PERIODICA POLYTECHNICA SER. CIV. ENG. VOL. 43, NO. 1, PP. 3–11 (1999)

FUNDAMENTS OF BASIC MAPS FOR THE DIGITAL DOCUMENTATION OF PUBLIC UTILITIES AND MUNICIPALITIES

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Received: June 1, 1998

Abstract

In Hungary, bringing about modern graphic and alphanumerical information systems that ensure modern updating and data supply are much needed in several fields, thus in the field of land survey, public utility and municipality registration.

The paper gives a short summary about the present state of digital basic mapmaking. This is primarily about the traditional and digital versions of basic maps that serve as basis for the digital public utility documentation. As of the writing of this paper, there are already some towns where the production of up-to-date digital basic maps has got under way as part of the National Cadastral Program.

Keywords: digital basic map, public utility registration, land information system (LIS).

1. Introduction

From the start of this century, countries with highly-developed economies began using the map-based (graphic-type) documentation of public utilities and equipment step by step, the intensity of application depending on the level of development. The control and development structures of settlements and the related map-based documentation methods followed a similar course of evolution.

Some major towns in Switzerland (Bern, Basel, Zürich) were pioneers in *up-to-date documentation of public utilities,* while the German, Dutch and Scandinavian were the first in the field of urbanistic control. Naturally, the development of infrastructure, even in less developed countries, required some form of map record of public utility networks. These were, however, mostly created by utility companies themselves, without any special regard to unification. The situation was the same in Hungary, up until the early seventies. This was how the quite heterogeneous records in various utility-branches came into existence. Around 1970, circumstances brought about an ever more pressing need for a unified system of documentation. One issue was that it had become almost impossible to reconciliate between utility branches in case of new designs and reconstruction works; other factors included the increasing technical level based on international experience of rxelevant expert personnel, and also the progress of computer technology. There were certain drawback effects, too, such as the lack of funding, or certain indifference due to the low level of economic interest.

After a few years of preparations, a new system of regulations, no. 3/1979.(Ép.Ért.11)ÉVM, was created in Hungary, to serve as the set of rules concerning a new, unified documentation system. At the time, this only meant updating the traditional, manual method, but it was able to meet the requirements and possibilities of those days by clearly regulating how basic maps and branch works should be made.

The system of documentation in the field of *settlement control* and design support was not fully under central regulation. In practice, architects and construction engineers created a system of various site drawings, development plans and sections, where the geodetic location accuracy was not of primary importance. This different approach is especially evident in the so-called thematic maps of today (e.g. medical, population debnsity, environmental, etc.).

The basis for traditional map documentation was provided by some form of geodetic or cartographic product. This was no problem as long as the continuous re-drawing of map documentation's could be done in the traditional, manual way, and we could count on the personal judgement of editors and drawers. Wherever connection or junction problems were encountered, a skillful drawer could correct this, according to situation and environment. The situation changed drastically when needs for documentation rose sharply. Today, traditional methods of tracking the changes have all but collapsed in several areas.

The dramatic progress of computer-assisted methods and graphic software lights is the way for a bright future. It is easy to say that digital documentation will solve all our problems, provided the necessary funding is available. But is digital documentation truly a cure for all our troubles?

The issue of introducing digital documentation has been on the agenda for the last fifteen years, and it can be declared that, on a national level, billions of HUF have been pumped into this programme. But are results that they should be? Are we on the right track?

The following paper mainly deals with the traditional and digital geodetic basic maps and cartographic products that serve as the fundaments of digital mapping documentation. We intentionally avoided the expression GIS (Geographical Information Systems). We shall avoid it also in the forthcoming text, since from the aspect of the digital fundaments of maps we consider it irrelevant whether these are used only for graphics documentation (e.g. documentation of public utilities) or for analytical purposes, as a form of GIS for decision support. A separate paper could well be devoted for discussing how the 'recording' (AM/FM) and 'analytical' (GIS) expressions are mixed, both in Hungary and abroad.

2. Different Views Regarding Digital Basic Maps

It is usually on geodetic basics that the map (graphic) modules of digital documentation systems are produced. Some sorts of traditional basic map are available in all developed countries, and the number of digital basic maps is also increasing.

Based on information gained from international literature and professional conferences, it is evident that, even today, there are significant differences in how American and Central-European experts consider basic maps. It is a well-known difference in perception that, in America and several Western European countries, the buyer buys a given piece of land, together with all its environment, advantages and drawbacks, while in Hungary for example, a given m^2 area is bought, and we are extremely concerned about this area being accurately marked. It is partly due to this fact that Central Europe has a more detailed and more accurate land registry. This also affected the other, traditional map-based records.

