

THE EFFECT OF GOOGLE EARTH ON THE DEVELOPMENT OF A SDI AT A GOVERNMENTAL AGENCY

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ABSTRACT:

This article discusses the experiences of a governmental agency (Rijkswaterstaat) combining the long term development of a SDI with the recent success of geo-applications like Google Earth. As Rijkswaterstaat aims to be the most public oriented governmental agency in the Netherlands, the development of a new Internet site was given a high priority. One pillar of this new site is the GeoTool, an interactive interface that enables the user to retrieve geographical information. The GeoTool requirements as set through Corporate Affairs were highly inspired by Google Earth and similar products. On the other hand Corporate ICT has been developing an SDI over the years, based on open standards; open source software and server based computing. The SDI provides the standard development framework for geo-applications for Rijkswaterstaat. It had, to a large extent, an internal focus, in order to support the business processes. As such, little experience had been gained with the general public as end-user of a geo-application. In developing the GeoTool, two main challenges had to be met: to modify the available SDI towards a dissemination tool for the general public and to fulfil the high expectations of Corporate Affairs. This article discusses the development process of the GeoTool and describes the technical framework. It is concluded that the emergence of Google Earth has boosted the development of the Internet segment of the SDI of Rijkswaterstaat. Secondly, application development ordered by non geo-professionals requires special attention on drafting requirements and managing expectations.

1. INTRODUCTION

Rijkswaterstaat (RWS) is responsible for maintaining and administering the main roads and waterways in The Netherlands. This infrastructure is, like any other in the world, very intensely used and susceptible for decay and congestion. As such, adequate information and communication about the road, the road works, and delays are not only necessary for maintaining the condition of the road. It will also facilitate the road and waterway users and support cost reduction within the transport sector.

Within RWS, the Corporate Affairs Department (CD) handles the communication to the general public, the Data and ICT Department (DID) is responsible for the information and technology, mainly to support the business processes of RWS.

In the GeoTool project both departments joined hands in order to communicate geo-related information to the general public. This cooperation was driven by internal and external developments.

In the following chapter an overview is given of the internal and external developments that moved this project. The next chapter is about the project itself; here both the technical framework and the development process are discussed. In chapter 3 the influence of this project on the Spatial Data Infrastructure (SDI) and its development is handled before

conclusions are drawn. In a closure the expected development of the tool is sketched.

2. THE SITUATION

2.1 Internal developments

Internally, within the RWS organisation, one of the standing orders of the DID is to meet the challenge of reducing ICT-costs considerably. At the same time DID is asked to get more information out of the data it manages and make it more readily and easily available for all employees.

The strategy to meet this challenge is built on the principles of uniform working models, open standards, server-based computing, data hosting at the source and maintenance.

To deal with geo-information, an infrastructure based on the Open Geospatial Consortium (OGC) Services Architecture has been established for this purpose. This infrastructure is the Spatial Data Infrastructure (SDI) and is referred to as Geoservices.

2.1.1 Background of the SDI Geoservices:

RWS has a long and standing tradition of mapping and geospatial data processing. RWS, like many similar organizations, moved through the consequent stages in which the process of geospatial data management was automated:

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information gathering, automated mapping, stand alone GIS, client-server GIS and web services.

In order to increase efficiency, it was decided to move from a decentralized approach to a centralized steering model for IT and all its components. This made it possible to work on a SDI for the RWS Enterprise GIS in which geodata is well and securely managed but also accessible for everyone that needs it. **Anytime, anywhere** became the new motto.

2.1.2 Challenge

While, at the start of this project, the Geoservices SDI was in place for use within the RWS organisation, little experience was acquired for the use outside the organisation. So **anytime, anywhere** was possible for the employees of RWS but not yet for the main public. It is this challenge, which was met in this project. How to make the existing SDI suitable for the dissemination of information outside the RWS organisation, to the main public?

