GENERALIZATION OF BUILDINGS AND ROADS IN LARGE SCALE MAPS

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Worldwide-recognized studies on generalization have been undertaken at the Institute for Cartography of Hanover University (IfK), especially in the generalization of large-scale maps. Based on these studies, the CHANGE software product was developed, which is capable of generalizing building and road objects, in a scale range from 1: 1000 to 1: 25 000. In this paper, a case study was reported, which is about applying and expanding of the Hanover generalization approach by using Turkish map data.

1. INTRODUCTION

Although computer technology has been widely used in cartography, in generalization, there is still no adequate solution in scientific and practical sense. On the other side, these new technologies have led to a rapid development in the field of data capture. In developed countries, National Mapping Agencies have built large data bases that include mostly large-scale map data. For applications in smaller scales, like preparation of background maps in electronic atlases, etc., existing large-scale maps should be used through digital generalization, to avoid redundancies in data capture and to ensure consistency between different data sets that refer to the same geographic area.

Prominent studies on generalization, which are recognized worldwide, have been undertaken at the Institute for Cartography of Hanover University, especially in the generalization of large-scale map data [Staufenbiel, 1973; Lichtner, 1976; Menke, 1983; Grünreich, 1985; Meyer, 1989; Schmidt, 1990; Powitz, 1993]. Based on these studies, the CHANGE software product was developed, which is capable of generalizing building and road objects, in a scale range from 1: 1000 to 1: 25 000.

2. MATERIAL AND METHOD

The aim of the study was applying and expanding of the Hanover approach by using Turkish map data. For this purpose, digital large-scale maps produced by the Municipality of Metropolitan Istanbul were selected. These maps include topographic data as CAD objects in so-called spaghetti structure. Despite this basic structure, the CAD objects are classified due to layer, line type, color and line weight. Using these attributes, certain types of objects (in this study buildings and roads) can be selected into new files and processed.

Since the CHANGE system runs in the so-called batch-mode, AutoCAD MAP software was used for interactive operations. Data exchange between these systems was performed via DXF format. Before generalization, building and road objects were analyzed to determine whether they could be used with CHANGE. According to this analysis a program that converts DXF to CHANGE-database (namely IfK-database) or vice versa was developed. The building and road objects were preprocessed in order to reach the best performance of CHANGE and the generalization results in high quality. The preprocessing of roads consisted of interactive corrections and structural transformation for CHANGE. The former was needed because the base map data was not clean. The latter was needed because CHANGE is not capable of processing roads in spaghetti form. Using a program developed for this study automatically did this transformation. Thereafter, the centerlines of roads were built with CHANGE. After interactive reviewing of the centerlines a network topology was created in the AutoCAD MAP environment. On this topologically consistent basis, line generalization and symbolization were undertaken. In the preprocessing of buildings following operations were realized: topological and geometric analysis and corrections before generalization, partial generalization in separate logical regions that were bounded by road centerlines, automatic separation of buildings into these regions, statistical analysis of source and generalized data, e.g. computation of b/w ratio etc. For these purposes, various substitute programs were also developed (Table 1, [Bildirici, 2000]).

Building generalization was performed in six variations, which are called models. All of them are generated from the same base map data (same extraction scale). The differences between these models are scales of compiled maps (derived scale) and generalization parameters. Road generalization was undertaken in two variations or models. An overview of the generalization models is shown in Table 2.

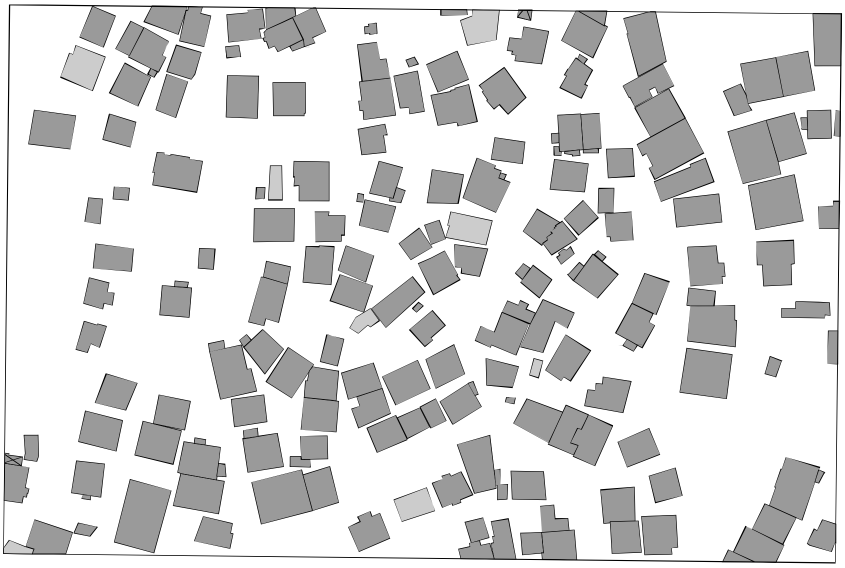
Table1: An overview of the developed programs