Upon looking at international examples, one might ponder whether the accuracy levels required nowadays from digital utilities records are justified. We are also about to touch this issue.

The mentioned difference in perception is not only present in case of traditional basic maps, but also in case of the LIS (Land Information System).

The situation is all the more complicated, as even map users interpret the LIS in different ways with otherwise more or less similar ideas regarding the accuracy of cadastral survey. For experts of regional planning, it is only a means of realising their design targets, for surveyors it is an up-to-date element of the control net and the cadastral basic map system; land regulators value the data of the LIS real estate cadastre, while for urbanistic designers, the dotted, linear and area data are of importance, together with their interrelations.

Consequently, in terms of accuracy, it is the system of traditional basic maps in a given country that is determinant when producing a digital basic map. If no traditional map is available with the required level of accuracy, then it is only by cadastral resurvey that the lack of accuracy of the traditional product can be eliminated. At the same time, the LIS must meet all the above-mentioned requirements, or at least must be suitable for expanding and complementing in all areas of utilisation.

A decade ago we were truly and expectantly wondering at examples seen abroad, primarily in Western Europe. Today it is already evident that we can only adopt certain part-technologies, and the digital recording and GIS systems we shall have to establish ourselves as best we can.

Sorry to say, software available on the international market shows a quite varied picture, despite the enormous rate of development. One might debate whether this is the result of deliberate protectionism of major software houses, or if it is due to the extremely varied market demand. Probably both factors play a role. In any case, no real ‘plug-and-play’ systems are at hand, and there is great demand for software experts engaged in developing software applications further.

3. Requirements that Digital Basic Maps Should Meet

From the above thoughts it is clear that up-to-date digital map documents require very different digital basic maps.

Contents: application needs are extremely widespread. It is impossible, and unnecessary, to list these. It is evident that one needs to try and meet all requirements to achieve the maximal contents level. On the other hand, financial possibilities limit the scope of contents that can be incorporated in digital maps.

Knowing the target of the project, the type of digital basic map can be determined (geodetic, topographic, some sort of thematic). Then it is the range of functional requirements that determine the sequence of importance of the various contents elements.

One of the most debated elements of the regulation on digital basic map system [3] now being introduced in Hungary is the contents. Experts creating the regulation tried to maximally serve the needs of both the urban-control and public utilities areas, but the primary target was to make sure that there is a possibility to expand the contents.

Accuracy: this term needs a much more exact definition. The scope of user requirements is, of course, extremely widespread. It must be remembered, though, that most of the user experts are not familiar with the questions of surveying. Some users within the same group may require cm-accuracy, while others may need meter-accuracy for the tolerance (locations, standard deviation) of the very same map element.

Generally, it can be said that it is usually advisable to apply one scale better accuracy than that required (and considered reasonable) from the users' side. This is all the more justified, if we consider the surveying convention that any mistake cannot be greater than the three-fold of the standard deviation. When re-working the different public utility records onto digital means, it is basically the regulations of location and measurement accuracy of utility lines that need be observed. The 10 – 30 cms given in [1] is a reminder that the utilities documentation requires a basic map produced according to the maximal accuracy regulations.

From among the graphic (map) modules of urban control systems, the activities of construction authorities require the greatest accuracy, since they handle documents that basically need the same level of accuracy as land office basic map documents. One must also calculate with the tendency that, as digital documentation and up-to-date basic networks become more and more widespread, an increasing number of land office task sections will be transferred to local municipalities.

The various thematic municipality modules require lower accuracy levels, although each of these projects need separate requirement assessments in the form of an EXISTS-NEEDED analysis and a Feasibility Study.

Being up-to-date: the situation in this respect is clear, since all users need up-to-date basic maps.

It is our feeling that it is in the area of being up-to-date that the requirement for a unified digital basic map to be available is the strongest. Different users have the same requirement, but because they work on different areas at the same time, each of them needs the map portion of the given area to be up-to-date. If they are left to update their digital basic map in parallel to updating the professional contents it carries, then we will be faced with a range of very different contents in the various basic maps of different users. This would bring us to the same situation as in case of the traditional documentation, i.e. a heterogeneous fleet of digital basic maps with the users, which can never again be unified.

This in turn means that a generally acceptable level of unification of digital basic maps can only be achieved if changes are logged centrally. The system of regulations mentioned earlier and related to the unified documentation of public utilities [4] was basically aimed at achieving this target by saying that in each settlement only one organisation, namely the Central Office for Public Utilities Documentation, operating within the construction authority, is responsible for the unified tracking of changes.

