Integrating GIS and SAP workflows

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1 Paper abstract

Pidpa is a Belgian water utility, offering drinking water and wastewater services to 65 communities in the Antwerp province. Over the past few years, Pidpa has implemented and extended an ArcGIS based solution, to maintain geographic information on drinking water and wastewater networks. With an important focus on integrating GIS and 'location awareness' in several work processes for technical as well as customer departments. The most extensive integration is towards several SAP modules, which now provides easy and more efficient access to administrative data via GIS-views for a lot of users. Relevant GIS and SAP data flows are linked where possible, to ensure data consistency throughout both enterprise applications.

2 Pidpa, the company

Pidpa is a progressive European water company, situated in the Antwerp province in Belgium (Flanders region). Being one of the biggest Flemish water companies, we provide almost 500.000 customers or more than 1.1 million people, with tasteful and pure drinking water at home 24/7. At a very modest rate.

Day after day, our staff devotes it's energy to the sustainable purification of ground water into drinking water. A highly technological process, that is implemented in 12 water production sites, and yearly generates over 66 million m³ of drinking water.

Pidpa is active in an area of about 2581 km², in which we continuously maintain, renovate and expand an extensive drinking water distribution network of over 12.600 km in length. Over 100 mobile crews are daily working on the water network with over 150.000 equipments like hydrants, valves etc. throughout the area. Or at infrastructure locations, like water towers or pumping stations.

The water quality is permanently checked in our own certified laboratory. Daily a large amount of water samples are taken on different locations in the network, and checked for potential water quality problems. When a problem does occur, a detailed intervention procedure is executed, to react quickly to isolate problems in the network, and switch the network to minimize the number of affected customers. And, if necessary, alternative ways of distributing drinking water to customers like small water bags, are available through an emergency production line.

Customers are supported by a large customer service department, and in-house call-center. Allowing Pidpa to provide efficient customer service for administrative calls regarding items like invoicing, as well as more technical calls like requests for new connections.

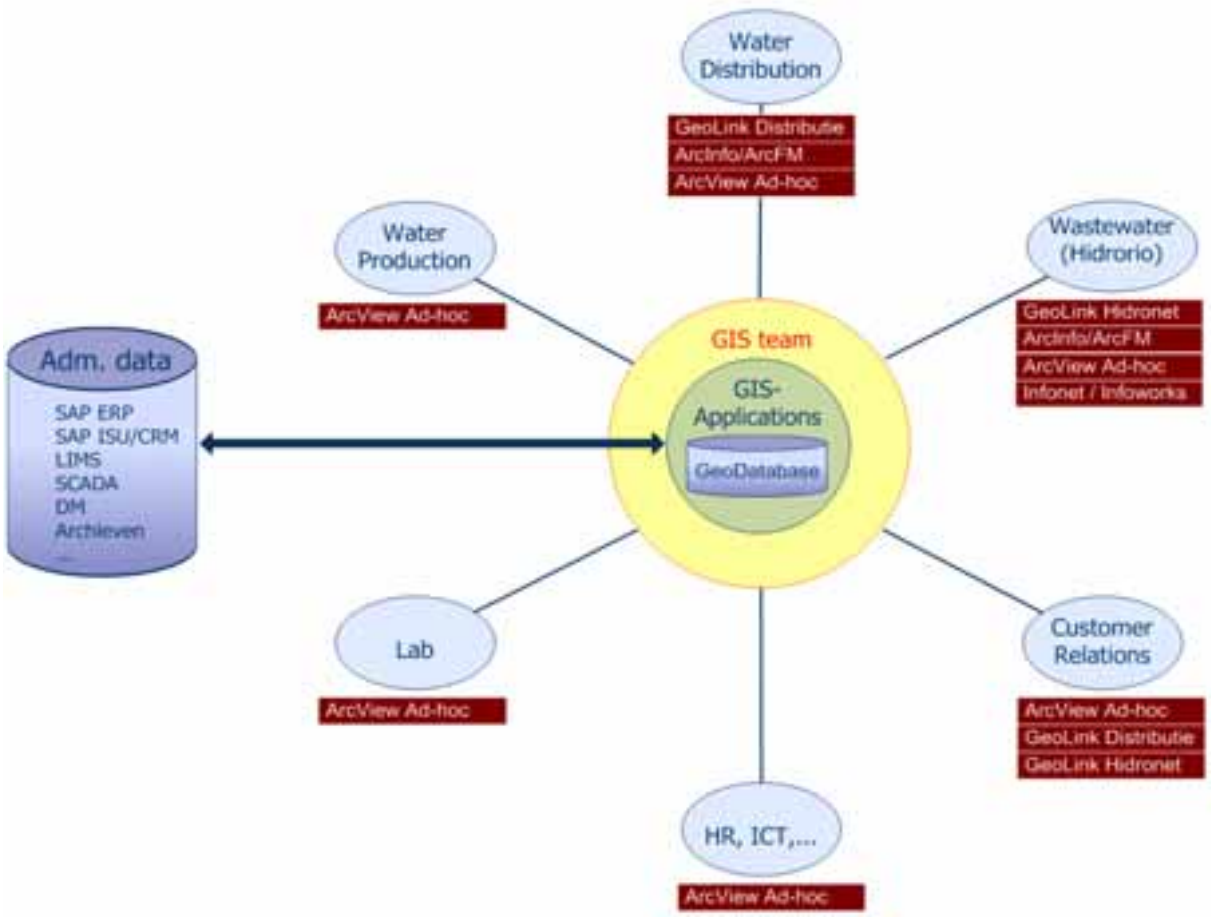
Through the Hidrorio department, Pidpa also provides wastewater services to 29 municipalities in the area. A quite new activity, that can vary per municipality from wastewater services on demand like installing personal water treatment facilities, to acquiring and maintaining the complete wastewater network for a municipality. An exciting and rapidly expanding new business, in which over 2.300 km of sewage network is maintained. An activity that offers Pidpa new opportunities to actively work on the entire water chain.