Program	**Function**
DCB	Data conversion between IfK and DXF formats
DBCNV	Data conversion between Digplot and IfK-Database, invoked by command line
BUHOM	Line cleaning and geometric improvement of areal data (building data)
BUSEL	Separation of the entire building data into generalization districts
SSB	Structural improvement of the road data for the creation of centerlines with ACHSE
FDP-Inspektor	Statistical investigation of areal data, it also delivers histograms for sides and areas
DIREKTOR	Automation of building generalization

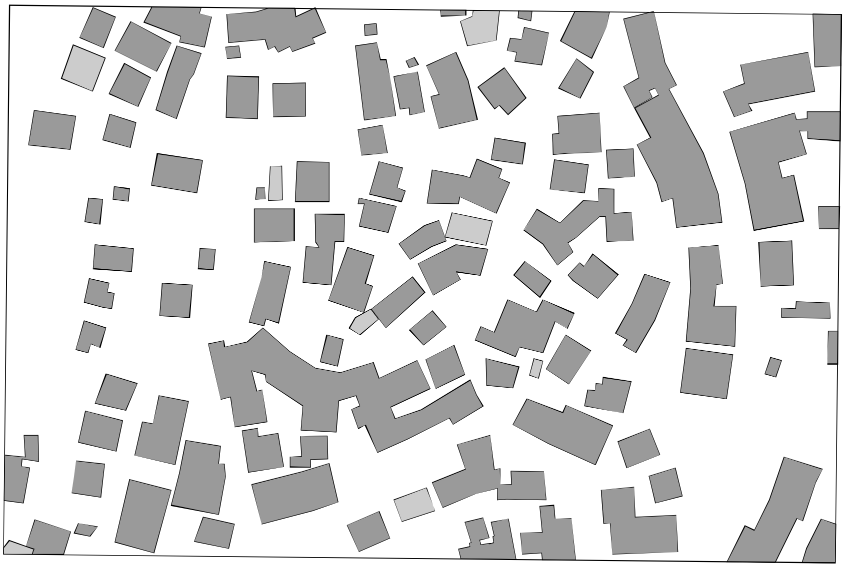
Table2: Generalization models

	Extraction Scale	**Derived Scale**	**Specification**
Model 1	1: 1000	1: 5000	Buildings
Model 2	1: 1000	1: 5000	Buildings
Model 3	1: 1000	1: 5000	Buildings
Model 4	1: 1000	1: 10 000	Buildings
Model 5	1: 10 000	1:25 000	Buildings, derived from Model 4
Model 6	1: 5 000	1:25 000	Buildings, derived from Model 3
Model 7	1: 1000	1: 25 000	Roads
Model 8	1: 1000	1: 10 000	Roads

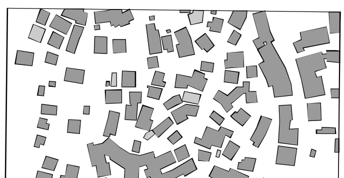
A sample view of the building generalization is given in Figure 1.



Source Map (1: 2000)



Compiled Map (1: 2000)



Compiled Map (1: 5000)

Figure 1: A sample view of building generalization

3. RESULTS and CONCLUSION

All generalization results of the building models mentioned above were statistically and visually examined. After visual examinations some few geometric corrections had to be made. Statistical examinations showed that the results are acceptable according to Töpfer's selection law [Töpfer, 1974] and b/w ratio criterion. Some of the calculated statistical parameters are shown in Table 3. Since the structure of roads in base map data was not appropriate, similar comparisons could not be performed [Bildirici, 2000].

Finally, CHANGE, AutoCAD MAP and the substitute programs are components of an integrated system that can be used by National Mapping Agencies and similar institutions. Overview of the results of the case study shows the evident applicability of this system.

Table 3: Statistical parameters about generalized models (buildings) [Bildirici, 2000]

	Number of objects	**Total object area (km^2)**	**Area portion of objects (%) (b/w ratio)**
Source data	9180	1,121	19
Model 1	5089 [4105]	1,128	19
Model 2	4880	1,131	19
Model 3	5053	1,128	19
Model 4	3679 [2902]	1,142	19
Model 5	1986 [2326]	1,197	20
Model 6	1625 [2259]	1,101	19
Study Area: 5.866 km^2	[...] : Num. of objects according to Töpfers Law		

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