A LANDINFORMATION SYSTEM (LIS) FOR AN URBAN REGION

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1. ABSTRACT

Urban regions are marked by a high density of objects on the surface and below. The management how to make use of the available space is a continous process of planning, execution and administration. The knowledge of the local relationship is an important prerequisite for controlling these processes. The paper describes the state of the art of an geographic system in operation in the municipality of Vienna (Austria). In detail a description is given of the production line starting from different types of data collection until the automated production of multipurpose cartographic output such as standardized large scale maps, special and thematic maps. The features of the data bases and the ways of maintaining them are mentioned as well. As a long range objective it is envisaged that all geographic data processing should be automated by ADP and fully supported by computer graphics. Therefore a detailled model of the urban region has to be stored in the near future comprising a broad variety of data with geographic relationship.

2. DATA COLLECTION

2.1 Requirements

Basically it is envisaged to include step by step the inventory of objects which are described already in different types of graphic documents. Priority is given to the capture of topographic data. Underground objects and town planning themes will be inserted subsequently.

According to the needs of users data are captured with the utmost accuracy of geodetic data, the highest degree of geometric detail, classification and keying facility.

Therefore it is likely that the central data base will be able to fit all requirements and it can be prevented, that separated and redundant data must be maintained for special purpose.

2.2 Data sources

2.2.1 Field measurements

2.2.2.1 Digital tacheometry. The most accurate method of data collection is applied in the road area, where available space is scarce and conflicts of interests have to be solved frequently. The council of Vienna decided to survey the complete network of streets in order to get reliable data in these sensible areas of the town. The final result will be a complete framework of precise geographic data.

Features of this measuring method are:

- Coding in the field
- partitioned data set per street segment
- generating derived geometric elements (e.g. parallel lines for rails, walls; completing rectangular objects, composing segments)
- highly automated dataflow from the field to the plotter (linework included)

The remaining bloc area is filled up by photogrammetric measurement (2.2.2).

2.2.1.2 Survey plans. The large archives of maps and survey plans represent a useful stock of geodetic data. By manual digitising of existing analogue documents, mostly road planes 1:200, additional data are obtained. The digitised data are adjusted by control points. The final datafile resembles that of a field measurement in the tachometric mode.

2.2.2 Photogrammetric measurements.

In the early stage analogue documents of a stereoplotter had to be digitised completely. Now, the photogrammetric model is measured analytically and stored during the interpreting process. These digitised data represent a supplement of the skeleton built up by ground survey.

2.2.3 Existing maps

2.2.3.1 Manual digitising versus scanning. Due to the vast extent of analogue sources digitising is still the bottleneck of geographic data processing. Efforts in the last years had been made to automate the digitising process. Scanning and a subsequent vectorisation has successfully proved its feasibility in several applications.
Although scanning does not signify a fully automated data capture - interactive postprocessing is still necessary - it is a fact, that it can alleviate the nearly invincible task of compiling the vast amount of existing analogue documents.

2.2.3.2 State of the art of scanning methods. In practice the range of economic scanning is dependent on the graphic quality of the document and its complexity in terms of lines, symbols and text. Recognition of lines together with a rough classification according to the line width and line pattern can be an economic counterpart to manual digitising. Further advantages are expected by more sophisticated pattern recognition for symbols and text. Then scanning will become more economic due to increased possibility of automated classification and keying.

The recent production line makes use of manual offline digitising, scanning, interactive editing or a combination of those methods.

2.3 Assembling of different data sources

In the last processing stage of data collection all these different kinds of source data have to be checked, merged and harmonized.

2.3.1 Geometric adjustment. This complex task is done partly automated (within a tolerable range) partly interactively.
Digitised or scanned data are adjusted by means of control points.
Manual digitised and scanned data are composed.
Photogrammetric data are adjusted to identical ground survey data.

2.3.2 Overall coding system. For each measuring device a special coding system is used to minimize operator´s input. After checking automatically the codes additional data are derived. In the final stage the isolated coding systems had to be fitted into a comprising overall coding system.

3. USING THE DATABASES

3.1 Types of databases

3.1.1 Local reference system. In the first step a reference system was built up covering the whole area of the city. It is based on a hierarchical order of areas ranging from district to the bloc (census tract, bloc) and a street network (crossing point as nodes).

