ON THE AUTOMATION OF A UNIFORM PUBLIC UTILITY REGISTRATION

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Abstract

As a result of development in computer technique, a number of big, registration data bank systems had been realized in the past decade. In Hungary, bringing about modern graphic and alfanumerical information systems that ensure modern updating and data supply are much needed in several fields, thus in the field of land survey and public utility registration.

The paper gives a short summary about the present state of public utility registration in Hungary, mentions some foreign examples and informs about preparatory steps to realize the Budapest Public Utility Information System.

Work concerning a uniform public utility registration has been going on in Hungary since nearly 15 years. The factual preparatory work has started in 1974 with an investigation of the registration of individual special branches and the pertaining technology has been developed continuously. In several towns the preparation of special branch registration, the development of a uniform registrative map-system has been started the traditional way, without computer techniques.

Concerning Budapest this is an exceptionally hard task. The majority of the public utility network of the capital is rather old, a 100-year old pipeline is not exceptional. Thus also the registration according to special branches is not uniform. In past decades different scale and different content maps and plans were born.

Incorporating these growingly confused registrations into a uniform system means extraordinary difficulties and also finding underground mains not indicated with sufficient accuracy makes the work very difficult, indeed.

Despite the above it can be stated that the work progresses well but a registration developed in this way does not solve problems in the long run.

It is to be expected that the continuous updating in the ever increasing amount of maps cannot be solved manually and also their filing causes problems. As regards Budapest, for instance, the number of 1 : 500 scale special branch map sections exceeds 30 000.

It is therefore our aim that parallel to the traditional registration of public utility data an automated public utility information system should be established. The ideal solution, of course, would have been to use computer techniques already when starting the new registration. This was not possible as the

development of modern information systems has begun even in countries more developed than Hungary only some 5 to 6 years ago. On the other hand, also financial means were lacking. And, though the latter is still present, a solution of updating is too urgent to be shelved, as it may well happen that maps elaborated the traditional way are obsolete already at the moment they are finished.

In the past three years the Institute of Geodesy of the Budapest Technical University, together with "ERŐTERV" planning office operates a closed-circuit geodetic and stereophotogrammetric system that enables to elaborate the most up-to-date, automated registration technology. The relevant research work undertaken by the Institute of Geodesy is a suitable basis for the automation endeavours of leading bodies of our capital. It figures among the near plans of the Chief Administration for Public Utilities and Civil Engineering of Budapest Council, the Budapest Land Surveying Office and some concerned institutes to gradually replace the mentioned traditional public utility registration with a computer technique. The long-range aim, of course, is to build up and operate an automated data basis which, over and above survey and public utility data would also contain the municipal technical registration.

A short survey of public utility registration in Hungary

According to the 1979 injunction of the building authorities a uniform public utility registration is to be established in Hungary concerning the towns. There is, of course, no mention as to whether it should be a traditional or an automated one, but the dead-line indicated is December 31, 1989.

A special difficulty is presented by the fact that the system of basic surveying maps is being reworked into a new, uniform projection system during these years. The majority of existing public utility registration maps has been prepared in the former projection system thus a great amount of transformation surplus work has to be reckoned with.

Concerning country towns this work is undertaken first and foremost by the Company for Surveying and Mapping Budapest. It is to be noted that in certain towns (e.g. Nyíregyháza, Szombathely), due to a lack of organization is to entering up changes, this costly work gradually loses its value. In some towns the processing of some special public utility branches is undertaken for the time being.

As to Budapest, the organizer and main realizer of uniform public utility registration is the Cartographia Co.

The abovementioned building authority injunction deems the establishment of a Central Public Utility Recording Office necessary in the towns, which realizes the organization of data collection, surveying and registration while also shouldering information about data and maps needed for municipal man-

agement and entering up all changes. The Cartographia Co. in Budapest is also the Central Public Utility Record Office for the capital. A rather difficult organizational problem is that individual public utility works order investigation and recording their own mains in different parts of the capital. Over and above this organizational problem there is also the disadvantage presented by the fact that the unified public utility map so very important for municipal management, public utility planning and municipal technical planning is being finished but very slowly. This coloured map is to contain all major installations of all public utilities.

