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USABILITY OF NEW, OBJECT-ORIENTED 1:10,000 TOPOGRAPHICAL PRODUCT FOR THE NETHERLANDS

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1. INTRODUCTION

In 2000 the Dutch Topographic Service (TDN) initiated a research program to investigate upgrading of their topographical products and production environment. The first project comprised of a study into the development of an object-oriented data structure for the 1:10,000 data and the production of a prototype (TOP10NL). The current TOPvector products (1:10,000, 1:50,000, 1:100,000 1:25,000 and 1:500,000) are fully accepted in the Dutch GIS community, but new applications and the wish to link the topographic data with thematic databases, urged the Dutch Topographic Service to think about a new data structure. With the new object oriented data structure more efficiency (lower costs), a more effectively (structured) use and an improved exchange of TOPvector data will be achieved. It is planned to replace the current TOPvector products in 2005 by the TOPNL products. Since this change-over will have a large impact on all Topvector users the Dutch Topographic Service is doing as much as possible to make this change-over smoothly for its customers. In the end, the usability of the new product will determine the smoothness of the change-over. Therefore an onset to an analyses of the usability of the TOP10NL product as far as is possible in this stage will be made in this paper. First a description of the project TOP10NL and its 5 phases is given.

2. PRODUCT TOP10NL

Three research institutes, Technical University Delft (TUD), International Institute for Geo-Information Science and Earth Observation (ITC) and Centre Geo-Information, Alterra (CGI) were asked to participate in this project. The project was structured into five phases (table 1). The project focussed on the data structure and not on the visualisation of the data. Therefore a distinction was made between the digital landscape model (DLM) which is comparable to a geodatabase concepts introduced by GIS vendors implemented in spatial databases and the digital cartographic model which deals with visualisation in a more cartographic sense. The objective of this project was to develop an object-oriented data structure for a digital landscape model. In the first phase CGI formulated eleven user demands. In phase two ITC and TDN set up a structure definition of the digital landscape model based on the user demands. In the third phase a prototype was build by Technical University of Delft according to the structure definition provided in phase 2. In the fourth phase the prototype was evaluated by CGI in relation to the user demands. The prototype was adapted according to the results of the evaluation and send to users for review. Users were asked to study the prototype and documents of the 4 phases and give their reaction by filling out a questionnaire. The reactions were analysed by CGI.

Phase	Participants	Time schedule
1. Specification of user demands	CGI	2000
2. Structure definition of DLM	ITC/TDN	spring 2001
3. Implementation prototype in XML	TUD	summer 2001
4. Evaluation and testing of prototype	CGI	autumn 2001
5. Evaluation by users	All and users	2002

Table 1 Description, participants and time schedule of the five phases of project TOP10NL

2.1 Specification of user demands

Based on the wishes and advise of several user groups and external institutes eleven specifications of user demands were compiled [1]. By involving these groups and institutes during the product definition it was aspired to obtain support among the users for the new product. The specifications were compiled to be achievable and testable and it was found important to limit the amount of specifications to 10, if possible. During this phase 11 specifications were drawn up (table 2).

Specification	Priority
Forward and backward compatibility	needed
Monitoring objects in time & actuality	needed
Open Standards	needed
Meta-data (also on object-level)	needed
Real world objects	needed
Multi-level representations	wished
Linkage with other databases	wished
Usability	wished
Seamless database and complete coverage of the Netherlands	needed
Affordable	nice to have
Network communication	nice to have

Table 2 Eleven specifications and their priority

2.2 Structure definition of DLM

In the second phase of the project TDN and ITC worked together to define a data structure of the digital landscape model [2]. As said, in this project distinction is made between digital landscape model and digital cartographic model. The cartographic model will be dealt with in a later project. A description of all present entities, the attributes of the entities and the values that can be assigned to the attributes is given. Specific attention is given to the demand that all current existing data should be present in the new data structure. The data structure is translated to an object-oriented design with use of UML.

