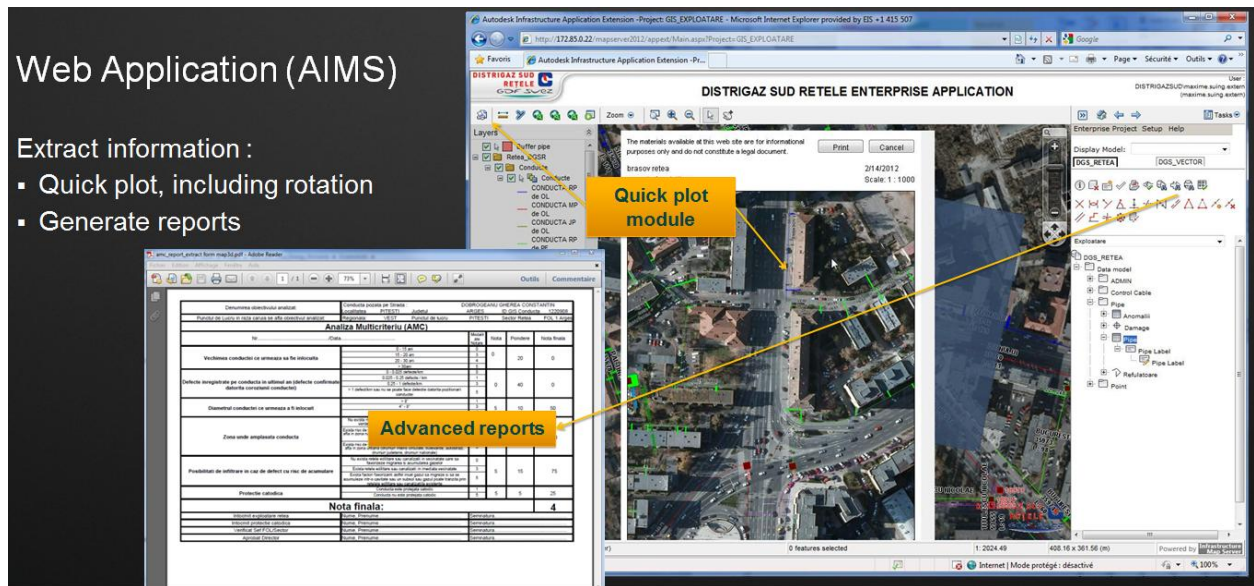Extract information :
- Quick plot, including rotation
- Generate reports

Quick plot module

Advanced reports

Web Application (AIMS)

Data split into 4 regions (Vest, Est, Centru, Bucuresti) :
- Every web user belongs to a group in the AD
- Every group in the AD is linked to a region
- Every group is linked to an Oracle schema created with the security administrator
  DGS_RETEA_BUCURESTI, DGS_RETEA_CENTRU...
- Data filtered accordingly
  - Through Oracle VPD (Virtual Private Database)
  - VPD applies extra filtering conditions to any SQL query issued by the database user *where region = 'xxx'*
  - Those dynamic filters are applied to any request
    - Maps, forms, position finder, property panel
- No data replication, no impact on the data model

Web user belongs to
DGS_RETEA_BUCURESTI
group in the Active Directory

Web user belongs to
DGS_RETEA_CENTRU
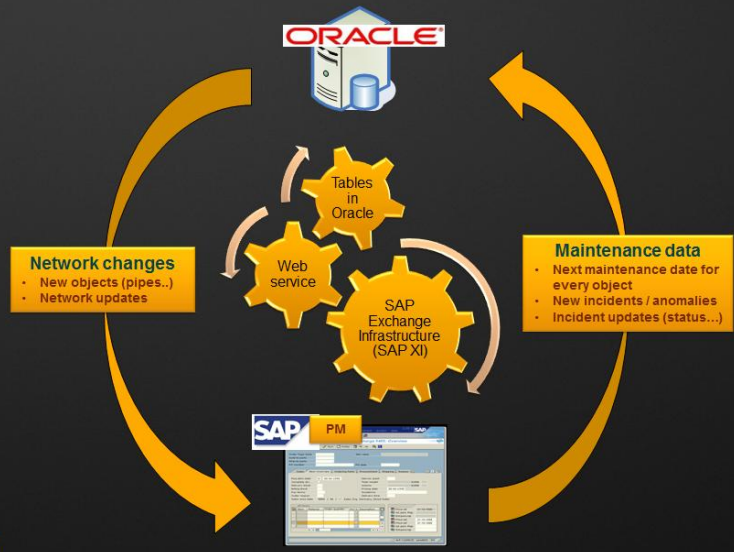group in the Active Directory
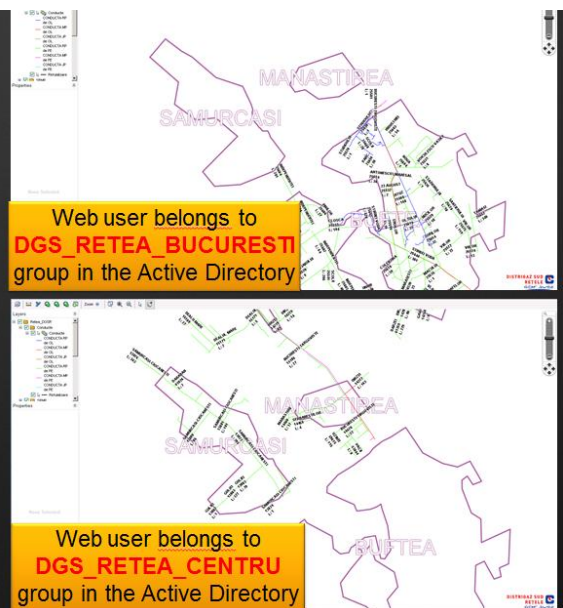
SAP Plant Maintenance