3.1.2 Topographic database. Is still in the process of building up. It represents a detailled description of topographiy separated into features combined with an geographic inventory of objects. It contains

- geodetic data
  partly threedimensional of different qualities (according to source data)
- classification of object groups (layers)
- identification keys (postal address, pylon, etc.)
- object names (text)

3.1.3 Thematic data basis

- land use
- planning zones
- protected areas
- environment cadastre

3.2 Access to the geographic database Retrieval paths

Apart from the selection by coordinates there are a set of user oriented selection modes:

- postal address
- street segment
- street name
- bloc code
- census tract
- layer code
- identification key of objects

Among these are interconnections and pointers to other regional keys:

postal address to its bloc and to its street segment, or to its constituency.

3.3 Geographic data connection

The keying facility of the geographic database allows the linkage to other data basis storing statistical and technical data.

e.g. density of population
  growth of population (e.g. forecasting the number of children of schoolage for the demand of teachers and classroom)
  density of built up areas
  traffic system (local coordination of road construction works and excavations in the road)
  medical care of the population
  environmental aspects
    annoyance by noise
    provision with areas for recreation

4. CARTOGRAPHIC OUTPUT

Despite the advantage of digital data for processing analogue representation of geographic information will be needed further on. Even its range of application is growing fast, as graphic output is the adequate output format. A powerful graphic capability by ADP is therefore an important prerequisite of such an information system.

4.1 Standard large scale map

In areas with ground survey the base map starts with 1:200 (the map sheets follow the street network). Smaller scales continue with 1:500 (sheets gridwise), 1:1000, 1:2000, 1:3000 up to 1:5000 (1:10000 is produced by reproduction). Sample map see App. 1.

4.2 Special maps

District maps or any other special purpose plan or map. Parameters are:

- window
- layers
- legend (symbolisation, line and area pattern, text fonts).

Sample map of lightning system (wiring chart) see App. 2.

4.3 Thematic maps

The keying facility enables the user to link other data bases in order to examine special relationship of data. This feature causes a fundamental change: the time consuming task of collecting statistical data and of referencing to their local distribution is obsolete. Automated geographic data processing reduces the "response time" for the production of thematic maps, so that maps become an up-to-date image. Recently obtained data of administration can be transferred quickly into cartographic images as useful means for the day´s work.

e.g. Controlling of registered obstacles in the traffic system makes use of thematic maps: an overview of excavation and construction work in the stage of execution and planning can be published within few days.

5. UPDATING

5.1 Geographic mail box for updating

A prerequisite for an effective revision of a geographic data base is the observation of all changes in a region and to recognize them as soon as possible. There are many signals in public administration which give hints to future changes: changes of parcels (cadastre), planning and building permission of future construction activities on the surface and underground. These signals are obtainable by tapping existing files of the administration. Those activities which will be later on a case for updating (e.g. construction of demolition of buildings, changes in the zoning etc.) are stored in the mail box. Finally different types of changes are linked with their relevant geographic reference (e.g. postal address, parcel number or street segment) and stored in a mail box. If a map sheet is plotted additional news are available to the user, referring to the changes in the area of the map sheet since the last updating of the data base for each layer. These news can be delivered in alphanumeric way as listings but also in graphics. Thematic maps with geocodes symbols can be produced automatically displaying type of changes, the responsible authority where to find further information etc.

5.2 Temporary update

In those cases where a quick updating with less accuracy is necessary, a prerelease of an up-to-date database is built up. Site planes, maintenance reports can be used to generate provisional cartographic data which are labelled especially.

5.3 Final update

Similar to the building up of the geographic database maintenance of its data makes use of different sources as well.

5.3.1 Field surveying. Additional to the input of the data collection codes for updating and the reference to existing points by junction points allows an automated insertion of a new object or a part of it (in development).

5.3.2 Aerial Survey. For those areas where less accurate data are needed, photogrammetry contributes her part of geodetic data.

5.3.3 Processing for updating. The software development is aimed towards a maximum degree of automation. Automated data flow from measuring equipment to the insertion into the data base is envisaged. It is evident that this cannot be

realised totally. Interactive computer assisted activities will reduce manual interferance to a minimum. Not to mention that a lot of auxiliary function of updating can be automated: Checking that all update cases were executed (data of the mailbox can be compared with corresponding files of objects).
Adjustment of new geodetic data with old data, logic checking, uniqueness of identification keys, admissible range of identification keys.

5.4 Distribution of recent geographic data
Computer assisted revision of geographic data is expected to cut down the response time of map revision essentially. But in the final stage it is important that data can be transmitted to all users fast and in such a way that it need not processed manually. Apart from the distribution of analog documents the transmission of cartographic data can either be handled by ADP via a digital interface.

