Research Project on the Usability of Oracle Spatial within the RWS Organisation

Detailed Project Plan (MD-NR. 3215)

Dr.Dipl.Ing. S. Zlatanova

GISt No. 15 Delft, December 2002

Summary:
This report describes the content, time schedule, deliverables and conditions related to a study on the applicability of Oracle Spatial 9i for storing, querying and maintaining the topographic objects of DTB-Nat, Beheerkaart-Nat, Regiokaart-Nat and TISBO.

This report has been prepared under the authority of Rijkswaterstaat – Meetkundige Dienst.

ISSN: 1569-0245

Rijkswaterstaat – Meetkundige Dienst
P.O. Box 5023, 2600 GA Delft, the Netherlands
Tel.: +31 (0)15-269 1111; Fax +31 (0)15-261 8962;
E-mail: md-info@mdi.rws.minvenw.nl
Section GIS technology
TU Delft, Faculty of Civil Engineering and Geosciences
Thijsseweg 11, 2629 JA Delft, the Netherlands
Tel.: +31 (0)15 278 4548; Fax +31 (0)15-278 2745;
E-mail: gist@TU Delft.nl

CONTENTS

1. PROJECT DESCRIPTION

The goal of this project is to investigate the functionality offered by Oracle Spatial 9i with respect to the needs of RWS towards an integrated maintenance and query of objects and their characteristics (organised currently in several different systems and data models). The expectations are that this model will provide the RWS organisation (and more particularly Meetkundige Dienst) with extended functionality and improved services that will reduce the resources (in terms of time, man-power and money) needed for maintenance of the information. The logical consequence of such a new organisation of data should be significant reductions in the production and maintenance cost and improved services to customers.

1.1 Project Objectives

- Development of an integrated model that will be capable of maintaining objects from DTB-Nat, Beheerkaart-Nat and Regiokaart-Nat;
- Implementing and testing the model, using the currently available geometry types of the object-relational model of Oracle Spatial 9i.

Since ArcGIS is largely in use within the RWS, it will be utilised as a visualisation tool for the queries, editing and update of information. In this respect, this project is closely related to the pilot project "Storage of DTB-Nat in Oracle Spatial using ArcGIS and ArcSDE" carried out at RWS (Opdrachtnummer 23016).

1.2 Problem Definition

Prior to defining the problems a short description of the three types of RWS Nat-maps follows:

- The DTB-Nat maintains the objects of interest along the rivers at scale 1:1000 (or 1:5000). The objects of this map are created from aerial photographs in the software *InfoCam* and are represented as closed non-overlapping polygons. The objects of DTB-Nat are defined with respect to their physical appearance in the reality (or in the aerial photographs). The rivers are subdivided into sections, which are dependent on the aerial photographs (each section is a separate object). *InfoCam* stores all the information in Oracle 7, most probably in a topological structure. From this model the objects can be exported to an other system using ArcView shape files, ArcInfo coverages, DXF, etc (currently shape files are used mostly).

- The Beheerkaart-Nat contains the objects as they are defined and maintained by the RWS Dienstkringen. The object codes correspond to the classification in TISBO. The scale of this map is the same as the DTB, i.e. 1:1000 (1:5000 for regions where 1:1000 does not exist). The Beheerkaart-Nat is created in ArcView and ArcInfo, as boundaries of the objects are closed polygons (stored as shape files), which also coincide with the borders of the DTB objects. The objects of the Beheerkaart-Nat do not correspond in general to the objects of DTB-Nat due to three general reasons:

- ° Most of the Beheerkaart-Nat objects are compositions of DTB-Nat objects;
- ° The Beheerkaart-Nat contains objects that are not part of the DTB-Nat, e.g. riverbeds.
- ° Some objects that are not maintained by RWS are not included in the Beheerkaart-Nat and therefore some gaps (compared to the DTB-Nat) may appear.