3 GIS vision

If we look at typical utility work processes, and the information that is used, a huge amount of information is related to a location.

It can be technical information based on a work order, like a job that needs to be executed somewhere on the water network, a water/sewage connection that needs to be constructed at a customer's location or a repair action that's necessary at a water tower or pumping station site.
But it can also be more customer related information like the location that is referred to on a water consumption invoice, the location where we take a water sample for lab-analysis, or the home location where a mobile worker starts from every day that's important for work-planning as well as the HR department.

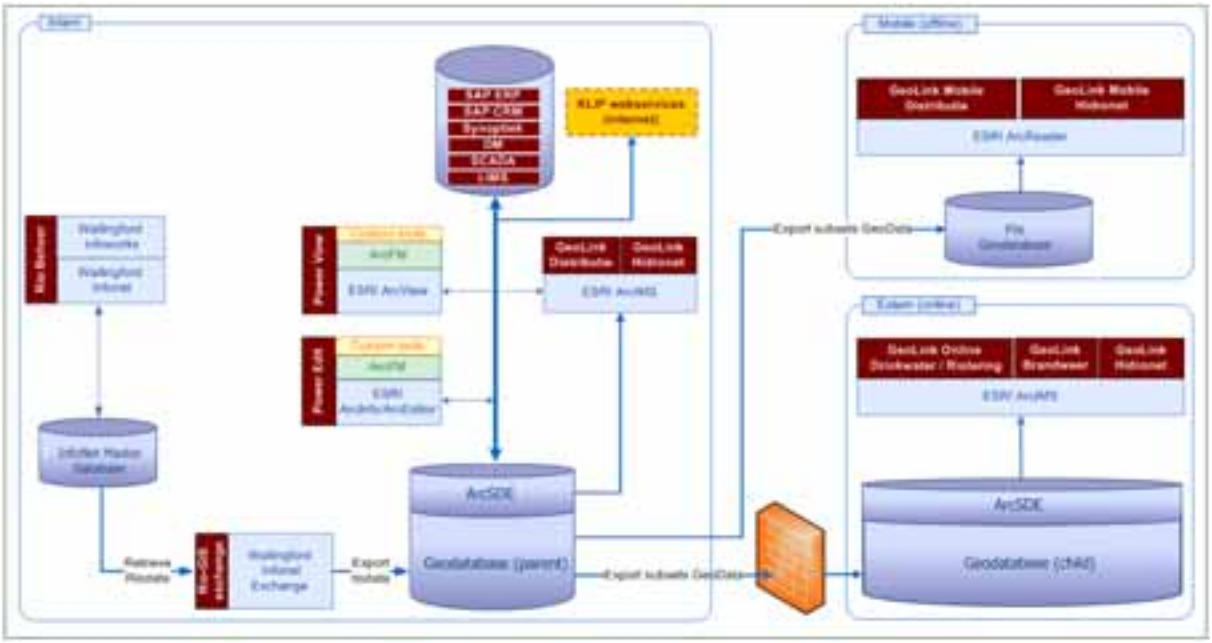
Location can be referred to in different ways, of which address is of course still very commonly used. But more and more ID-based object references between SAP and GIS, or X and Y coordinates in non-GIS information systems, are used. Since so much information is location-related, we consider GIS to be an important Enterprise application. And we are convinced that GIS can offer added value to almost any department.



The central master GIS database, is maintained by a GIS team that combines geo-ict profiles with data-management profiles. All departments use the same basic Esri GIS tools for all kinds of purposes, and share datasets where possible. Connections from GIS to other information systems like SAP ERP, SAP CRM, SCADA, Lab information or historical archives are implemented, and offer a lot of added value and access to extra information in a simple mouse-click.

4 GIS architecture

Over the last 10 years, the Pidpa GIS architecture has become quite extensive with facilities for GIS-editing, GIS viewing via web-applications on the intranet or internet, and a mobile GIS application. All Esri GIS-tools are used for maintaining the water distribution network and the wastewater network, as well as for more thematic applications.



A closer look on the components in this architecture :

1. **Database** : all users (editors and viewers), work on the same versioned master Geodatabase, which is based on SQL*Server 2005 and has ArcSDE 9.2 running on top.

   Water network data is directly maintained in the master Geodatabase, wastewater network data is imported from an Infonet database (wastewater network management tool) and complemented with extra gis-datasets that are maintained in the master Geodatabase.

2. **Editors :** there are 24 concurrent editors that use ArcInfo or ArcEditor as a base software, extended with Telvent ArcFM functionalities and a limited set of custom tools.

   They work in an edit environment that is ‘configured’ by the data-managers for optimal use in the Pidpa work processes. Everyone uses the same menu’s and toolbars and the same basic stored displays(mxd’s) with symbology, labeling, scale levels etc. readily defined for use. Detailed descriptions on how to use all available tools, are available in a document based GIS Knowledge base.

3. **Power viewers :** there are 7 ArcView seats available for GIS-analysis, more intensive or custom gis-data access, and ad hoc map creation.

4. **Internal Viewers :** the majority of the viewers use GeoLink for viewing GIS data.

   GeoLink is an ArcIMS site that is available to everyone at Pidpa, and offers a gis-view on water network data as well as wastewater network data. This browser based application(s) offer a fast and user-friendly access to gis data.

   GeoLink contains several interfaces to other information systems like SAP ERP & CRM, SCADA, document archives etc. allowing users not only to view gis-data, but also easily access related information they need from or in other information systems in a mouse click. The approach to support the associative thinking process of users when retrieving information, has proven quite successful.

5. **External viewers** : we offer access to a somewhat stripped set of GIS data via GeoLink Online to several external parties.

   Municipalities or fire departments can get detailed information on the water/wastewater network data via GeoLink Online ArcIMS sites (http://www.geolink.be).