2.2 External developments

On the external side, outside the RWS organisation, we see the enormous popularity of Google Earth, Google Maps and Car Navigations Systems. This kind of geo-applications is hot and readily available to the public.

We also see that the work of the agency becomes more visible and more susceptible for criticism. This is a result of the continuing increase of congestion on the nation's infrastructure, because of the increasing mobility of its inhabitants. It stresses the need for RWS to communicate with the public about the job they are doing.

Both developments inspired managers and communication advisors to ask for these kind of geo-applications to use in communicating with the main public. Or to put it simply: *'to use more smart maps and images when communicating with the public'* (similar to the wikification of GIS, Zui 2008).

In order to fulfil the agency's mission, to become the most public-oriented governmental agency, all Internet information dissemination should henceforth be conducted from one integrated, new Internet site.

This resulted in a new project and DID was asked to realise a geo-application to supplement this renewal of the agency's Internet website with the desired smart maps and images.

At the same time, one of the requirements of the new Internet site was to consolidate the information of the large collection of independent Rijkswaterstaat sites, informing the general public on RWS-works, water heights, ecological monitoring etc.

2.2.1 Challenge

The main challenge was to bring these geo-applications to the main public in an equally appealing and comprehensive way as the illustrious reference applications and at the same time maintaining the high information density of the former collection of internet sites.

3. IN PRACTICE

Using the existing Geoservices SDI, the assignment resulted in the GeoTool, a web based Internet viewer for geo-information. This chapter will describe both the development process, the

what, as well as the technical framework, the how of the GeoTool.

3.1 The development process

The main part of the development process is to get clear requirements of what is needed to be developed (the 'What' question).

3.1.1 One new Internet site

Till 2006, the various departments of Rijkswaterstaat were relatively autonomous in their IT-business and Internet-publication as well. This resulted in a large collection of Internet-sites, having characteristics like (RWS, 2006):

- Targeted user group unclear;
- Applications of various layouts;
- Various sites on one or related themes, without a clear structure;
- Existing sites not directly linked to the core business of Rijkswaterstaat
- Difficult to find;
- Maintenance: scattered.

In addition, where sites had geographic components, various technologies (like Flash, Google Maps, and clickable images, see figure 1) and various data sources were used.

This situation became unmanageable for everyone involved (IT specialists, data managers, communications advisors and managers).

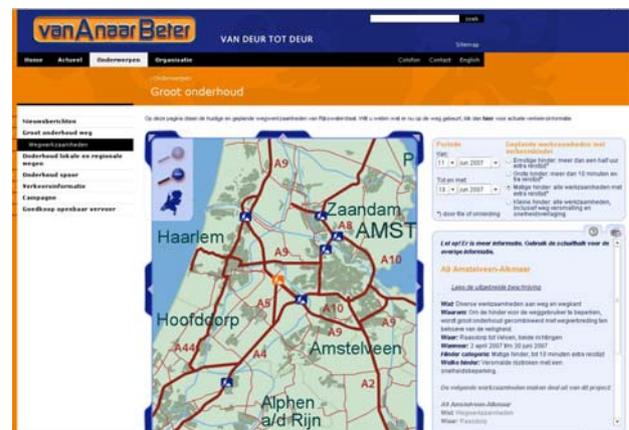


Figure 1. Former site of 'van A naar Beter' with Flash based maps

In order to improve the communication to the general public, it was decided to migrate all existing sites to one central portal: www.rijkswaterstaat.nl.

3.1.2 Guidelines

The guidelines for this portal can be split into guidelines based on policy and guidelines for content and functionality.

Guidelines based on policy (Van Asperen et al, 2006):

- Corporate Communication strategy RWS;
- Guidelines on governmental publications on the web;
- Guidelines Barriers Free.
- Corporate Communication strategy RWS focuses on target groups for communication, so called

'Stakeholders' and 'Users'. For information dissemination on Internet 12 user groups have been defined within these target groups (like press, business community and science, RWS, 2006).