- The Regiokaart-Nat contains the RWS Nat-objects that are of interest for the RWS Regional Directions. It is compiled from the Beheerkaart-Nat in a scale of 1:50000. This map is maintained in two parts: The "Beperkte Bopper Kaart (BBK)" and the "Uitgebreide Bopper Kaart (UBK)". The BBK contains water systems and water parts. The UBK contains the Beheerkaart –Nat objects (Note: UBK is the previous name of the Regiokaart-Nat, so UBK and Regiokaart-Nat are actually the same). The Regiokaart-Nat is created by digitalisation of the Beheerkaart-Nat objects in ArcInfo and ArcView. The objects are closed polygons stored as ArcView shape files. The objects from the Regiokaart do not correspond to the Beheerkaart objects because of:
  - ° Different boundaries (due to the generalisation, but they fit on the TOP50raster);
  - ° Some of the polygon objects in the Beheerkaart-Nat are represented as symbols in the Regiokaart-Nat (i.e. bridges).

Note: the concepts of Beheerkaart and Regiokaart are still under development. Therefore the test datasets may not have 100% one to one relationships.

To be able to organise these three maps (or the objects from these maps) in one generic model, several general problems have to be solved. The currently identified ones can be summarised as follows:

- The types of objects differ for the three maps;
- The geometry (boundaries) of the objects also differ as the largest difference is in the Regiokaart-Nat;
- The structures of the maps are different. Eventually DTB-Nat can be exported with its topology (as coverages), but the Beheerkaart-Nat and the Regiokaart-Nat are only geometries (shape files).
- The Beheerkaart-Nat and the Regiokaart-Nat may contain "gaps", i.e. some "real" objects are not maintained by RWS.

This project has to investigate and propose a solution (i.e. integrated model) that will be able to resolve differences in object types and geometries.

2. APPROACH AND METHODOLOGY

The project can be subdivided into three general work packages:

- Study of the existing systems, formats and types of objects. The study will be carried out in close cooperation with specialists from RWS as follows:
  - Getting familiar with the models and production line of the three maps. This task is going to be executed by literature study and meetings with projects managers from RWS. RWS is expected to supply the relevant documents and organise the meetings with the specialists responsible for the different maps.
  - Getting familiar with the objectives of the project "Storage of DTB-Nat in Oracle Spatial using ArcGIS and ArcSDE", current results and implementation problems. RWS is expected to supply the literature and organise meetings with the project manager.
  - Study of queries and analysis performed on the three maps and selecting the most often used ones. RWS will provide literature (i.e. functional models of TISBO GIS and BOPPER GIS) and organise meetings with selected users of the current systems if necessary.
  - Selecting appropriate areas for the experiments. The project will concentrate on a test area for which all the three maps are available, i.e. Hollandsch Diep and Volkeraksluizen (DTB-Nat, Beheerkaart-Nat, Regiokaart-Nat). RWS will provide the shape files with models and classifications of the objects (object codes). Any other information (e.g. coverages within the DTB-Nat) that is not currently specified but would be needed will be provided by RWS (more datasets will become available in the project period).
  - Investigating the possibilities to store a topological model. RWS is expected to provide information on the topological model used by *InfoCam*.
  - Installing all the needed software (e.g. ArcGIS, Oracle client, etc.) and hardware (additional memory) to be able to work (visualise and query) with the data sets.
  - Discussing the selected objects and spatial analysis with specialists from RWS.

- Design of logical and physical model. The integrated model will be designed considering the findings within the first work package. The model will concentrate on a subset of the objects of interest for RWS that can be found within the provided test maps. Some concepts for representing other objects (e.g. lakes) will be developed as well (but not implemented). The model for DTB will be developed as close as possible to the one already worked out within the project "Storage of DTB-Nat in Oracle Spatial using ArcGIS and ArcSDE". This task can be subdivided into following sub-tasks:
  - Classifying the objects (semantics) of the three maps and specifying their attributes and any supplementary information that is going to be maintained per object.
  - Defining the types of geometries (i.e. point, line, polygon) that have to be stored in the database and their dimensions (2D or 3D).
  - Classifying the relationships between the objects, especially between the different maps.