   But also any contractor that needs to dig close to Pidpa networks, can get access to a gis-view of our water and wastewater network data, to determine the exact location of the network and avoid accidental damages. This is a quite extensive user group of over 1500 external users, of which we receive about 20.000 information requests per year via a government portal called KLIP. By integrating with this external portal, and offering location information of our networks online instead of via paper maps, we can provide accurate and very specific information almost immediately upon request, in a fully automated process.

6. **Mobile viewers** : all Pidpa field-crews, fieldwork supervisors and engineers are equipped with a laptop, that contains a local file geodatabase with all relevant GIS water/wastewater network data. GeoLink Mobile is an offline viewer that is created based on ArcReader, and offers every field-operative efficient access to water/wastewater network data.

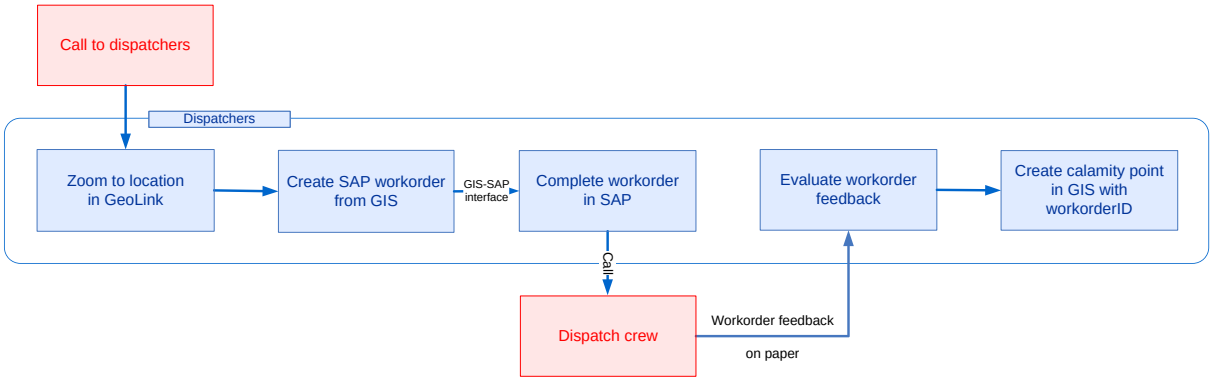
   Since we use mainly vector data nowadays, the local gis-dataset is limited in size, and can easily be updated in less than 5 minutes, whenever the laptop is connected to the network in one of our offices.

5 Integrated use of GIS & SAP for water network maintenance

One of the workflows that runs over GIS and SAP, is the creation of SAP work orders by the network maintenance department.

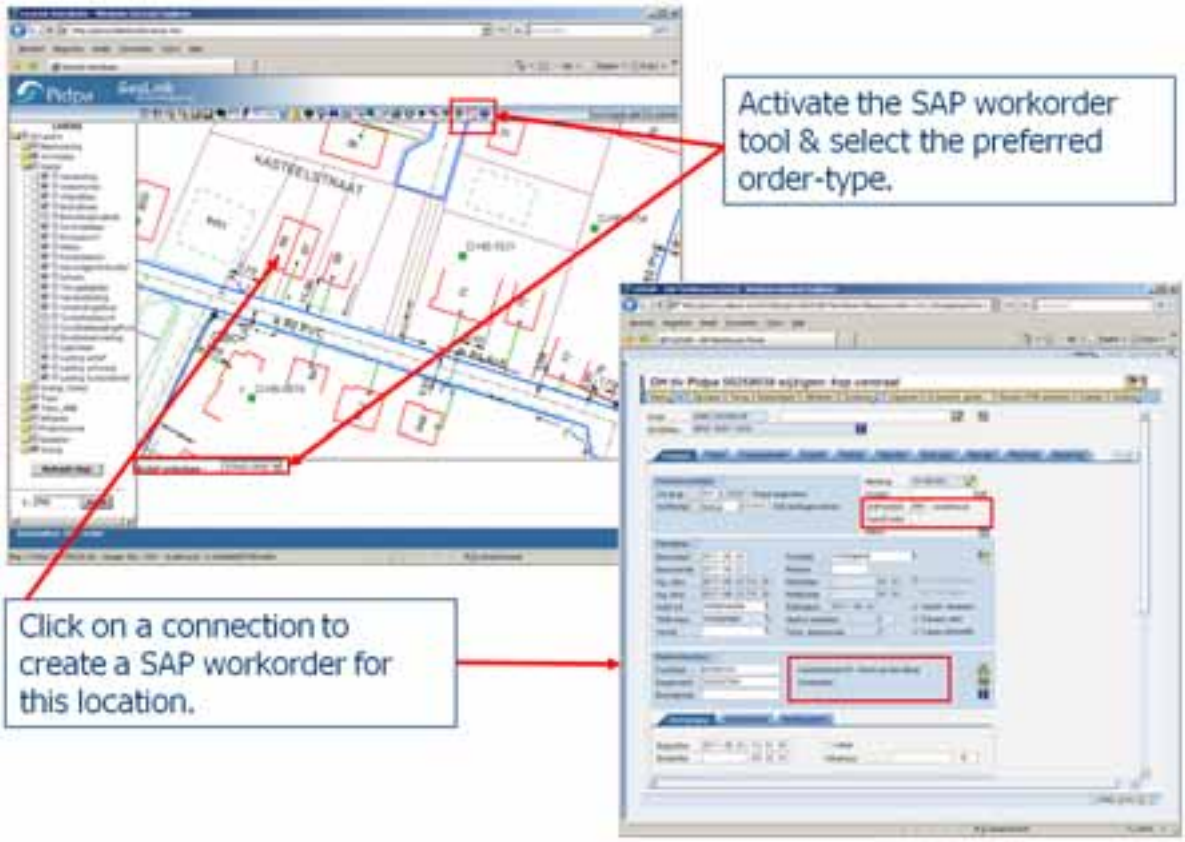
An overview of the workflow when there's a problem on the network (e.g. network leak) :

When a call is passed to the dispatchers of the network maintenance department regarding a problem on the water network, they typically ask for a location description and immediately zoom to that location in GeoLink, our GIS webviewer.