Eventually the site must serve all user groups. For the first release the new website was focussed on four selected user groups:

1. Road user,
2. Waterway user,
3. Neighbouring inhabitants of RWS-infrastructure
4. Potential employees.

- Governmental publication aims at a maximum accessibility for all web visitors. Access should be possible for:

- Visitors who do not have proprietary or closed technologies (plug-ins);
- Visitors who do not have (or disabled) client side script support;
- Visitors using text browsers or alternative browsers.

- 'Barriers free' aims at maximum accessibility for visually handicapped and colour-blind people. It is based on Web Content Accessibility Guidelines from W3C, <http://www.w3.org/>.

Guidelines based on content and functionality (RWS, 2006):

- Reliable, up to date, easy to use;
- Consistent with other communication channels, like adverts and press releases;
- In compliance with the behaviour of the end user;
- Professional and neutral content;
- Interactive;
- Dissemination of knowledge.

These guidelines are applicable for the entire new website (see figure 2) and are translated into specific requirements for the development of the GeoTool.



Figure 2. Front-page of the new Internet portal

3.1.3 Requirements for the GeoTool

One of the pillars of the new website is the GeoTool, the interface which enables the user to retrieve geographical information in the form of smart maps and images.



Figure 3. Screenshot of the GeoTool standalone, release 1

The following requirements for the GeoTool were derived from and added to the adopted guidelines:

- It should be expandable, new map layers should be added as required;
- Automatic updating of geo-information by linking to external data sources;
- Integration within the Content Management System (CMS), i.e. as a map of TOP5-works at the homepage, as standalone version and on thematic pages (see figures 2, 3 and 4);
- It should be usable in other sites as well (i.e. sites from the Ministry);
- The webmaster should be able to modify the map extent, map layer, legend entry and TOP5 of works in order to publish interactive map layers easily;
- Usage should be very intuitive;
- It should cover the entire management area of Rijkswaterstaat, including the North Sea;
- High performance.

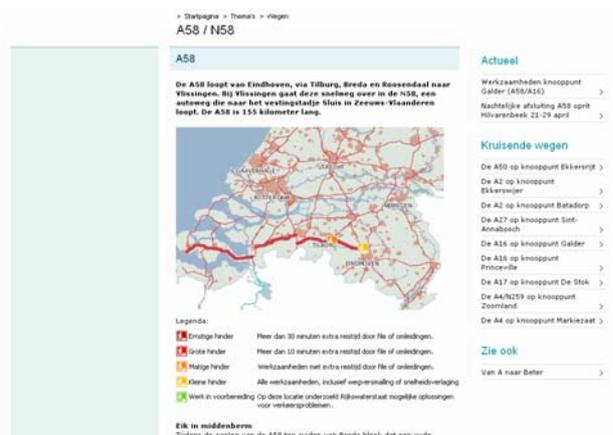


Figure 4. The GeoTool in combination with the CMS in a thematic page

The starting point for the development of the GeoTool was the existing SDI within Rijkswaterstaat (for technical details, see, De Haas, 2005 and RWS, 2007). Although Google Earth was often referred to when specifying the interface it was not an option, as it does not comply with the Guidelines on governmental publication (desktop application).

3.1.4 Implementing requirements

The DID has substantive experience with development of geo-applications, for geo-specialists and experienced users. However, to develop GI-tools for the general public, it needed different focus, this was acknowledged from both the supply side, DID, and the demand side, CD.

