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ABSTRACT

The main purpose of this paper is to consider some problems in transferring GIS technology to local governments in Poland. Two models of such transfer are specified: "Central" and "Local". Some case studies of implementations of GIS in local governments of different levels are also presented. Authors discuss problems of creating spatial databases in cities of various sizes in Central Poland large city of £ódz and finally medium and small cities of Plock and Sierpc. Where appropriate legal and organizational and human capital issues are discussed. Finally advantages and disadvantages of both models are contrasted.

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1 METHODOLOGICAL RESEARCH ALTERNATIVES

There are two basic methodological approaches in the research into the distribution of information technology (IT) and Geographic Information Systems (GIS) in local authorities. The first one is to conduct questionnaire research across all or selected category of IT/GIS users. This was pioneered in the classical American study of the use of computers in local authorities (Danziger et al., 1982) and in recent research in the UK (Campbell 1990) and has numerous followers. The questionnaire approach usually gives a wealth of information and a good basis for the general, country-specific characteristic of the process of the diffusion of the new technology. As Masser and Craglia (1993) have noted the number of local authorities as well as country specificity may make such approach difficult if not impossible to implement. The second approach, focuses on the investigation of selected case studies and is a lot more selective. It gives us less structured and more casual knowledge and usually does not allow for generalization.

In the case of Poland large number of local authorities (in 1993 there were 2465 local authorities on the lowest level of hierarchy), poor telecommunication and secrecy phobia excluded the possibility of comprehensive questionnaire research. Instead we are trying to specify and substantiate two competing models of GIS dissemination in Poland. This specification will be illustrated with some examples.

2 ADMINISTRATIVE CONTEXT

Introduction of Geographic Information Systems (GIS) into central and local governments depends on the number of factors: who owns the information (Cassettari 1993), what is the management's awareness (Mahoney 1991) and quality of the leadership (Masser, Campbell 1989), what are the organizational structures (Masser 1989) and consequently the structure of the administration. In the case of dissemination of GIS in Poland the latter factor has a decisive impact on the whole process. There are currently four levels of administration:

1. central, where only central (state) governmental administration exists.
2. regional (województwa), where both representant of central (state) administration as well as in some cases (i.e. capital city of Warsaw) self-governing administration coexist,
3. subregional - administrative areas (rejony) which are located between regional and local administration and which carry on some tasks of central (state) administration delegated down the hierarchy and finally
4. local, where only self governing administration exists[1].

Despite quite strict delineation of authorities the administrative duality (state vs self-government administration) may cause and does cause some confusion and frictions in practice. This is among others due to different objectives of central and local administrations.

In our opinion the development of GIS in regional and local authorities has been driven by this duality. In fact two general models of dissemination of GIS can be formulated. For the purpose of this debate we will name the first model "Top-down" or "Central" and the second the "Local" model.

3 CENTRAL MODEL

The Central model was invented by the Main Surveyor of the Country in the Ministry of Spatial Economy and Construction. It has been documented in Piotrowski (1991) and Ministerstwo (1993a,b). This chapter is based on these publications.

3.1 Principles

The principles of this approach were formulated in 1991 in the Ministry of Spatial Economy and Construction as a "GIS Modernisation Programme" (Piotrowski 1991). The aim of the study was to define the legal foundations and organisational structure for GIS. One of the most important statements in the document is that "GIS constitutes an element of organisational infrastructure of the State" (Piotrowski 1991, p.4). This assumes a leading role of the State in creation of GIS, and - on the other hand a serving role of GIS in the proper functioning of the State. The document describes the relation between organisations assigned to create GIS and possible users of GIS as "server-client" relation to use computer-based terminology.

3.2 Implication of the data ownership on the organisational structure of the system

In the specific Polish situation one of major sources of Central approach is the fact that governmental agencies own spatial data. For half a century institutions which were (and still are) responsible for collection of spatial data were the Departments of Surveying and Geodesy or their equivalents. According to the Law they own all collected data (eg. cadastral information) printed on paper maps 1:500; 1:1000; 1:2000 etc. Other Departments located at different levels of State administration, for example, Departments of Planning cannot use their spatial databases for official purposes without the authorization of Department of Surveying and Geodesy. In such a situation it is obvious that in Central model it is assumed that creation of any GIS should be based on the Departments of Surveying and Geodesy.

These Departments are supposed to form "GIS base units" located usually on subregional ("rejon") and regional ("województwo") levels. "Base units" are responsible for collecting spatial data about parcels, buildings, and infrastructure, at the largest scale (1:500, 1:1000). Various institutions (governmental, self-governmental, cooperative, private) can provide "GIS base units" with requested information related to the basic maps and for some of them it will be obligatory. Those institutions can form "associated GIS units", handling specific spatial databases being in their scope of interest (ie. branch, economic, social, environmental etc), but also passing them to

"base units" as a part of general State information system. The rules of how spatial information can be accessed by users other than "GIS units", ie. "clients" of the system, are not clear as yet, but it is assumed that they will have to pay for information, at least partly.