When it concerns a leak somewhere in the network, zooming in to the right location in GeoLink allows them to immediately assess which pipe(s) might be damaged and what the magnitude of the problem is. An assessment depending on location and diameter of the pipe, criticality, area etc. that determines which and how many crews to dispatch to that location.

To dispatch a field crew, a SAP work order is created from GIS, by clicking on a nearby connection and selecting the type of work order. Based on the received Connection Equipment ID and order type , in SAP a work order is created with address information automatically filled in. The order is then displayed to the dispatcher in a SAP WebGui screen, to enter extra information regarding the problem. Once the work order is complete the crew(s) is notified of the problem, location and work order to be executed.



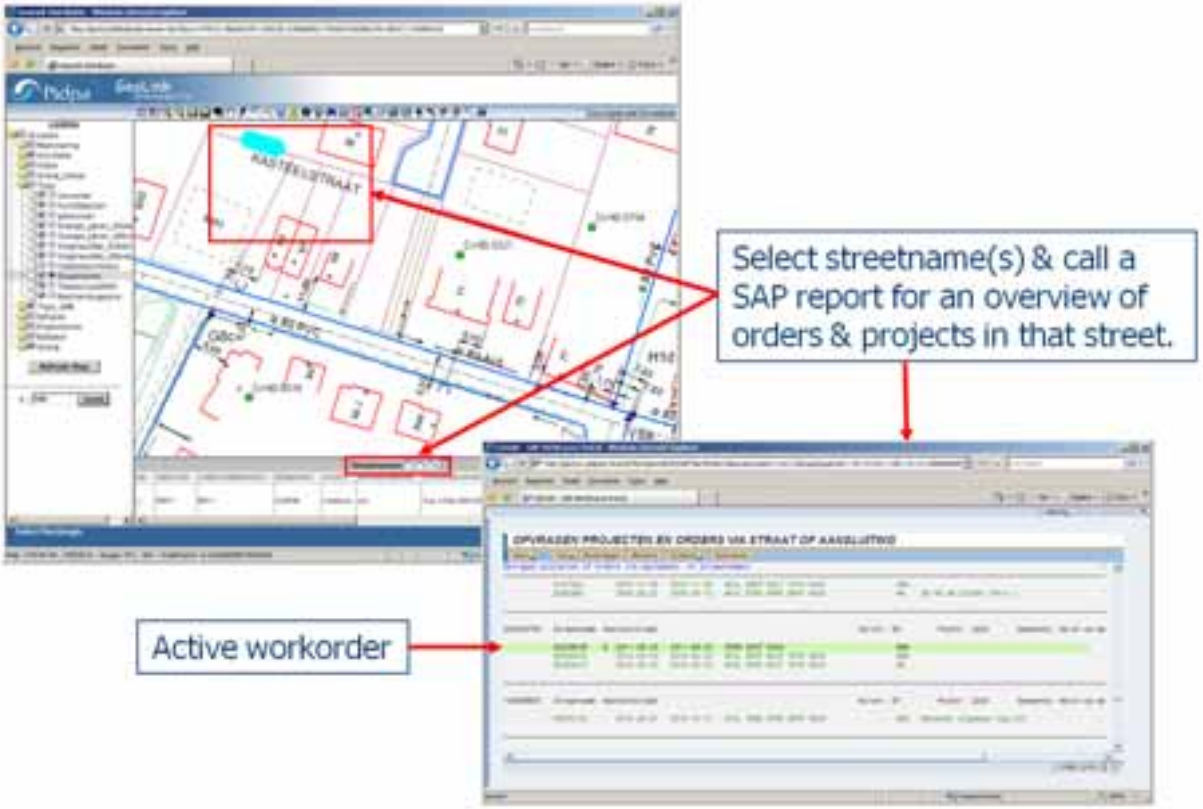
In situations where there's no connection nearby the problem location, work orders can also be created based on the selection of a street name in GeoLink. Based on the received StreetID, a SAP work order is then created.

After a repair action has been concluded, based on the feedback of the crew(s), there's an evaluation if there should be created a calamity point created on the location where the problem on the network occurred. A calamity point is entered when the problem was related to the structural integrity of the main, not when a leak/break or other problem was caused by accidental damage.

Entering calamity points in GIS whenever there is a problem that relates to the quality of the main, allows us to evaluate which mains often have problems and are candidates for replacement. A calamity can be caused by a quality problem with the main material, which is also assessed through lab analyses on a piece of that main. But it can also be related to the production quality or to the specific environment where the main is located (e.g. next to road with heavy traffic, specific soil composition, etc.) These are all factors that are taken into account in asset management decisions.

Results of this process :