5.5 Responsibility
As above mentioned layering of objects is designed user oriented in such a way that the responsibility for updating of geographic data can be distributed on to those authorities which have the duty to maintain those objects.

5.6 Aspects of time
Updating of the city map of Vienna had been done periodically adjusted to the aerial survey interval. This proceeding will be changed to flexible periodes, dependent on the priorities of the users of the data base.

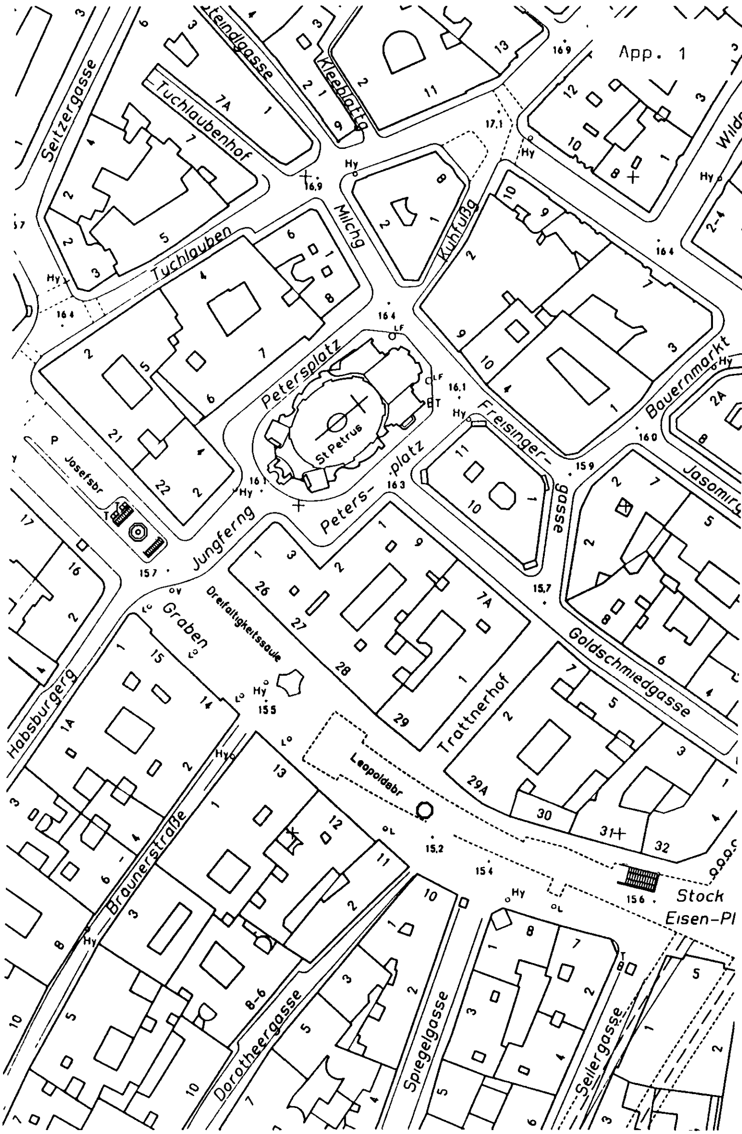
6. CONCLUSIONS

The Land Information System described above is desinged as a comprising source for geographic information. By means of an increasing use of the keying facility the data base becomes more and more a powerful tool for geographic integration of distributed data. An "inquiry bank" for local planning, executing and administration is therefore available.
Especially spatial coordination among several branches of authorities and offices - today a time consuming and cumbersome activity - will be supported by automated retrieval and combination of relevant data.

As a powerful userinterface information can be oblained in graphics manifolded according to the purpose. Either a general description of the local situation (basic map) or a special application oriented graphic (thematic map).

Advantages of this development are:

- increased quality of data
- multiple usage of geographic data
- integration with other data bases
- automated processing of local relationship and distribution
- flexible data exchange
- flexible output
  the data base represents an abstract storage without fixed linkeage a specific cartographic representation.



Weiterverwendung nur mit Quellenangabe: MA 41 - Stadtvermessung
Digitalisiert u. automatisch gezeichnet MD-ADV

App. 2

Weiterverwendung nur mit Quellenangabe: MA 33 - öff. Beleuchtung
Digitalisiert u. automatisch gezeichnet MD-ADV