4. The Present Situation, Issues and Solutions Regarding the Production of a Digital Basic Map

Digital basic maps have been produced in Hungary for the last fifteen years. Digital basic maps were produced already in the early eighties (Szeged), but it was only in the early nineties that experiments involving several settlements were started. Sorry to say, these efforts were not adequately supported by responsible authorities, and regulations concerning digital mapping were late to emerge.

'Decree no. 21/1995.(VI.29.)FM On the Production and Handling of Digital Geodetic Basic Map Data' [2] and the enclosed Regulation meant the turning point, since it made use of the then-actual computer aspects. It is of vital importance that the schedule 'Layer Allocation for Creating Data-Files for Digital Basic Maps' was issued. This seemed to solve the old problem of digital basic maps data files being created according to different layer allocations, with no chance of future unification.

According to 'Act no. LXXVI. of 1996. On Surveying and Mapping-Activities', Section 9, Para. (4), the new state-produced geodetical basic maps should be made in a way that can be handled by computer, and, according to Section 1, Para. (5), the documentations of official administrations and municipalities may only be based on the data files these new basic maps.

The mentioned DAT Digital Basic Maps system of regulations [3] is available from late 1997, which, based on Hungarian Standard MSZ 7772-1, provides detailed regulations on the design, production, renewal, data exchange format, documentation, quality control, authentification and state acceptance of digital basic maps.

This system of regulations now provides the adequate fundaments for the production of a unified digital basic map. It is also true, though, that the DAT regulation system has not yet had its 'live' test, and this can lead to a great number of problems.

Though it is good to have the regulation system, it is something that came too late. It is enough to recall that the National Committee for Technological Development launched the National GIS Project as early as the beginning of the nineties, providing funding for roughly 25 municipalities for development work on GIS information. These projects ought to have been based on a digital basic map produced according to unified geodetic principles. Instead, the digital basic map was produced reflecting the views of various different area-information companies, mostly by digitising the utilities basic maps of settlements produced according to [4]. In some cases the basic map was digitised, but without regard to land-office aspects. In the case of Budapest, a scanner-produced version of the utilities basic map is the most common. This has only been partly vectorized and structured, with basic geodetic requirements neglected and the tracking of changes doubtful.

The lack of a digital basic map also hindered the documentation work of public utility companies, and similarly, they got into the network of GIS companies who themselves lack even the most basic knowledge of basic maps and land-office registers necessary to support these systems. In some better cases, and in lack of a digital basic map, they tried to postpone the production of the high-accuracy modules of the to-be system (e.g. detailed digital location drawing of public utilities), and created overview documents (1:2000, 1:4000), requiring the digital processing of smaller-scale basic maps, with emphasis on the data base.

In lack of a digital geodetic basic map, utility companies very often turn to digitise or scan a map of different origin (e.g. public utilities basic map), and the customer believes he is getting a data fleet as dependable as the geodetic basic map.

Naturally, the geodetics branch also receives a lot of critic for not having been able to provide municipalities and utilities companies with a digital basic map in time. The defence of the geodetics branch is also understandable, since no country's geodetics branch is able to create a digital basic map on its own, this needs to be government-funded, and in recent years there have been no dedicated funds for this purpose.

The public utilities basic map has been mentioned several times in the previous parts of this paper. It has also been mentioned that it was a welcome means of replacing the traditional, manual documentation of public utilities. It was also indicated, though, that this can, nevertheless, not be regarded as an acceptable basis for the digital utilities and settlement control systems. Below, we shall explain why not.

Unfortunately – perhaps due to the inadequate information activity of the geodetics branch –, the technology used for producing the utilities basic map described in [4] is not widely known. We cannot go into detail now, but the essence was, that these utilities basic maps were produced by photostat-enlargement and manual copying of surveying basic maps onto transparencies, with domestic technologies geodetics companies had at that time (e.g. in Budapest: Sztereo/1, Sztereo/2, EOTR/1, EOTR/2, EOTR/3, etc). These maps were then supplemented by the contents mentioned in [4] (trees, curbs, entrances).

Even nowadays several municipalities and utilities companies in and outside Budapest use these maps that were domestically digitised and scanned, structured after some individual aspect, or not structured at all.

In case of users deliberately choosing this method, there is no problem since they are aware of the necessity to replace this data fleet sooner or later.