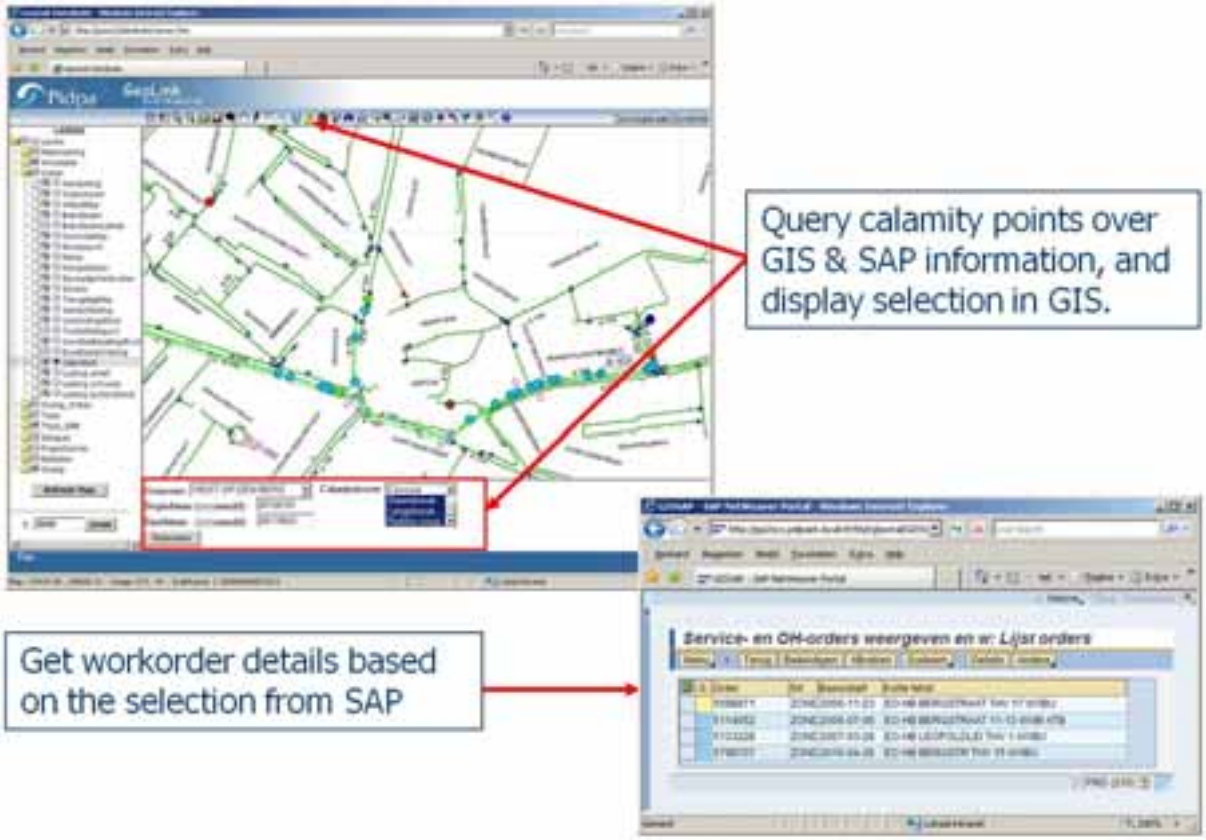
Creating work orders from GIS, and having them consequently linked to a street or connection (which also relates to a street), allows us to call a SAP report from GIS with an overview of orders and projects in a street, based on a selection of one or more street names in GIS.



It's not just a static SAP report, but a fully functional SAP WebGui is opened up, which allows clicking on each order to retrieve detailed information on tasks, costs, who executed the work etc. from the SAP environment.

The calamity points and condition assessment points in GIS, offer a valuable geographic view on which mains often have problems and should be evaluated for replacement in asset management context. It's not just a view of points on a main, but every point refers to a work order, that can be accessed by selecting those points and connecting to SAP with that selection.

Even a search over GIS and SAP data is possible, to select the calamity points of a certain type in a timeframe. In GIS the area and calamity type is selected by a user, and a timeframe is entered. Based on the area and calamity type, a set of calamity points is selected in GIS, passed on to SAP with the timeframe parameters, and SAP filters the calamity points based on the work order dates that are linked to those calamity points. Finally the filtered dataset is returned to GIS and displayed.

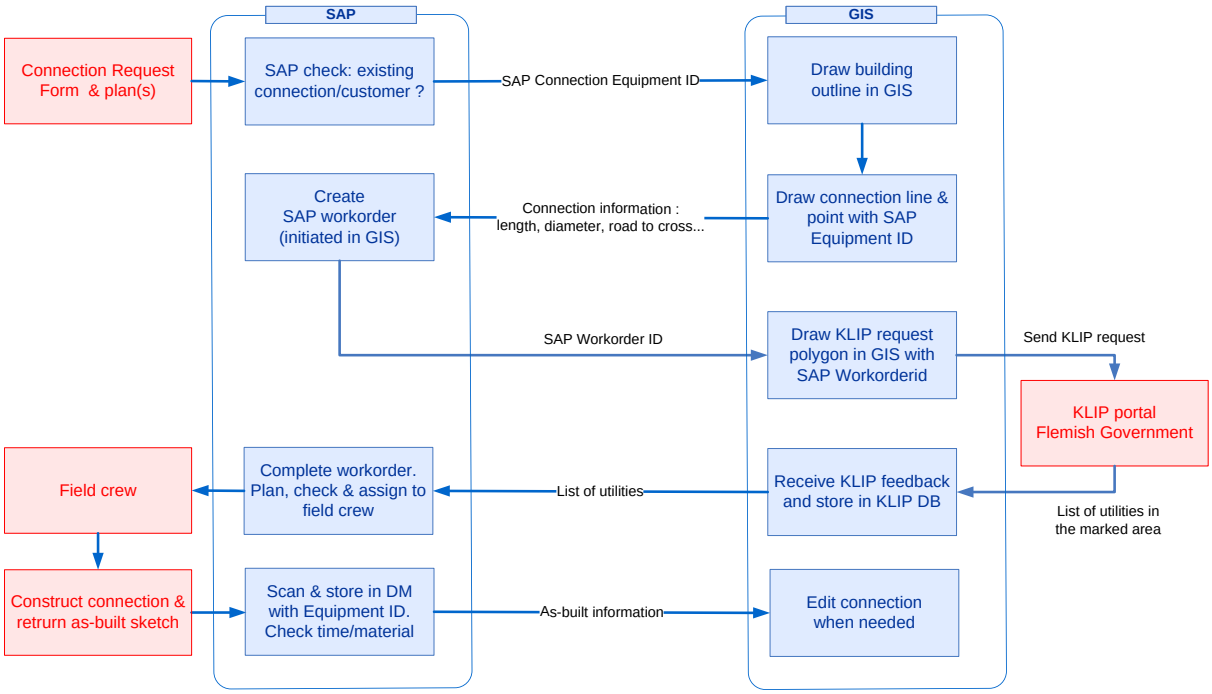


The selected set of calamity points can then again be used, to call an SAP report from GIS, displaying all related work orders.