At present the traditional mode registration covers about 30—35% of the Budapest mains. Considering the 1 : 500 scale special branch block plans the per cent of registration is about 20—22, as up to now work was mainly carried out in the City.

Let us sum up in short the automation experiments undertaken till now. A number of studies and experimental work indicate automation endeavours.

- Of special interest is the 14 volume general survey compiled for the Council of Budapest, summing up the problem of registration of Budapest public utilities. It also serves as a basis — among others — for computer technique processing [2]
- The Land Surveying Institute elaborated a plan for a future surveying and public utility data bank
- The Company for Surveying and Mapping Budapest undertook to fix the data by digitizing the completed public utility maps, in certain experimental areas [7].

We also intend to go into details of the experiments realized concerning the mentioned system of the Budapest Technical University and ERŐTERV, that can be taken as a direct preparatory work of automation plans.

A survey of automation work abroad

As a result of study tours and studying foreign literature we intend to give a short summary of certain foreign examples. But first of all some general experiences:

- In highly developed Western European countries, automated special branch registration is characteristic, few examples were seen of cooperation among special branches;
- It is first of all the registration of electric- and telecommunication networks where automation is aimed at;
- Elaborating an interactive registration that operates without fail does not only bring up software and hardware conditions. Where nowadays such a system operates normally, the development work had been begun

some years ago — even some 10—15 years ago. This period was not only needed to bring about the mentioned conditions but also to develop the suitable attitude.

— The installation of the system is undertaken by engineering offices familiar with the system and having suitable experience, sometimes by the enterprise delivering the hardware and the software. Some cases indicate that it is expedient to develop a contractual, long range and close connection with the supplier. In this way the enterprise delivering the installaton continuously develops its system, the pertaining software and need not fear the competition of those who operate the software.
— In different states of the German Federal Republic very different automation concepts are encountered.
— As to introducing the registration with traditional methods the socialist countries did pioneering work (Poland, Czechoslovakia), but no sufficient information could be obtained as to turning to automation.
— The methods of locating for public utility mains is still very much less reliable than the methods of surveying, illustration and recording.

No means suitable to look for non-metal mains can be had on the European market.The one manufactured in the United States is too costly while the installation of the firm Battelle in the German Federal Republic, using computer aided processing, is still being developed.

For the surveying of discovered or explored points of mains a generally used tool is the recording computer-tachymeter (total station) that enables a closed circuit automated processing from land surveying through interactive plotting to graphical representation on the plotter.

In certain towns in Baden-Württemberg the possibilities given by photogrammetry are successfully used when surveying surface public utility installations.

— And not to forget the most important: without interactive graphic systems no operative public utility registration can be hoped for as this is the only possible means of entering up all changes with the highest efficiency.

We should like to mention some public utility recording systems.

In Denmark, the recording and planning system of Jutland Telephone affects some 26 000 km^2, 900 000 subscribers. Its central is a PRIME 750 (2 MByte) computer; the recording is undertaken in 13 TEKTRONIX GMA 103 interactive graphic workstation. Their number will be increased to 30 within a short time. Besides keeping on record the telephone and cable-TV network also that of basic surveying maps is undertaken here.

The Institute of Photogrammetry and Engineering-Surveys at the Hannover Technical University is elaborating in Neustadt a town management recording system with software developed by the Institute.

The automated recording system of the Hannover Elektrizitätswerk covers 90% of the town area and the neighbouring Langenhagen. The recording of the electrical network and network designing is being done with the aid of 3 INTERGRAPH GMA, 2 INTERGRAPH RASTER interactive graphic work places in cooperation with the firm INTERGRAPH.