Process :
- Automatic mechanism between SAP XI and the Web Service
- Asynchronous, once/day

Purposes :
- create preventive and corrective maintenance plan for every equipment :
  - pipe
  - house connection valve
  - regulation station
- Synchronize constantly
  - the network in Map Enterprise
  - the maintenance plan and events in SAP-PM

ORACLE

Tables in Oracle

Web service

SAP Exchange Infrastructure (SAP XI)

Network changes
- New objects (pipes..)
- Network updates

Maintenance data
- Next maintenance date for every object
- New incidents / anomalies
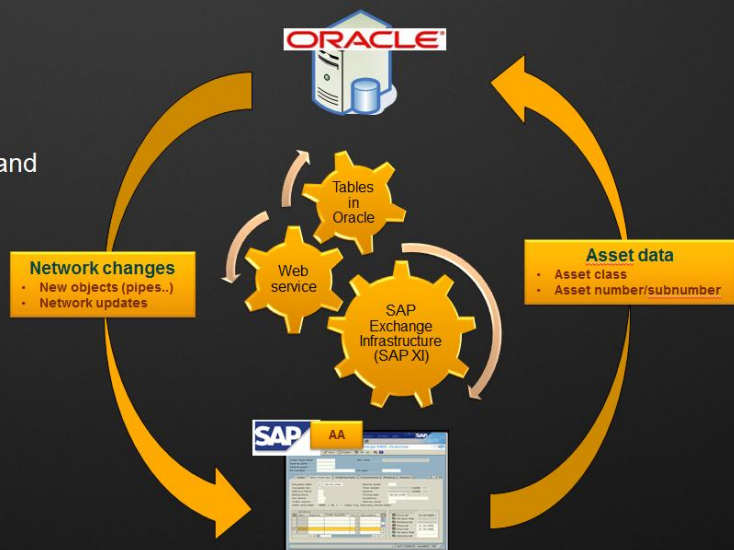- Incident updates (status...)

SAP PM

SAP Asset accounting

Process :
- Automatic mechanism between SAP XI and the Web Service
- Asynchronous, once/day

Purposes :
- Correlation between physical asset and financial asset
- Legal regulation
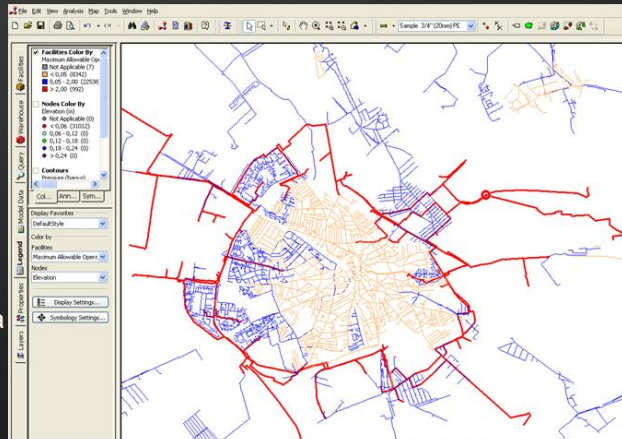- Optimize process for pipe replacement

ORACLE

Tables in Oracle

Web service

SAP Exchange Infrastructure (SAP XI)