6 Integrated use of GIS & SAP, for connections to the water network

When a customer requests a new connection to the drinking water network, a workflow starts that runs over several enterprise information systems. A quite extensive process of which only the main GIS & SAP steps are be described here.

Over the last couple of years we have invested in optimizing this workflow. Though it still contains pragmatic choices with parts still on paper, a number of links between GIS, SAP, and a central document management system were created. Making it easier and more efficient to handle new connections, and making more information on connections accessible from GIS.



When a customer contacts Pidpa for a new connection, we request that a 'Connection Request Form' that is available from the Pidpa website, is filled out. This form must contain the customer's contact details and technical information on what type of connection he would like, location where the water connection must be constructed etc. The form can be digitally completed, but still needs to be signed and send to Pidpa on paper. Also a detailed location and layout plan of the building the customer would like to have connected to the water network, must be attached.

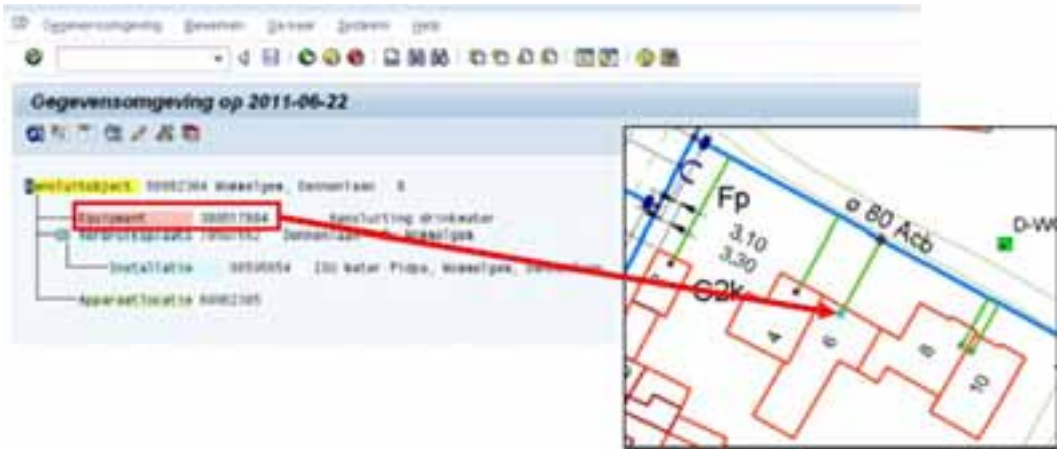
When such a new request is received, it's handled by people that have access to GIS and SAP. Both systems are used to register all received information, and create the necessary objects like cost-estimate & offer, work order, etc. in SAP and topographical and connection objects in GIS.

<u>Based on the received application the process starts with two checks in SAP :</u>

- Check in SAP CRM if it's an existing customer. If so the Business Partner ID is retrieved, and used in the next steps of the process. If not, a new Business Partner is created.
- Check in SAP if it's a new connection for this address, or records of a previously existing connection at this location can be found. Specific action might be necessary in that case.

This results in a SAP Business Partner ID and a SAP Connection Equipment ID, that are available as important unique ID's for further steps of the process.

Based on the building layout plan and indication where a connection is wanted, the building outline is drawn into GIS. Also a new connection to the water network is created in GIS, making a connection from the location the customer marked, to the water distribution network. At the end of each connection, there's a connection point that contains the SAP Connection Equipment ID as a foreign key attribute.



Once the connection is drawn in GIS, information like connection length, diameter, if a road needs to be crossed etc. is known. Starting from the connection in GIS, a SAP work order can be created for that location, and the detailed GIS information relevant for cost calculation is entered.

After creating a SAP work order, in GIS a polygon is created to mark the area where we will be digging on public property to create the new connection. The SAP work order ID is entered as an attribute of this polygon, and the polygon is send to the KLIP portal.

<u>What is KLIP ?</u>

In the Flanders region, everyone who digs mechanically on public property, has to request maps from all other utility companies that might have underground cables or pipes in the marked region. KLIP is a government portal, accessible via web browser or integrated in an own GIS environment through webservices, with a goal to improve information flow on the location of underground network facilities and help avoid network damages.

This is done by sending a GIS polygon to the KLIP portal, with the work order ID as a unique Pidpa ID. The KLIP system will pass the request for information, to all utilities present in that area, and they are obligated to provide information within 15 days.

This automated process, results in KLIP sending us a list of utilities that we will receive information of, and have to wait for before we can actually start the work. Based on this information, in the SAP work order a permit for each of the utilities we have to receive information from, is defined and blocks the work order from being planned or executed until all information is available.