The main issues are:

- Emphasis on design, lay-out and interactive icons (mouse-over, popins, etc.), forcing tailor-made solutions instead of using standard available design and functionality (i.e. a highly intuitive user interface instead of button-functionality as is the standard within the geo-domain);
- Focus on point-based information retrieval, instead of implementing lines and polygons as well;
- GeoTool embedded within the content management systems in various ways (including interactivity between content and GeoTool);
- High performance levels, often conflicting with significant amounts of data transfer and cartographic data processing.
- Little knowledge available at the demand side on the possibilities and complexity of Geodata and its processing;
- Google Maps and Google Earth were often used as reference on the demand side. For example when defining functionality like:
 - Switch between map and photograph,
 - Ajax navigation,

Some demands can be easily implemented while others can not be implemented at all, because the Geoservices framework has a different architecture compared to Google Earth or Google Maps.

As a result, adequately exact specifications of map layers, legends, scale and labels were hard to get. Various iterative developments have been carried out in order to reach an acceptable result.

3.2 The technical framework

Since 2003, DID have developed its SDI, also referred to as Geoservices. Development of the SDI is based on the following principles (RWS, 2007):

- Based on open standards, for example standards set by the Open Geospatial Consortium (OGC);
- Prevention of single supplier dependency;
- An application is looked at as a logic composition of services;
- Data should be available in such a way that it can be used independent of time, location and tools.

Currently, Geoservices contains various components for Web Map Services (WMS), Web Feature Services (WFS) and Catalogue Services for the Web (CSW).

The entire GeoTool application was built on Geoservices – components. In addition it was to a large extent built with Open Source software. The usage of Open Source software gives the opportunity to limit the dependency on proprietary source software. It also reduces the possibility of a vendor lock and stimulates the development of the Open Source community in and outside The Netherlands.

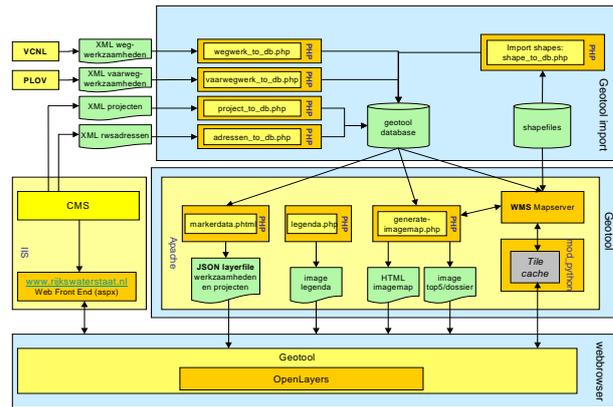


Figure 5. Application architecture

The architecture of the application can be divided into three parts (see figure 5. and RWS, 2008):

1. The ‘GeoTool’ (client side/GUI),
2. The database layer (XML data sources are stored in a relational database),
3. The services layer: WMS, WMS-C (cache-able WMS, TileCache) and custom application scripts (PHP).

GeoTool

The GeoTool itself consists of a number of JavaScript files as supplied by the OpenLayers library of Metacarta. Some of the source code of OpenLayers had to be specifically adapted. At the activation of the GeoTool the JavaScript file will be automatically downloaded and loaded into the client’s web browser. The GeoTool interacts with the Content Management System (CMS) through its Web Front End (WFE). The WFE activates the GeoTool when geo-information is requested.

Database layer

XML convert scripts import the XML exports of datasets from several different management and maintenance systems from organisations throughout the Netherlands, like the CMS of the Internet site or roadwork information from the Dutch Traffic Control Centre (VCNL). The XML information is stored in a relational database. Depending on the dynamics of the information, the period of updating can be set per theme. Most themes have an XML-feed on a daily basis.

Services layer

The WMS runs independently on a Mapserver and generates the maps served by the GeoTool. To generate these maps, the following components were used: Linux, Apache webserver, UMN Mapserver, PHP and TileCache. Most of these components were already implemented within the Geoservices framework and could be deployed easily.

Besides the data provided by the external sources, the WMS is using background map information or imagery. At a scale of 1:50.000, the imagery automatically switches from satellite imagery to aerial photography. The minimum scale of the GeoTool is set at 1:10.000. In order to improve the performance, all maps and images are cached.