The technological filing in Finnish towns is gradually automated. This typ of system is being tested in Tampere and the system due to undertake technical filing of the capital, Helsinki, is already operating. Its central computer is a VAX 780 and also INTERGRAPH work places are at disposal.

In Japan, the Tokyo Gas Group developed a public utility registering system. It works with a VAX computer, the interactive graphic work places are Japanese products, JRC.

The Vereinigte Elektrizitätswerk, Westfalen keeps the electric network of Dortmund and its environment on file with Contraves GRADIS interactive graphic workstations.

Some general aspects of realizing an automated public utility Informationsystem in Hungary

A number of consequences can be drawn on basis of experience gained both abroad and locally. To mention but a few:

As a first step of automated public utility registration it is expedient to bring about a pilot project that could serve as basis for the complete development. A later use of experimental results is possible smoothly if for building up, the final hardware configuration and software are identical with the ones used in the experiments or are improved types of same, meaning that a modular development of the starting system must be made possible.

The same is also true for the special branch data structure. Its building up depends on the system later, basic changes present a great difficulty.

Different size towns have differing specificities from the point of public utility registration. A growth in the number of the population does not only mean a quantitative growth from the point of public utility supply and registration. Thus an experiment carried out in a small town cannot be an acceptable basis to organize the registration of a several million city.

In Hungary, the registration of Budapest is at present in the most critical state. To decrease the number of road breakings, now 25 000 a year, and the harrassing work of reconciling public utilities previous to planning is of national economy interest.

It therefore seems most expedient to realize experimental work in Budapest and then improve the technical information system of the capital.

This is supported by the fact that, because of the specific situation of

Budapest, the major special branch public utility and surveying enterprises are situated here as is also a Central Public Utility Recording Office. Thus the expert realization of both the experiment and a further improvement work seems to be guaranteed from every aspect.

We should like to emphasize, as a basic viewpoint, a factor very little underlined in literature meaning, that a modern, automated public utility registration enables to modernize the planning of public utilities. An interactive graphic planning (public utility CAD) based on a data bank may well eliminate time consuming check-ups, with the result that any design work would be more accurate, more reliable. But it is also of interest to both those operating the system and the designers, which may increase financial possibilities.

Another basic factor to be mentioned is the problem that exists at present with building up a public utility data storage system. This would comprise the alfanumerical data stock of individual special branches, not independently, of course, from the graphic data stock but as its connected part. The purpose is to supply the management of the city, the designers as well as the special branch enterprises, too, with the necessary summarizing data. Though the injunction deciding about establishing a registration deems a public utility data stock also necessary but concerning the detailed contentual and structural build-up neither the relevant authorities nor those operating the public utilities have developed any factual plans.

The system of the Budapest Technical University — ERŐTERV can be considered mainly in the field of graphic data handling but the aim should also be to develop a public utility data stock. This is supported by the fact that when assessing the state of the installations, the total length of mains by material types, the inventory of property, the number of sheets often an uncertainty is to be felt.

The possibility of a centralized or decentralized siting of hardware needs careful consideration. Not only the demands of the operators of the system and the special branch enterprises have to be taken into consideration but also the possibilities of telephone connections should be investigated (both from a financial and a technical point of view).

Preparatory work concerning the Budapest Public Utility Information System

We will now discuss tasks to be realized concerning the Budapest Public Utility Information System.

The main steps, up to the point of continuous operation, can be summed up as follows:

- preparatory work, compilation of the system-plan;
- installation of hardware, software and other means (e.g. surveying means and those used to explore public utilities), training of employees,

— elaboration of final data structure (according to the framework put down in the system-plan),
— input of data,
— operation of data bank (updating and supply-service of data).

It should be noted that at the time this paper was compiled the organs of the council were considering to develop the system into a so-called land information system that would also contain several records of council management. In the present paper the registration of survey- and public utilities data is supposed and the preparatory work is discussed.

The contents of registration

The system has to satisfy the following main requirements:
— cadastral registration,
— central public utilities registration and
— special branch public utilities registration.