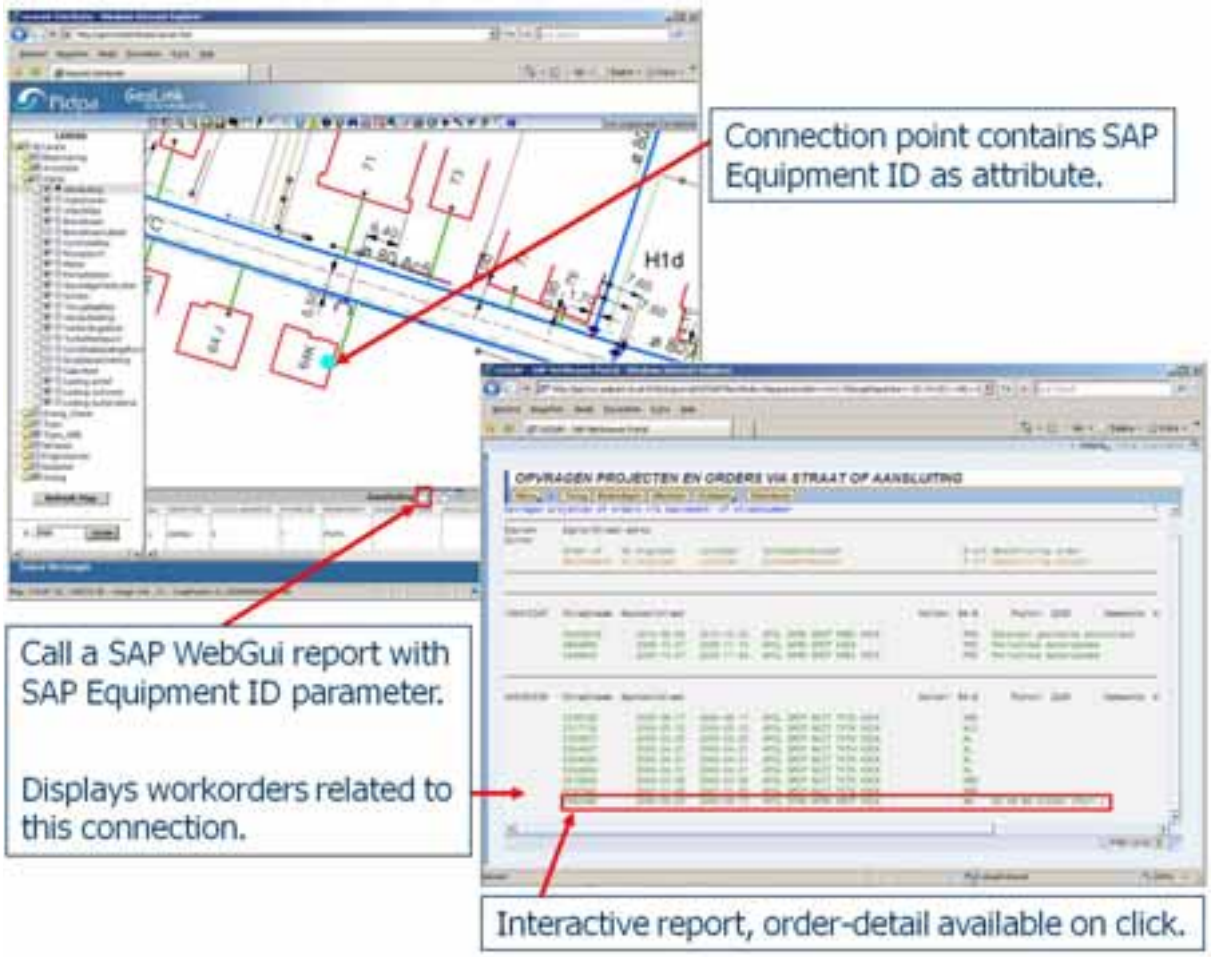
When all external and internal permit requirements are fulfilled, the work order can be planned and executed by a field crew. When the connection is constructed, the field crews fills out a paper form with feedback on time and material, and a detailed as-built sketch with measurements. This sketch is scanned and stored in the central DM document management system, with the Connection Equipment ID as metadata. In GIS the connection that was drawn, can be adjusted with the as-built information if necessary.

Results of this process :

Having the Connection Equipment ID in GIS as an attribute of a connection, and in SAP as an attribute of a work order, allows us to make a connection between the two environments.

<u>GIS connection(s) → SAP list of work orders</u>

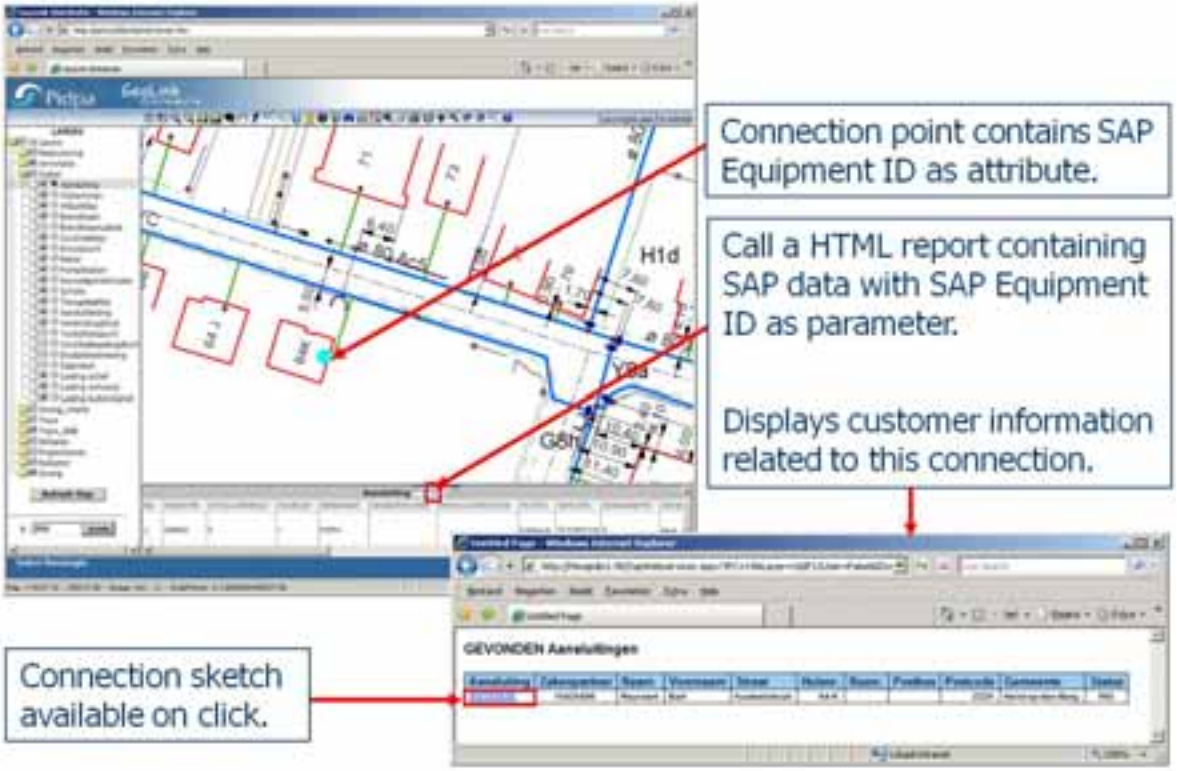
Based on a selection of one or more connection points in GIS, a SAP WebGui report that displays all related work orders, can be retrieved. This gives a complete history of work executed on that connection.