3.2.1 Releases

The first release of the GeoTool handled information on road and waterway works managed by Rijkswaterstaat and was released on 5 September 2007.

The second release integrated the GeoTool in the main communication site for the Ministry (www.vananaarbeter.nl, December 2007). This release focussed on two issues:

1. The reach of the main public,
2. The reusability of the tool.

The reach of the main public

The new site of RWS must become the main communication channel for the agency. In addition, the Ministry has several well visited and well advertised sites which draw most of the main public's attention. 'www.vananaarbeter.nl' is one of those sites. In this light this release was the main test to see if our geo-applications can appeal to the main public.

The reusability of the tool

The integration of the GeoTool in a completely different site should show not only the reusability of the map services but also of the application itself.

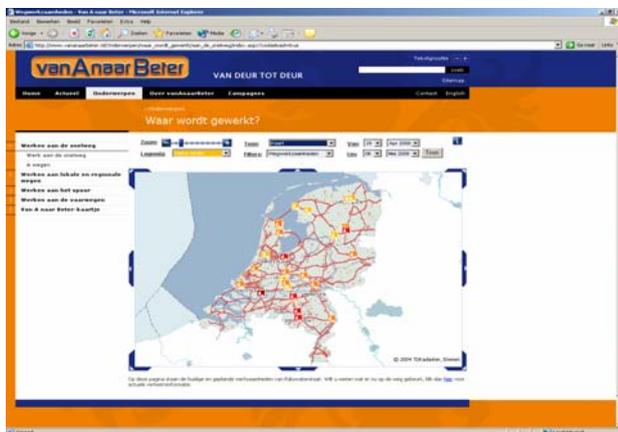


Figure 6. Screenshot of the GeoTool incorporated in the 'vananaarbeter site', release 2

The third release implemented line-segment based information, the visualisation of sound effects of main roads on its environment and the location of all RWS-offices. For a detailed topographic background, Open Street Map of the Netherlands, will be added (May 2008).

In the near future more information layers will be integrated from the large collection of former independent Rijkswaterstaat sites (water heights, opening times of bridges and locks, etc.). And more user groups (see §3.1.2) will be served. As this information is published through open services and standards, they can be easily incorporated into other websites and web services.

4. THE EVOLUTION OF THE GEOSERVICES SDI

RWS has a long and standing tradition of mapping and geospatial data processing. First the mapping process was automated using mostly CAD and automated drawing techniques. Then stand-alone desktop GI-Systems were introduced, first mainly for more complicated geo-processing tasks, like modelling and analysing data for policy making. When desktop GIS became more lightweight and easier to use and access, the use of GIS further spread throughout the organization. As it was relatively easy to develop add-ons,

scripts and applications, and there was no strict policy for application development and maintenance, many smaller and larger GIS-applications popped up. Because on the one hand less emphasis was laid on data management and data distribution and on the other hand application maintenance was not embedded within the organization, a sub-optimal situation was created in which software maintenance was expensive and data management cumbersome.

At an early stage the responsible professionals recognized the drawbacks of the very bottom-up approach in which geospatial data processing was managed and developed. Single-user GIS applications were replaced by multi-user client-server type solutions. Although the bottom up steering (and funding) of development still blocked a more structural solution, the first outline of a Spatial Data infrastructure became visible.

A new Dutch government policy urged RWS in the last years to deliver "more value" on the same budget. To achieve this goal, the organization is moving from a decentralized approach to a centralized steering model using uniform working models and organization-wide standards. This made it possible to work on a Spatial Data Infrastructure (SDI) for the RWS Enterprise GIS in which geodata is well and securely managed but also accessible for everyone that needs it within the organisation.

The technical choices made during the development of the SDI, support the Internet usage of this SDI. Nevertheless most projects were defined for usage within the RWS organisation. With the GeoTool project, we had to answer the question how to use the SDI to communicate with the public?