- Representing the objects with their semantic and geometric characteristics, operations that can be performed on them and relationships with other objects in UML (using the notation of the Class diagram).
- Designing the scheme for Oracle Spatial 9i. The objects will be represented using the geometry types of Oracle Spatial. If it is possible to organise a topological model, additional study is needed to select the most appropriate 2D topological model (apr. 1-2 days more).
- Writing scripts (PL/SQL) to create objects, table's and organise Oracle Spatial metadata (not the metadata with respect to CEN and ISO).
- Reporting the model.

- Implementation of the model and performing tests, consisting of:
  - Installation of software (e.g. FME) for converting shape files into the designed tables.
  - Indexing of the data and validation of the polygons.
  - Testing and adapting software for visualisation in ArcGIS. Development of the software will be completed by RWS (project no. 23016).
  - Visualisation tests in Microstation GeoGraphics (since AutoCAD MAP is not available at TU Delft) and ArcGIS.
  - Performing overlay tests between the objects from the Beheerkaart-Nat and the Regiokaart-Nat to establish 1:1 link between the two maps.
  - Performing the selected queries (analysis) specified in the first work package.
  - If topological model is going to be used, functions for conversion between topology and geometry has to be written (the conversion could take a considerable time depending on the type of data.)
  - Reporting the implementation and the test results.

2.1 Preconditions

- The project concentrates only on the development of the database model and not on visualisation;
- The project should make maximal utilisation of existing functions and operations offered by Oracle Spatial 9i;
- All the scripts and developments will be organised as functions and operations and will run on a database level. The scripts will be written using PL/SQL.
- During the tests some operations with large objects (consisting of many points) may consume longer time than expected. In this case modifications to the time schedule could be necessary.

2.2 Expected Results

- Integrated model maintaining DTB-Nat, Beheerkaart-Nat and Regiokaart-Nat (described in UML). All the objects from the maps will be considered.
- Database model and set of scripts that can be readily used for other data sets.
- Knowledge (expertise) on the data organisation of the objects used by RWS in relation to TISBO.

2.3 Additional Issues / Questions to be Answered

- Functionality offered by Oracle Spatial regarding data storage, conversion, querying, analysis and topology;
- Possibilities of Oracle Spatial for use in a distributed database environment;
- Built-in functionality of Oracle Spatial regarding 2½ en 3D data storage and processing;
- Compatibility / applicability of Oracle Spatial with new standards as GML and OpenGIS;
- Possibilities and/or complications for the application of Oracle Spatial in combination with ESRI products ArcGIS and ArcSDE;
- Advantages of storage of spatial data in Oracle Spatial instead of in other databases like SQL server or Oracle in combination with ArcSDE (on the basis of already available knowledge and experience within TUD, and without performing tests);
- Utilization of Oracle Spatial without ArcSDE as a database for ArcGIS or Microstation GeoGraphics without loss of functionality or threatening the database integrity;
- Functionality and/or advantages offered by Oracle Spatial for use as a database for Web Services applications.

Note: Some of the above issues will be discussed in the report on the basis of TU Delft know-how and experience from other projects and consultations with Oracle Spatial developers. The following will also be dealt with on the same basis as far as possible:

- Applicability of Oracle Spatial for integrated storage, query and administration of metadata with respect to the CEN and ISO standards for metadata.
- Possibilities of Oracle Spatial for data dissemination via Internet, especially in combination with ArcIMS of ESRI

3. PROJECT ORGANISATION

3.1 Project Management

The over-all responsibility to the Client will be with the Project Director, prof. ir. K.F. Wakker, chairman of the Department of Geodesy, TU Delft. He will deal with all contract-related matters and represents the Contractor towards the Client.

The principle researcher from TU Delft is Siyka Zlatanova. She will be responsible for the set-up and implementation off all project tasks. She will be supported by Theo Thijssen at TU Delft, section GIS technology, and by Paul van Asperen, Frans Spruijt, Patricia Bannier and Marco Boeringa of RWS Meetkundige Dienst when and if necessary, via meetings and discussions.