The present work-parts of registration the contents of which the new one has to handle are:
— basic cadastral map,
— basic map (for the map of public supply mains), which essentially is a copy of the basic survey map amplified by the necessary surplus content (trees sidewalks, columns, posts, etc.) on basis of on-site measurements, needed for the public utilities registration,
— detailed special branch layout plan, the basis of which is the basic map This detailed special branch map contains all necessary graphic information for the pertaining special branch
— combined (total) public utilities map, also based on the basic map, containing all public utility pipes, lines as well as their main establishments
— a special branch comprehensive map, which gives a survey concerning special branch network of pipes, lines, in scale 1 : 4000,
— special branch graphic work parts (drawings of streets, sketches according to individual demands),
— alfanumerical real estate registration data,
— public utilities data stock data,
— alfanumerical special branch registration data.

Investigation of the available cadastral and public utility special branch basic material

As regards the *cadastral basic material* certain specificities have to be considered in Budapest.

The first is that, because of the size of the town the basic survey mapping work has taken considerable time.There is a difference of several years between

the survey work of one or the other district, and, in the meantime, the technology underwent changes. The result is a rather dissimilar state of town-part maps, which may also concern accuracy. As a 1 : 1000 scale of cadastral maps is not sufficient for public utilities registration, viz. an enlargement is needed, the problems of accuracy, junctions, etc., manifest themselves rather strongly.

A number of experiments carried out in Hungary show that digitalizing on modern means does not deteriorate in a major way the accuracy of maps. If, however, the basic maps is not accurate, digitalizing does not help and not even transformation possibilities realized by blocks in interactive graphic work stations solve the problem.

As a consequence, the data input of the registration has to follow up the new survey and renewal of maps under way at present in Budapest.

Parallel to the new survey the computerizing of data stock of the cadastral map is also being done. For the present, this covers the structured fixing of property-line points. The structure is rather simple but may well serve as a basis for further processing.

When investigation the basic surveying material the basic map for public utilities is to be mentioned. As special public utility branches have special branch surveys done more or less independently from each other, at different points of the town, basic public utility maps are needed practically for the entire area of Budapest, at the same time. This explains the fact that the degree of preparedness of these is rather high. This, of course, also means that basic maps have been prepared also in areas where no new survey has happened and the cadastral map material may well be rather inaccurate. This calls attention to the fact that prior to digitalizing the basic survey material should be studied in detail.

The *basic material for public utility special branches* also bears the signs of past decades. A very high amount of registration work-parts has been amassed by individual special branches. However, the qualitative difference is more important than the quantitative problem. The survey of all that material, in the form of lengthy studies concerning special branches, has been undertaken.

From the point of automated processing, the detailed special branch block plans, on a 1 : 500 scale, prepared according to the aspects of a uniform registration, are the best usable. Accordingly in areas where no new survey has happened, these can be regarded as excellent from the point of public utility special branches, only, but from the point of land survey they are to be studied.

In areas where the new special branch registration sheets have not yet been finished two possibilities are open:

— using the old special branch material but as a kind of assistance, new public utility survey is undertaken as far automated as possible (field data fixing, interactive processing)
— after a careful study the old special branch material is digitalized and

pipeline locating and measuring, is undertaken where absolutely necessary, only.

Most probably, the first method will become the general one. In any case it is being studied by special branch and area-unit and the new operative plan will come into being accordingly.

Let us mention, finally, that the old special branch material is of technical and in certain cases even of "museum piece" interest and part of it should be preserved even after introducing the new registration.

Investigation of the data stock to be stored, assessment of the potential data-amount

In cooperation with the Budapest Central Public Utilities Record Office we investigated the potential data amount also from the point of storage capacity. The basis for this work was the experimental work undertaken concerning the Budapest Technical University — ERŐTERV system. We assessed, by individual special branches, the structured data stock of 1 sheet covering about 90 000 m^2, the scale was 1 : 500, and the storage capacity needed for such a section.