In order to meet the changing requirements when moving the SDI to the Internet (see § 3.1.4), we fall back to more simple proven techniques. In order to meet users expectations we use tiled cache to ensure performance and point-based information to ensure understanding. Furthermore, we started to use professional GUI and web designers to make sure our geo-applications appeal to the main public.

4.1 Summary

In taking this latest step in the evolution of the SDI (Geoservices at Rijkswaterstaat), we see a changing focus from technique and functionality to simplicity, stability and design. Instead of offering the latest techniques and lots of functionality emphasis is placed on a user-friendly interface design, keeping it simple and appealing. And also on stability and proven technology.

In order to make this step forward with our SDI, we consolidate our technique and add professional design.

5. CONCLUSIONS

Two main conclusions can be drawn from this project:

1. Specification, understanding and communication are of vital importance in GIS projects.
2. The popularity of Google Earth has given a major impulse to the development of geo-applications.

Ad 1.)

The most visible applications of GIS are very suitable for their task, like planning a route (Car navigation) or showing aerial

photography (Google Earth), that's why they are such a success. However this does not mean that they are directly suitable for other tasks as well. When implementing new applications, the reference to these systems by the management take a heavy toll on the expectation management of the development process. Functional specifications like; 'I want this the same as in Google Earth', are a nice starting point for the Functional design of the application but are by no means sufficient for starting the development.

Thorough specification of requirements is the key to successful projects, for this you need understanding between supply and demand, which can only be reached through communication. The dissemination of governmental information through GIS projects is not easier but also not more difficult than any other project.

Ad 2.)

Where the managers' appeal for the 'GeoTool' came from Google Earth (desktop- and closed source application), the technical similarities and possibilities came from Google Maps (Web application). The comprehension of this misunderstanding gave managers and developers the common ground they needed to create this successful communications tool.

In this light, it can be concluded that the emergence of Google Earth and Google Maps has accelerated the development of the Internet-segment of Geoservices and for geo-applications in general.

6. CLOSURE

6.1 Lessons learned

Although we learned much more in the course of this project, three main lessons can be drawn:

1. Adequately specify requirements in an early stage.
2. Geo-developers are no designers or communication experts.
3. Use a clear project management structure

Requirements

As geo-information is not core business on the demand side, it has proved to be difficult to specify their requirements at a sufficient level, lacking the knowledge of the (im)possibilities of geo-data and geo-applications. Although this was managed by continuous delivery of advice and prioritising user requirements during the project, it is better to take sufficient time and resources to specify requirements before the designing process.

Communicating is a specialism

As Communications is not core business of geo-developers, the development must be strictly monitored by the demand side and supported by professionals. This means that every development issue, with impact on the GUI, must be looked at by designers and approved by the demand side.

Project management

The project had to deal with a variety of key players: the content managers, the developers of the CMS, the internal and external data suppliers. For every user requirement, agreement had to be reached with the responsible body and the effect on the business of other players had to be carefully studied and

discussed. Use Prince2 or any other project management-structure.

6.2 Future challenges

In the future the GeoTool will meet the following challenges:

- Adding more data layers and functionalities.
- Manage organizational issues; data is supplied through different systems, different sources and different departments.
- Manage multiple data sources, manage multiple data integrities and manage interdependencies (CMS, multiple data sources).
- Manage communication and design issues.

The emergence of Google Earth and Google Maps will result in the development of more geo-applications for the general public. This means that new markets emerge, in which geo-information will be used. Focus will shift towards display, marketing etc, mainly because it gives people a sense of simplicity when accessing complex information.

As we continue the development of our SDI, the GeoTool will continue to develop as the geo-related Internet portal on spatial information held within RWS. Through the GeoTool, the general public will be better informed about the activities of RWS. It is also hoped that, through the application of open standards, the GeoTool will act as an information provider to other related portals as well.

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FINAL REMARK

This article reflects the personal views of the authors and does not necessarily correspond with the views and policies of the employers.