It's not only a static SAP report, but a fully functional SAP WebGui is opened up. This allows users to click through on each work order, to retrieve detailed information on tasks, costs, field crew that executed the work etc. from the SAP environment.

GIS connection(s) → SAP list of connections and customers

From the same selection of connections, also customer information can be accessed. Again based on the SAP Connection Equipment ID that is passed in a URL to a SAP webservice, which executes a query that retrieves the active customer information for the selected connection(s).



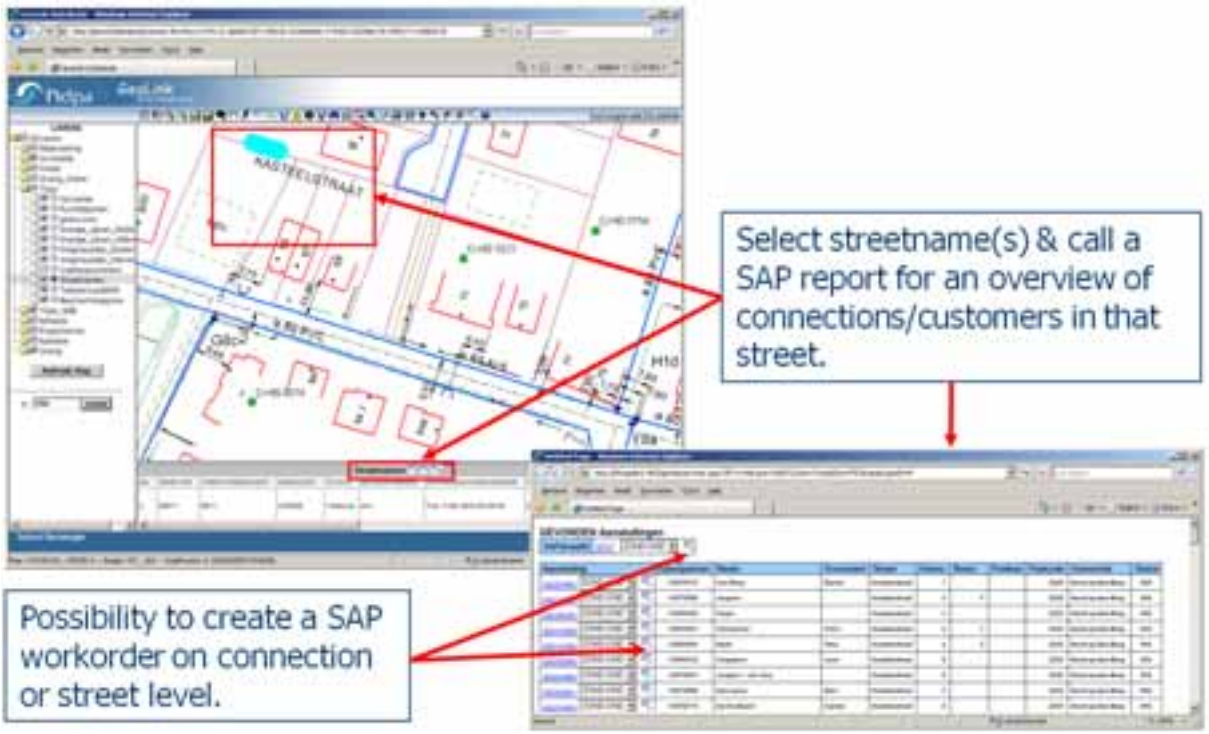
This result can be displayed as a HTML report, that allows further links to a document management system, where as-built sketches made by the field crews are stored. A huge archive of 500.000 historical scanned documents, that's queried based on the SAP Connection Equipment ID from GIS.

GIS street name(s) → SAP list of connections and customers

Since there still is an error margin on the connections that are available in GIS, it's also possible to use the same interface on street level. Three major information systems at Pidpa : SAP, GIS and LIMS, use the same master database with streets in which every street has a unique Street ID.

When a street name is created in GIS, it gets the unique Street ID as an attribute. When a SAP order is created, the user enters address information based on which the unique Street ID is automatically linked.

So when we select one or more street names in GIS, the Street ID(s) can be passed to SAP via a URL. Resulting in an overview of all connection equipments and the active customer information.



All mentioned SAP reports are accessed by calling a SAP URL from GeoLink or the GIS Edit environment. By passing the Connection Equipment ID or Street ID, along with an interface ID as parameters to SAP, a lot of SAP information becomes accessible within a mouse-click from GIS.

On the SAP end, webservices were created that receive these type of requests from GIS and other information systems, and start the requested transactions. An easy, flexible and powerful way of interfacing between GIS and SAP.

7 The road ahead

The future will, without a doubt, bring more integration between GIS and other information systems at Pidpa. An even broader use of GIS, within technical as well as administrative departments, is to be expected. A geographical view or map is no longer considered something exclusively technical or 'exotic', but something everyone can see added value in.

There are new projects defined to link and display the lab results of water quality analysis to GIS, asset management analysis, hydraulic modeling based on GIS etc.

An upgrade project to implement ArcGIS 10 is also being prepared, allowing us to offer more functionalities in the browser based GIS viewer with ArcGIS Server technology. This opens up a lot of possibilities, to give more people access to more advanced analysis functionalities, tracing functions, or limited editing functions.

So an exciting time in using GIS technology to further improve processes at Pidpa, is still ahead !!

For more information about the implemented GIS at Pidpa, and integration with other enterprise information systems, feel free to contact us :

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