It seems, though, that a significant number of users, having ordered the product, are not aware that these digital basic maps carry data fleets whose co-ordinate-basic (data of property boundaries) are not, and cannot be, identical to those on surveying basic maps, since, evidently, each digitising produces different co-ordinate fields for the same group of points, and each of these differs from the official land-office co-ordinates, if only by a few cm-s.

The situation is similar in case of the various digitised and scanned versions of surveying basic maps, since, evidently, these digitisings also produce different co-ordinate fields than the land-office ones.

As a matter of fact, geodesy never supported the use of two or more co-ordinate fields on the same area, and cannot handle the fleet data stemming from the digital processing of various aborigine maps and location drawings. The essence is that it cannot undertake to track the changes of property-boundary fields different from its own.

It is therefore not possible to attain the continuous tracking of changes as mentioned at the end of Section 3!

This in turn means that several users perform tracking of changes in the same area, and this leads to a heterogeneous data mass at least as bad as mentioned at the beginning of this paper, when we described the period prior to the unification of traditional utilities documentation.

What is to be Done in the Present Situation?

First of all, officials directing new developments should be reminded of the above dangers. They cannot, of course, be asked to wait for the professional digital basic map of their settlement to be completed. They can be asked, however, to use the surveying basic map as fundament in case they produce a digital basic map – either by manual digitalisation or by scanner –, and to strictly prescribe for the company performing the digitalisation to observe the layer allocation, enclosures and other geometric conditions as finalised by the geodesy branch [4]. An especially important requirement is the question of identical layer structures, since this provides for the digitised, so-called skeleton-map data (network of property-boundary points connected by lines) to be replaceable by the land office register, if and when it is issued, and from then on, changes can be tracked, based on the land office data, even by the land office itself, on a commission basis.

The possibility of tracking changes related to base-map data produced by processing material obtained earlier from some aborigine base material should be examined separately.

The issue is clearly difficult to address in settlements where even the land office lacks the co-ordinate-data of property-boundary points. In this case one has to wait for the digital surveying basic map to be produced, and then decide if the skeleton-map data can be replaced.

Where the land office disposes of skeleton-map data, it is reasonable to obtain this and to continuously replace the earlier digitalized property boundaries (provided, of course, that the processing system applied makes this possible).

Users who are using base-map data produced from aborigine maps subsequently digitalized in an unstructured or partly-structured way, and who had professional or thematic base-map data digitised after this base, influenced by business considerations and having decided on this application without due consideration, are in a more or less hopeless situation. If the professional digitising was made correctly and the digital data of the professions involved is totally independent from the base-map data, then the base-map data can be replaced. It is unfortunately common practice that the professional data had been ‘spoiled’ intentionally, to correspond with the base-map data digitised from an aborigine map. This leads to a truly hopeless situation, since the dual co-ordinate fields are maintained, and it is up to the user himself to track the changes in future.

Most of the users, though, are not yet addressing this issue. They can easily be misguided by cheap and worthless digitising, as he is happy to somehow – anyhow – make his data appear and more or less be able to handle this on a CAD system. This provides ground for the widespread – as we see it, cynical – opinion saying ‘this will do for the utilities companies and municipalities’. At the user side, mid-level project managers, perhaps caught in the net of sub-contractors, will try and postpone the real are-information developments, to avoid highlighting the problems and, eventually, the mistakes of their own work.

It should be noted that the so-called added contents of public utilities basic maps (trees, curbs, entrances) are worthwhile to be carried over into the GIS system of land offices, since these data are extremely valuable and usually kept up-to-date. Correct conjunction is important, though, since changes in property-boundary lines should also drag with it the added contents.

5. Summary

This paper is primarily about the traditional and digital versions of basic maps that serve as basis for the digital documentation of settlement control and public utilities.

The thoughts mentioned here might be misleading in the sense that they emphasise the highly accurate basic maps produced strictly according to geodetic principles as the sole basis of digital documentation. It has to be noted, therefore, that there are several thematic GIS and documentation systems that do not require such a high level of accuracy, meaning that the application of some smaller-scale topographic or cartographic maps in digital form can be absolutely suitable. One must, nevertheless, seriously consider whether, in case of the thematic modules of settlements and utilities, it is appropriate to use the digital version of some topographic or cartographic product, or rather to use the generalised version of digital surveying basic maps of utilities and construction management as a basis.

On the long term, the issues mentioned in this paper can be best addressed by the National Cadastral Program launched nowadays, as well as the development schemes of the geodetic branch. As of the writing of this paper, there are already five towns where the production of up-to-date digital basic maps has got under way as part of this programme, so, for settlements who share the costs of the programme, even the near future looks bright.

References

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