2.3 Implementation prototype in GML

In the design process of TOP10NL prototypes for several distinct areas are produced by Technical University of Delft [3]. The prototypes are covering map fragments over different areas in the Netherlands, in such a way most of the existing objects, attributes and domains can be showed. The geographic elements are split up and supplemented in such a way that they are in accordance with the new data-model. The prototypes were made available in Geographic Mark-up Language (GML) (figure 1). GML (Geography Mark-up language) is one of the (conceptual) standards, which are being developed at this very moment within the OpenGIS Consortium. GML is based upon XML (eXtensible Mark-up Language), which as HTML originates from the Internet world and is specifically designed for the exchange of structured information (information instead of "open" text) [4]. Since no viewers that support GML were available at the time, the prototypes were converted to shape-format (figure 2). In addition for two areas an experimental Internet site is made to show the prototype with a SVG-viewer (figure 3).

```
<?xml version="1.0" encoding="iso-8859-1" standalone="no"?>
<!-- File: tiel.gml  -->
<tdn:Top10Themas
 xmlns:tdn="http://www.gdmc.nl/tdn"
 xmlns:gml="http://www.opengis.net/gml"
 xmlns:xlink="http://www.w3.org/1999/xlink"
 xmlns:xsi="http://www.w3.org/2000/10/XMLSchema-instance"
 xsi:schemaLocation="http://www.gdmc.nl/tdn tdn.xsd">
….
<gml:featureMember>
      <tdn:WegDeel fid=”TOP10.2100328”>
      <tdn:top10_id>2100328</tdn:top10_id>
      <tdn:begindatum>24 JUN 2001 16:11:33
      </tdn:begindatum>
      <tdn:einddatum/>
      <tdn:actualiteit/>
      <tdn:tdncode>3533</tdn:tdncode>
      <tdn:rijrichting>Tweerichting</tdn:rijrichting>
      <gml:geometryProperty>
        <gml:Polygon srsName=”EPSG:7408”>
          <gml:outerBoundaryIs>
                <gml:LinearRing>
                  <gml:coordinates>
                    158505.424,433761.509,0.0 158491.335,433759.022,0.0
                     158456.727,433755.542,0.0 158457.597,433750.352,0.0
                    158484.611,433753.875,0.0 158496.481,433755.214,0.0
                    158505.06,433755.682,0.0 158505.424,433761.509,0.0
                  </gml:coordinates>
                </gml:LinearRing>
          </gml:outerBoundaryIs>
        </gml:Polygon>
      </gml:geometryProperty>
      <tdn:hoogteniveau>0</tdn:hoogteniveau>
      </tdn:WegDeel>
    </gml:featureMember>
```