Special branch	Storage capacity
Sewage system	0.2 MByte
Water conduit network	0.12 MByte
Gas network	0.1 MByte
Heating network	0.1 MByte
Telephone network	0.15 MByte
Electric network	0.3 MByte
Other (traffic lamps, trolley, material lines, etc.)	0.1 MByte

Besides the above also the storage space needed for cadastral and public utility basic maps is to be reckoned, which is about 0.2—0.3 MByte, as well as the storage space requirement, 0.3—0.4 MByte, concerning the combined public utility and special branch comprehensive map.

It is also known that the area of Budapest is covered by a number of special branch map sheets. Of course, not all special branches cover the entire area of the capital.

According to preliminary studies, about the following storage capacity will be needed:

Cadastral basic map + public utility basic map surplus contents	1170 MByte
Sewage system	720 MByte
Water conduit network	700 MByte
Gas network	300 MByte
Heating network	80 MByte

Telephone network		750 MByte
Electric network		1740 MByte
Other special branches		40 MByte
Combined public utilities map		1500 MByte
	Total:	7000 MByte

The above is, naturally, but the storage space requirement of graphic data, but the majority of the planned data structure is also accessible in an alfanumerical form. The public utility data stock and other alfanumerical records further increase this requirement.

Potential joining requirements to other systems

The Public Utilities Information System has to have output possibilities that enable certain parts of the data stock to be accessible also for other systems. Automation endeavours are characteristic also concerning other special branches. A critical problem of council town management is, for instance, to automatize building registration. Preparatory work is underway to establish a co-ordinated so-called "outskirts recording system", concerning pipelines, networks, roads, railways and other installations outside inhabited areas. But also the automatization of modern real estate registration may be mentioned.

All the above should be studied jointly, but this would most probably result in a number of labyrinths that would greatly hinder the original aim. At present the use of a "geocode" promises to be a link, which, essentially is a co-ordinate pair subordinated to a land section or some other object, completed with a qualitative code.

In the course of preparatory work, joining to some other systems will not be discussed as our aim is only to increase the number of output possibilities in a way to be able to satisfy later on, also the demands of other systems.

Points of law, data protection

The property protection as well as secret-protection of the systems is regulated by orders, also in Hungary. To this sphere belongs protection against physical and personal danger sources as well as the protection of land-survey and real-estate registration data. Prior to putting into operation the system, therefore, all potential danger sources have to be uncovered and data protection measures in harmony with valid provisions of law have to be put down in writing.

System protection is a task in close relationship with the above. The system plan will analyze the control possibilities to be potentially used while operating the system. Besides it will also give a guideline to elaborate tests that can indicate potential breakdowns of hardware as well as the operation system.

Test programmes are similarly needed for a periodical control of the system software.

Saving the data files at predetermined periods is of special importance. It is characteristic of the Public Utilities Information System, that two or more users may want to gain access to a given file, simultaneously. Thus, the priority of users has to be previously determined.

Research work concerning an interactive sample system

As to the system operated by the Geodetical Institute of the Budapest Technical University — ERŐTERV the research work aiming at an automated public utility registration covers the following.

a) Data recording of the cadastral map sheets.

The co-ordinates of real estate boundary points are recorded on magnetic tapes in Budapest, by the Land Survey Service. After reading in these can be visualized on a screen at the interactive graphic workstation and by connecting up the points the structured digital map can be constructed. As a basis the cadastral basic map may serve, that at present is still being kept collaterally, from which the internal content of the parcels can be recorded by digitalizing. Later on, the task can be continued in the form of interactive construction, viz. the connecting-up of the points visualized on a screen is realized by the operator on basis of an on-site sketch. For this — as for other research tasks, also — the following are being elaborated:

- menu,
- table of symbols,
- data structure considering later retrieval possibilities as far as possible (key-number system),
- necessary additional information (attributes), to be stored as adapted to the objects to be fixed and can be retrieved by the key number of the relevant object.