Prof. dr. ir. P.J.M. van Oosterom of TU Delft will be the Project Supervisor for this research project. He is responsible for the timely completion of all project tasks up to the quality required.

Mustafa Yaman of the RWS Meetkundige Dienst will act as the over-all Project Manager. He is responsible for the day-to-day project management and co-ordination of the project team. He will guard the quality of services to be provided by TU Delft, and will ensure that the work plan and time schedule correspond with project planning and goals.

3.2 Quality Control

TU Delft aims at performing this project with the highest possible quality. The total quality of the work is concerned with the quality of the content of the Final Report (project result) as well as with the quality of the project organisation. For this purpose, all the documents will be reviewed by Prof. P. van Oosterom prior to submitting to the Client. If needed TU Delft's partners within the Geo Database Management Centre (GDMC) (i.e. Oracle and/or ESRI) will also be consulted.

In order to meet the project requirements, the project will be executed in close contact with the Client. TU Delft aims to be pro-active in this process by identifying and reporting (possible) problems in time, and by advising creative solutions.

3.3 Reporting

A progress report will be submitted monthly during the project execution period. Furthermore TU Delft will report the project achievements to the Client every two weeks by verbal consultation.

4. PROJECT PLANNING

Tasks	Details	Method	Location
0. Writing project plan			TU Delft
1.1 Getting familiar with the models currently used	DTB-Nat, DTB-Droog	Literature study, demonstration	RWS
	Beheerkaart-Nat, Regiokaart-Nat		
	TISBO		
1.2 Getting familiar with the software and hardware currently used	Import, export file possibilities	Literature study, demonstration	RWS
1.3 Studying user requirements	Most often used queries	Literature study, conversations	RWS
	Visualisation & prints & forms	Demonstrations, conversations, literature study	RWS
1.4 Analysing objects and selected queries		Discussion with project managers of other projects	RWS
2.1Developing a logical and physical data model	Designing the model	Selecting, developing, extending on the basis of existing models	TU Delft
	Creating logical model	Developing scripts	
	Creating physical model	Developing scripts	
2.2 Reporting the model		Report 1 (part of the final report)	TU Delft
3.1 Populating the model(s) with data	Selecting data	Relevant Subset	RWS and TU Delft
	Exporting	(with RWS)	
	Conversion	Developing software	
	Import in Oracle	Developing scripts (with TU Delft)	
3.2 Performing tests on the server side	Query of geometry and attributes	Developing scripts	TU Delft
	Analysis		
3.3 Query and visualisation in a front-end engine	Using ESRI environment	Developing software (with RWS)	TU Delft (RWS)
	Using MicroStation and GeoGraphics	Establishing connection between the data model in Oracle and GeoGraphics	TU Delft
3.4. Presenting the results	Demonstration & discussion		TU Delft
4.1Writing the Concept Report		Report 2	TU Delft
4.2 Writing the final report		Final report	TU Delft

5. DELIVERABLES

The project will have as deliverables several reports (see below) and software developed for project purposes. The schedule for the submission of the reports (in English, MSWord DOC file) including text, table's illustrations, and developed software is as follows:

Detailed Project Plan:	15 December 2002
Report 1 (part of the Final Report):	20 January 2003
Concept Report:	28 February 2003
Final Report:	30 March 2002

6. TIME SCHEDULE

The period for executing the project is from 15th of November 2002 until 31st of March 2003. A rough scheduling, including the estimated man-days, is given bellow:

Tasks	**December**	**January**	**February**	**March**	**Total**
0. Writing project proposal	0.5				**5**
1.1 Getting familiar with the models currently used	1	1			**2**
1.2 Getting familiar with the software and hardware currently used	0.5	1			**6**
1.3 Studying user requirements	0.5				**5**
1.4 Discussion	0.5				**5**
2.1 Developing a logical and physical data model	2	2			**4**
2.2 Reporting the model (Report 1)		1			**1**
3.1 Populating the model(s)		3			**3**
3.2. Performing server tests		4			**4**
3.3. Performing front-end tests		2	1.5		**2.5**
3.4.Presenting the results			0.5		**5**
4.1 Writing the Concept Report			3		**3**
4.2 Writing the Final Report (Final Report)				1	**1**
Total man-days	**5**	**14**	**5**	**1**	**25**