Fig. 3 Fragment of GML file describing a part of a road in the Tiel Area

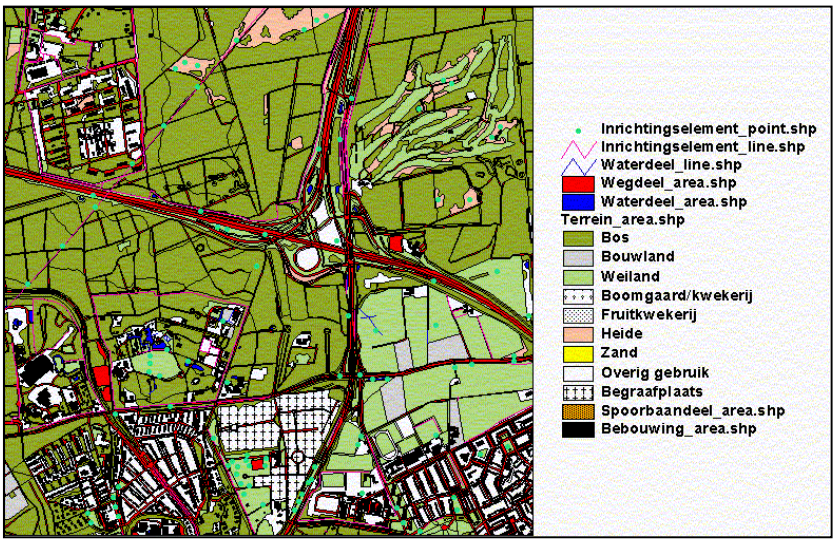

Fig. 4 Prototype of Arnhem area in shape-format

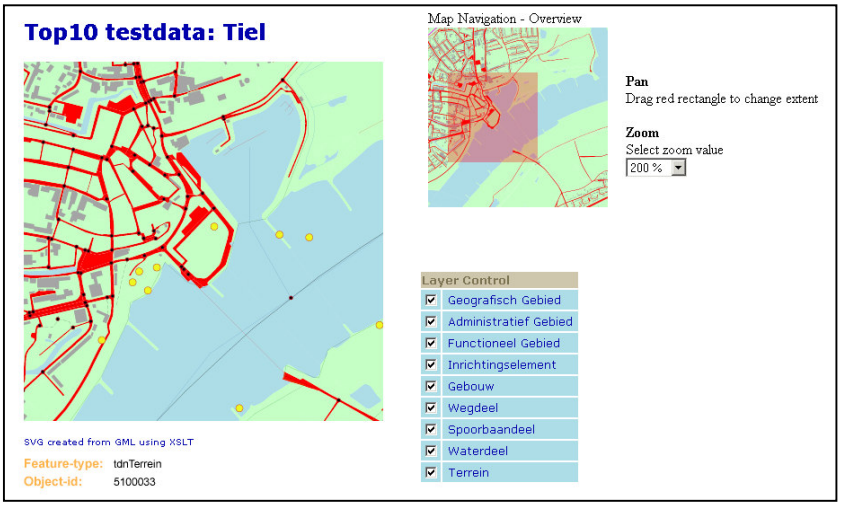

Fig. 5 Prototype of Tiel area visualized by SVG-viewer

2.4 Evaluation and testing of prototype

The prototypes were evaluated and tested according to the user demands defined in phase 1[5]. It was concluded that the prototypes satisfied the demands reasonably well. Some of the demands could not be tested, like usability and affordability, since the product was still too new at that stage. It was recommended that meta-data on dataset level needed to be added and to improve the object-hierarchy if requested and if the improvement fits into

the topographical domain. It can be concluded that the fact that TOP10NL is object-oriented will increase and facilitate the usage. According to the results of the evaluation the prototypes were adapted.

2.5 Users evaluation

The second set of prototypes have been made available to the geo-community in the Netherlands in order to receive feedback about the prototypes (made available in GML as well as shape-format). A demo CD [4] has been spread among the user community, and an internet-site, with the research-reports and downloadable prototypes, has been created (www.tdn.nl DemoTOP10NLincluding an English version). Also through other modes of communication, such as national GI magazines, GI conference and flyers users were made aware of the possibility to review TOP10NL. Users were asked to fill out a questionnaire in order to make their ideas and suggestions on the product explicit. At least 700 persons of the user community received a Demo CD. In total 75 users responded which is less than we expected considering the effort put in spreading the CD. However, the number of respondents was large enough to draw some valid conclusions about the users evaluation, which was done by the Centre Geo-Information [6].

The respondents were reasonably evenly distributed over the several institutes that work with TOPvector products (universities, municipalities, provinces, etc.) and a large part of the respondents worked on a daily or weekly base with TOPvector products. In general the respondents were very positive and gave the new product a 7.5 out of 10. Even so the Dutch Cadastral Organisation and TOPvector users platform (OGT) reacted positively on the prototype. A few useful suggestions for improvements were made and these will be taken into consideration when the final data model will be defined.

2.6 Future developments of TOPNL

The Dutch Topographic Service is planning to have the TOPNL products operational in 2005. Until that time a number of projects need to be carried out to facilitate the change-over from TOPvector to TOPNL products. The next step is a cluster of projects to define the final data model of TOP10NL and the cartographic model. Other clusters of projects cover items such as the production process, marketing, generalisation (1:50,000, 1:100,000, etc), Linkage to (inter)national datasets, conversion TOP10vector to TOP10NL and distribution.

3. USABILITY OF TOP10NL

In Phase 4 of the project one of the user demands TOP10NL was tested for was usability. The conclusion was drawn that the product was too new yet to be tested for this aspect, but the available documentation and the use of standards (GML and UML) were considered positive indicators for usability. However usability can be regarded broader than those indicators, as is described by Wachowicz et al. [7]. They identified Usability of spatial datasets as an umbrella term consisting of several elements aggregated into 5 main groups (figure 4).