  In principle also retrieval according to attributes is possible, however experience indicated this to be rather difficult in case of big data systems with a complicated structure.

b) Data recording of the basic map for public supply mains.

The surplus content of basic maps (trees, sidewalks, columns, posts, etc.) has to be imagined as a coverage of the basic cadastral map. It is to be realized that at the interactive graphic workstation the basic cadastral map may be retrieved as such and also together with the public utility basic map surplus content, as the system has to fulfill in the future not only the requirements concerning a cadastral map of land survey authorities but also the special branch public utility basic map ones.

This, of course, brings up a number of problems.

To mention but one: on cadastral basic maps the names of streets and the parcel numbers of individual street sections figure on the area of the street as do the boundary lines of street sections. This causes inconvenience when describing public utilities and thus it ought to be solved that when retrieving public utility basic maps the street name should be written on the area of the parcels and the boundary lines dividing street sections as well as parcel numbers of the public area should not figure.

c) Recording public utility special branch data stock.

It is, of course the biggest task. Our experiments are carried out by individual public utility special branches, based on similar work realized on industrial sites. Up to now, processing by digitalizing of new public utility sections completed the traditional way, was done. A further task is to examine the old registration material (1 : 720, 1 : 1440 scale maps, sketches, street drawings, foreman-sketches, etc.) still used by some public utility enterprises, as to its usefulness. From among the technologies in use the one is the most important, that takes from on-site public utility line location and measuring, through interactive data recording, up to automated data supply and updating of data. We call this a closed circuit technology and use it systematically concerning industrial sites. The sketch is given in Fig. 1.

From among the two methods of on-site data recording only method a) is available to us, method b) is still being developed in the German Federal Republic, but has to be taken into consideration. The system also has to accept the measuring results of traditional rectangular or polar co-ordinate measuring, this, however, does not figure here.

The system has a modern analytical plotter. We have to consider the possibility to determine surface public utility installations (manhole covers, hydrants, bolt-locks, etc.) from aerial photopairs taken by aircrafts, or model aeroplanes and the survey of underground lines is then built on this co-ordinate

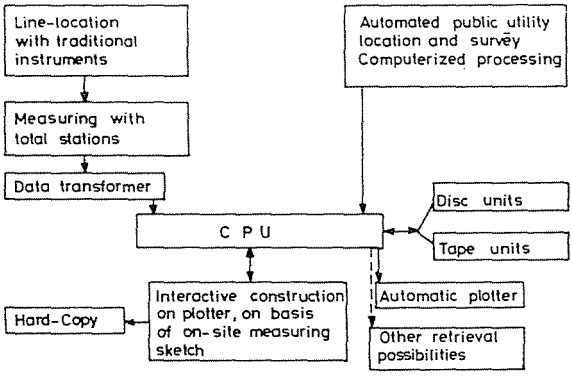

Fig. 1

frame. Earlier experiments of this type are rather promising. In the solution of other photogrammetrical tasks the data supplied by the analytical plotter are systematically used as input material for an intermediate PDP 11/23 small computer and then, for the purpose of interactive construction furthered to the interactive graphic workstation.

Though, in general, we intend to satisfy the demands of special branches as far as possible, this causes a high number of difficulties. The demands of these special branches is not formulated in a form suitable for us and/or it is difficult to find specialists who would undertake this work being aware of their responsibility. At the same time it is very probable that when the system is put into operation, when it has everybody's attention, they would appear with a number of new demands. It is also to be expected that the requirements of administrative, townmanagement organs cannot be collected prior to putting the new system into operation. All this speaks for a gradual and modular build-up of the system.