Network changes
- New objects (pipes..)
- Network updates

Asset data
- Asset class
- Asset number/subnumber

SAP AA

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Network modeling and analysis
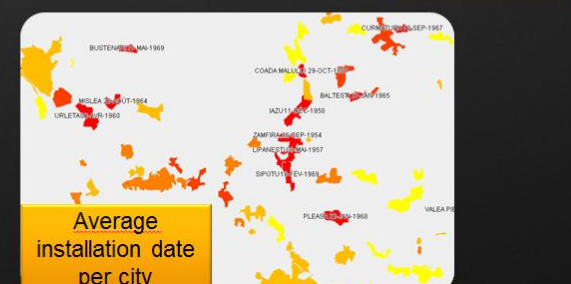(Synergee gas)

Process :
- Extraction of the network with an ETL
- Automatic process
- Once/day

Purposes :
- Simulate network isolation on a user-defined area
- Simulate a closure of a valve or a regulation station
- Pipe size options assessment according to specific loading conditions : pipes models, material cost, installation cost and best location

Network overview

Total length of the network per county

Average installation date per county

Number of pipes per county

Average installation date per city
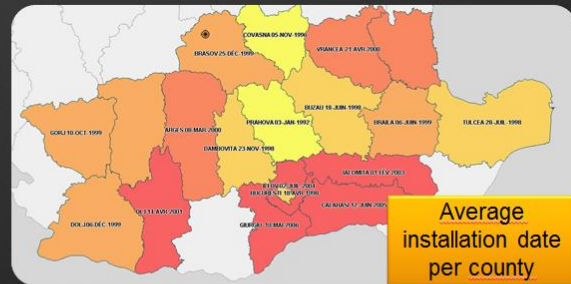
Challenges

Since GDF Suez wanted to open the information to a lot of users within the company, between 600 and 1000, the main challenge that they meet was around the stability and overall performance of the web application.

Here are some of the hints used to check, stabilize and optimize the system.

Performance and stability of the web application

- **Database** tuning
    - Check SQL hints, indexes and statistics
    - Use EXISTS instead of IN statements
    - Limit the number of attributes
    - Reduce optimizer_index_cost_adj parameter
- **Web Application** tuning and stabilization
    - Create dedicated IIS Application Pools (MapServerAppPool, AppExtAppPool…)
    - Restart IIS 2 or 3 times a day
    - .Net configuration *<legacyUnhandledExceptionPolicy enabled="true" />*
    - Reduce web session length
- **Map Server** tuning and stabilization
    - serverconfig.ini optimization *(MaxConnections, QueueSize, CacheSize, DataCacheSize…)*
    - Serve tiles directly through a web application for map background
    - Access http:///server/TileCache/xxx instead of http://server/mapserver2012/mapagent/xxx
    - Existing tile → served by IIS
    - New tile → error 404 redirects to http://server/mapserver2012/mapagent/xxx
    - Easy to manage tiles expiration
    - Really faster
    - Cleanup AIMS repository (remove temporary AdoNet_xxx.FeatureSource)
    - 5 hotfixes delivered by product development team
    - Automatic restart of windows service
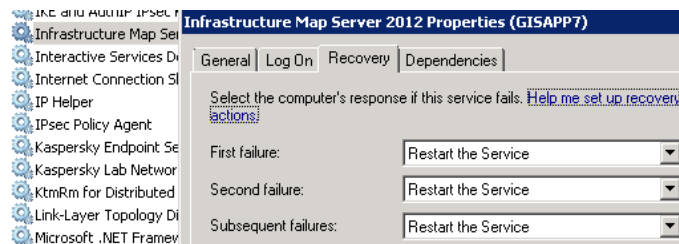
Stress test / system sizing

To be more factual and check how many users a single could handle, we have run a stress test on 1 server with the following characteristics:

- Performed with Visual Studio 2010 Ultimate
- 4 scenarios (web sessions recorded)
- 25-50-75-100-125-150 users for 1 server
- The results were analyzed based on the following information
    - Windows perfmon, event viewer
    - AIMS, AppExt, Oracle logfiles
    - Visual Studio reports
    - Recommendations

The outcome of this stress test is

< 70 users	• performance and memory OK
70 to 105 users	• performance decreases
> 105 users	• avg response time drop

And the main recommendation

| Add 1 new server	Setup load balancing	Reduce session length

Roadmap

Since the system is working well, GDF SUEZ Energy Romania is already planning for future enhancements and developments of the system which will include the following features:

- "Simple" AIMS viewer
    → Company-wide application, fast and intuitive
- Tracking tools for new investments
- SCADA integration (Supervisory Control and Data Acquisition)
    → Real time measurements from field devices, displayed in Map3D and AIMS
- SAP ISU integration (Industry Specific Solution for Utilities / Customer Care System)
    → Customer and meter positioning available for spatial analysis

- Develop routing and proximity modules
  - → Routing for network detection cars and mapping of the pipes covered
  - → Proximity analysis of the network
- Work force management integration
- Project BaseJump on the labs http://labs.autodesk.com/utilities/basejump
  - → Bing® WMS in AutoCAD Map
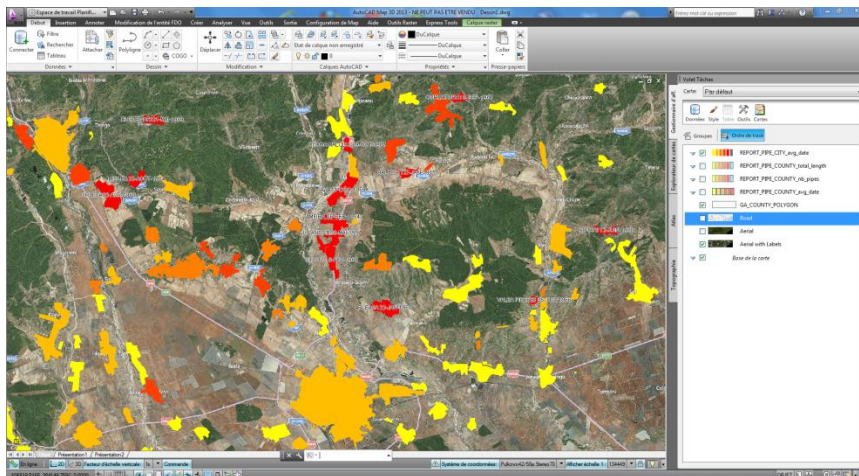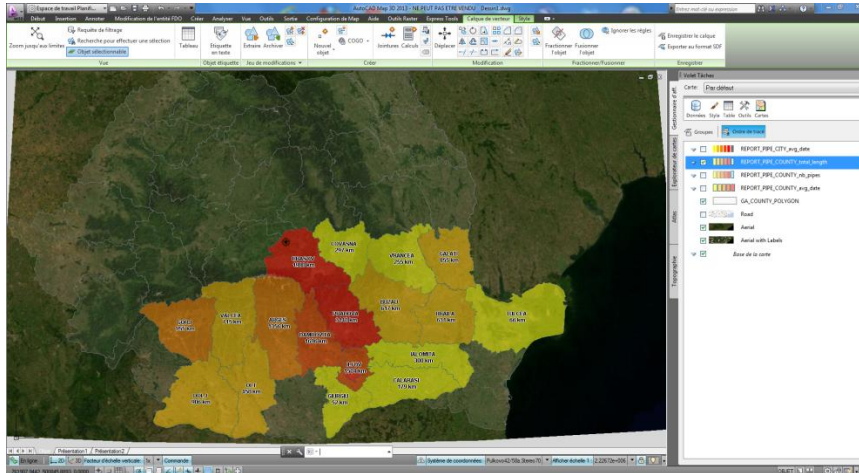
- AIMS Mobile viewer
  - o Mobile solution
  - o Identified for field operations

- Autodesk Infrastructure Modeler®
  - o 3D view of the assets + collaboration
  - o Web plugin to browse in a scene
  - o Mobile application / augmented reality

Summary

Despite the tight timeline, and with help from a five-member Autodesk Consulting team, GDF SUEZ Energy Romania created, implemented, and deployed the new network system by 2010, including 13 months in "project" mode, and it is now successfully supporting more than 600 active users. Through the latest version of AutoCAD Map 3D Enterprise software, the core, open architecture database uses accurate data to safely and securely manage important asset updates across the entire Romanian production environment.

Thanks to the open architecture, full integration with SAP plant maintenance, network analysis, and other enterprise systems is possible, while enabling creation and interactive revisions of design drawings and providing multi-criteria analysis for investment planning. The AutoCAD Map 3D Enterprise-driven system is also used for acquiring updated field data and creating new assets and analyses. Meanwhile, the web client—based on Autodesk Infrastructure Map Server—serves the entire operation in providing a detailed view into network geometry and characteristics, as well as easier map navigation of maps and generation of reports. The system also automates and enables data capture, field measurement, network topology, job estimating, graphical reporting, and network monitoring tools.