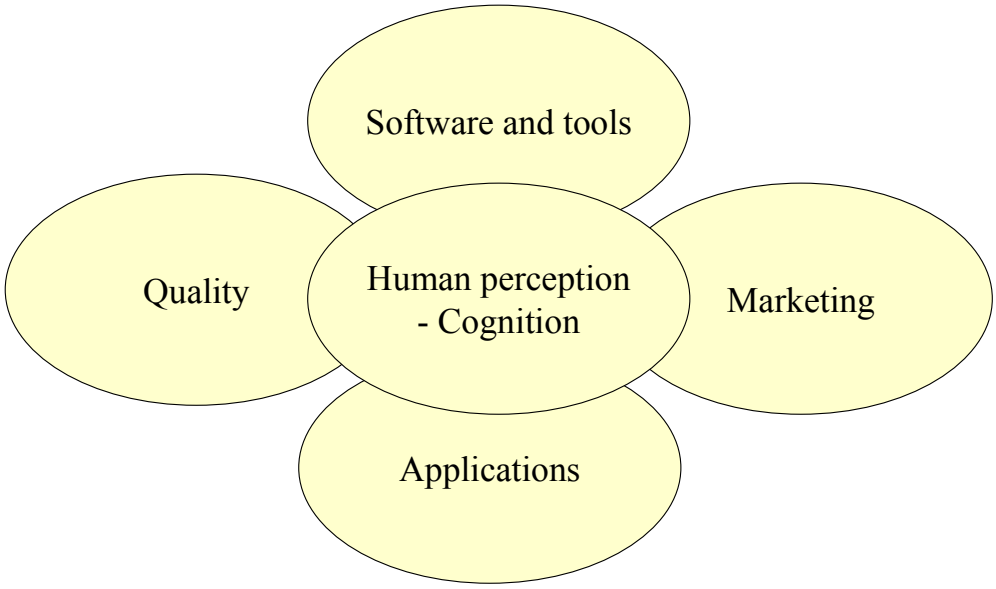

Fig. 6 The cluster of usability elements into categories (after [7])

The five clusters are described by the elements of usability:

Marketing: Added Value, Benefits, Costs, Novelty, Services Provided, and Satisfaction
Quality: Authoritative, Guarantee Against Error, Integrity, Metadata, Reliability, Validity, and Utility.
Software and Tools: Human Computer Interaction, Standardisation, Integration, Searchable, and Interface.
Human Perception - Cognition: Authoritative, Decision Type, Interestingness, Novelty, Popularity, Satisfaction, Trust, User Skill Levels, Familiarity, Interpretation, Visualisation.
Applications: Aggregation Levels, Type, Exclusiveness, Visualisation, Integration, Decision Type, Use with Models and Algorithms, Availability and Accessibility. [7]

The user demands as formulated in phase 1 can be categorised according to the clusters used to describe usability (table 3).

Specification	Usability elements
Forward and backward compatibility	Software and tools: integration
Monitoring objects in time & actuality	Quality: utility
Open Standards	Software and tools: standardisation
Meta-data (also on object-level)	Quality: meta-data
Real world objects	Applications: visualisation
Multi-level representations	Applications: aggregation and visualisation
Linkage with other databases	Software and tools: integration
Usability	-
Seamless database and complete coverage of the Netherlands	Quality: integrity and reliability
Affordable	Marketing: costs
Network communication	Applications: availability and accessibility

Table 3 Table 3: Specifications and the usability elements

It is noticed that the user demands cover 4 of the 5 categories. Only the cluster of human perception and cognition was not represented by the user demands. Although this was probably meant by the user demand of usability, it was not tested. It can be stated that phase four of the project tested for the usability elements of the clusters of quality, software and tools, marketing and applications. Since the product was still very new at the time it could not be tested yet for the usability elements concerning human perception and cognition. Additionally this project focussed on the digital landscape model and not on the cartographic model. With representation and visualisation being very important aspects of the cluster human perception and cognition it is not surprising that it is difficult to specify this aspect of usability at this stage. However, in phase five of the project the product was visualized in order to give users the chance to evaluate the prototypes and they were asked to review the product. With questions as: Would you use the new product?; Do you like the changes that are made? Would you like other changes to be made?; How would you grade the product (number out of 10)? It was possible to get an idea about popularity, trust, familiarity, satisfaction, novelty and interpretation. Since the evaluation of the user test was fairly positive, it can be stated that also the usability elements concerning human perception and cognition of TOP10NL are positively rated.

4. CONCLUSIONS

In summary the usability elements concerning quality, software and tools, marketing and applications of TOP10NL were evaluated in phase four of the project, while the usability elements concerning human perception and cognition of TOP10NL were evaluated in phase five. Since both evaluations have positive results, it can be stated that TOP10NL is expected to become a data set with high usability levels.The main reason for that is that the project TOP10NL was structured to ensure participation of the users in the set up and reviewing of the new product to create support for the new product. As a result the Dutch Topographic Service has succeeded in creating a product with a high level of usability.

At the moment the construction of the digital cartographic model is been carried out as one of the follow-up projects. It is strongly suggested to evaluate the outcome of this project against the results of the user evaluation. It is also important to include usability aspects in

the pilot projects carried out by some organisations in the user community to gain experience with the new product before the initial release of the TOP10NL product.

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