7. CONDITIONS

The conditions as mentioned in RWS Meetkundige Dienst's (MD) Request for Proposal dated 16-6-2002 (ref. no. MDI/2002/4065), and the resulting contract with MD no. 3215 and BTW-identification no. NL 003214412 B 06 will apply for this project.

Reports published before in this series:

- GISt Report No. 1, Oosterom, P.J. van, Research issues in integrated querying of geometric and thematic cadastral information (1), Delft University of Technology, Rapport aan Concernstaf Kadaster, Delft 2000, 29 p.p.
- GISt Report No. 2, Stoter, J.E., Considerations for a 3D Cadastre, Delft University of Technology, Rapport aan Concernstaf Kadaster, Delft 2000, 30.p.
- GISt Report No. 3, Fendel, E.M. en A.B. Smits (eds.), Java GIS Seminar, Opening GDMC, Delft, 15 November 2000, Delft University of Technology, GISt. No. 3, 25 p.p.
- GISt Report No. 4, Oosterom, P.J.M. van, Research issues in integrated querying of geometric and thematic cadastral information (2), Delft University of Technology, Rapport aan Concernstaf Kadaster, Delft 2000, 29 p.p.
- GISt Report No. 5, Oosterom, P.J.M. van, C.W. Quak, J.E. Stoter, T.P.M. Tijssen en M.E. de Vries, Objectgerichtheid TOP10vector: Achtergrond en commentaar op de gebruikers-specificaties en het conceptuele gegevensmodel, Rapport aan Topografische Dienst Nederland, E.M. Fendel (eds.), Delft University of Technology, Delft 2000, 18 p.p.
- GISt Report No. 6, Quak, C.W., An implementation of a classification algorithm for houses, Rapport aan Concernstaf Kadaster, Delft 2001, 13.p.
- GISt Report No. 7, Tijssen, T.P.M., C.W. Quak and P.J.M. van Oosterom, Spatial DBMS testing with data from the Cadastre and TNO NITG, Delft 2001, 119 p.
- GISt Report No. 8, Vries, M.E. de en E. Verbree, Internet GIS met ArcIMS, Delft 2001, 38 p.
- GISt Report No. 9, Vries, M.E. de, T.P.M. Tijssen, J.E. Stoter, C.W. Quak and P.J.M. van Oosterom, The GML prototype of the new TOP10vector object model, Report for the Topographic Service, Delft 2001, 132 p.
- GISt Report No. 10, Stoter, J.E., Nauwkeurig bepalen van grondverzet op basis van CAD ontgravingsprofielen en GIS, een haalbaarheidsstudie, Rapport aan de Bouwdienst van Rijkswaterstaat, Delft, 2001, 23 p.
- GISt Report No. 11, Geo DBMS, De basis van GIS-toepassingen, KvAG/AGGN Themamiddag, 14 november 2001, J. Flim (eds.), Delft 2001, 37 p.
- GISt Report No. 12, Vries, M.E. de, T.P.M. Tijssen, J.E. Stoter, C.W. Quak and P.J.M. van Oosterom, The second GML prototype of the new TOP10NL object model, Delft, 2002.
- GISt Report No. 13, Vries, M.E. de, T.P.M. Tijssen en P.J.M. van Oosterom, Comparing the storage of Shell data in Oracle spatial and in Oracle/ArcSDE compressed binary format, Delft, 2002, .72 p. *(Confidential)*
- GISt Report No. 14, Stoter, J.E., 3D Cadastre, Progress Report, Rapport aan Concernstaf Kadaster, Delft 2002, 16 p.