In the course of experiments we endeavoured to apply as many advantages of automation, as possible. Thus the possibility is given to challenge scales of any big order. This is advantageous, of course, only from the point that on the resulting lay-out there is more space for further planning, however, at the same time also the inscriptions become bigger, and that is mostly superfluous. By increasing the scale the informational content does not increase. It is now tried to increase the information content by increasing the scale over a certain limit. A mode of this is that, in case of retrieving over a certain scale limit, the unnecessarily grown code symbols of water network, telecommunication and electricity manholes, automatically the sketches of manholes be sketched. Manhole sketches are prepared anyway when surveying public utilities, and were stored up to now independently from special branch maps. Their advantage is that they also show internal dimensions and fittings. A difficulty is in such a case joining the lines pertaining to the shaft itself.

d) Recording the data stock of a combined public utility map.

The special branch content of a combined public utility map comes into being by reducing the detailed content of individual public utility special branches. According to valid prescriptions different codes pertain to a combine public utility map than a special branch one. In case of an automated solution there are but two ways possible.

- The presently used symbol-duality is kept up. In this case elements figuring also on the combined map should be given a key-number and a symbol that ensures retrieving according to the combined map symbol.
- Finding a compromise, by elaborating a symbol-system that suits both special branch and combined mapping. This would mean changing the code valid and compulsory at present, and also bringing about a new authorization.

For designers, the information content growing with the scale, viz. showing manhole sketches, would be of great advantage.

No investigation was done up to now concerning establishing a public utility data stock. Its urgency is justified by the fact that already when constructing the data structure of the graphic registration, the public utility data stock data structure has to be taken into consideration. If not, a parallel storage of data is inevitable, greatly increasing the storage capacity requirement.

Suggestions for the necessary basis of means and for its placement

Concerning placement of hardware elements both a centralized and a decentralized possibility has been studied. When assessing the user demands we stated that for the control, public utility operation and design institutions of the capital a decentralized hardware building up would be ideal.

The advantages of this are:

— the records would be kept by the operating enterprises, thus their interest would be a maximal one,
— interactive planning (CAD) would be possible,
— the operating enterprises could supply immediate data (e.g. hard-copy) for breakdown prevention and network maintenance.

The disadvantages, on the other hand are:

— complexity of organization,
— there is a need for data transmission lines.

As an experiment, a few kilometres long data transmission line was put into operation, connecting the two computers and the interactive graphic workstations that had previously worked independently from each other. The first experiences are rather good, but because of the potential problems with the postal network a broader use has not been begun.

The system will be a centralized one, for the beginning, and/or a solution that is a kind of compromise. Accordingly the computer centre and the interactive graphic workstations will be situated in a central, and the special branches will be able to get data from the central with the aid of sited alfanumerical terminals and quick-plotters.

Data input in the beginning will be started by the system operating at present and then the second phase will be constructed. This will have to have one or more central computers with a VAX 780-type computer capacity. At that point the new, interactive graphic workstations, disc-units, a precision plotter as well as the quick-plotters and alfanumerical terminals sited with different special branches, will be installed.

Preliminary experience indicates that in the second phase of building-up, at least five interactive graphic workstations are needed for filling up with data.

Together with it, the updating has to be started, too, thus it is not expedient to treat more than two or three special branches in this phase.

The third phase will comprise the decentralized placement of interactive graphics, viz. different special branches, public utility designers, etc. will have an independent function concerning updating and data supply. According to preliminary calculations the ideal number of interactive graphic workstations will be at least three times that of the ones installed in the second phase and this entails a proportional increase in CPU-capacity.

Complementing suggestions for the hardware composition is a major phase of preparatory work. In the present paper it can be outlined, only. Though a detailed proposition has been prepared, it will have to undergo modifications, most probably. We believe that only the final configuration to be installed should be published and therefore the question will be discussed in a future study.

The on-site line-location and measuring devices form part of the basis of means. As to the former, at present we have to rely on traditional ones. As for surveying the ELTA 2 recording tachymeter proved to be suitable in the course of experimental work. With its aid closed circuit processing could be solved without any difficulty. According to preliminary plans for a continuous measuring of changes a highly mobile group of about 30—40 people should be established which, supported by a regular observation service could solve measuring of changes within 24 to 48 hours. Needed here are 3—4 recording tachymeters and at least twice as many line-locating means (traditional ones).

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