At the subregional level it is assumed that cadastral data as well as various information currently stored in 1:500 and 1:1000 paper map will form backbone of the system. At the regional and central level data will be much more generalized.

3.3 Standardisation

As the paper-based information was strictly standardised ("K-1 Instruction"), it seems obvious that digital maps based on such paper maps should also be "standardised", so information can be passed forth and back through all administrative levels without any problems.

Standardisation includes various issues: adopting a set of rules to be used in the process of the creation of the system, imposing strict routines on how the system is being created and finally imposing decisions on the hardware and software used by various "base units". The scope of standarization was specified by Piotrowski (1991 p.18) in the following manner: There is a need for :

"...
common legal base, forcing obligatory data supply and price of the data
common global coordinate system
standards applied in the creation of databases
unified principles of information input...
unified regulations for units operation
integration of base GIS units with Departments of Surveying, Geodesy and Cartography, dependent from the State Geodetic Survey."

The scope of standardization proposed above is sensible and in theory does not exceed the necessary minimum. We will point later that if the implementation of the program is successful it may go much further: the software will have to be standardized.

Arguments quoted in favour of the central approach are obvious: graphical and attribute data should be in the same format at all levels and training of the operators and users of the system should be cheap and effective. In practice this means that at the central level it would be decided what software to choose (or at least prefer) and subsequently the chosen application would become a "standard"[2]. This chosen software may not fit the needs of final users at local levels. Another factor is purely financial: if Central administration invest in the writing of applications and shells for a specific software and gets a good deal on bulk purchase it will create irresistible financial pressure on subordinate units[3].

3.4 Pilot projects

It is obvious that such a gigantic project cannot be implemented instantly for financial, organizational technical and human capital reasons. In order to gain some experiences and to train staff it was decided to implement some pilot projects.

3.4.1 Łódz implementation

The model implementation of these officially formulated principles was started in the voievodship of Łódz in central Poland. This is one of highly urbanized and highly industrialized region of Poland. The priority task in this exercise was to get a Land Information System covering the whole region and meeting specified above principles. The region has been previously mapped in the scales 1:500, 1:1000 and 1:2000 on paper, but some of these maps are obsolete. Also some attribute data have already been transformed into computerized form with the help of the EWGRUN package (Goraj, Zaremba 1993). These data are usually updated. However in order to get exact and up to date data it was indispensable to survey some parts of the region. Goraj and Zaremba (1993) assess that in the process of the creation of the database it was necessary to update some 15% of attribute data and as much as 40% of geographic data. These changes resulted in alteration of 70% of information on areas of parcels! It may sound incredible but software selected for the creation of working version of LIS was AutoCad (Ignaciuk et al. 1993), with the intention to transfer the final product into Arc/Info environment.

3.4.2 Small scale implementations

Other projects undertaken within the scope of central approach were those started by already constituted "base GIS units" within the Regional Departments of Surveying and Geodesy in Sieradz and Lebork. In both cases the scale of the project was much smaller than in £ódz - covering small towns. The basis for GIS were existing digital land inventories in one of two systems elaborated in Poland and covering large areas of the country: EWGRUN (in Sieradz) and MSEG (Lebork). Both those centres concentrated on downloading the existing spatial data into a system that would enable to connect them to attribute information. Both these centres were fairly succesfull in the implementation of their systems.

3.4.3 An attempt at assessment

It is at that stage impossible to assess the results of the pilot project as no written information is available and those involved in the implementation refuse to give official statements. However we have our reservation towards this approach:

- Due to the quality of existing maps and surveys (precision and obsoleteness) it would take decades to cover country with computer base maps, especially as for many regions paper base maps do not exist or hold false information or are very old[4]. In many cases the legal position of some parcels is not clear as they were expropriated after the War with the breach of then existing law.
- Apparently both Polish commercial companies implementing the project and the administration suffer from lack of properly skilled staff and are forced to employ surveyors and computer aided design specialists in order to get the project done.
- It is not clear who would pay for data collection and digitising. The State budget, in our view, can not afford this kind of project. Lack of funds slows down the whole process. On the other hand, this sort of project may be financed from local budgets, but the problem here is that local authorities may be reluctant to finance projects in which they will not have their say and which may not meet their needs.
- Not all information covered on base maps is needed by all users, so it is more

efficient for final users to collect and update information that is of interest to them (for example utilities companies hold their own inventories).

- The Region selected for the pilot project was far too large and complicated. The process of learning has been hampered by hard struggle to overcome unexpected and numerous technical problems.
- There is a gap between the existing law and the needs of the project. The pilot implementation apparently suffered from this gap but on the other hand allow for the accumulation of expertise indispensable in the creation of the new law.

The model of the creation of the GIS by the central governmental administration reflects natural (from the point of view of Central Agencies) tendency to control everything what is going on lower levels of administration. It stresses the rights of the State, but to large extent it ignores the needs of many potential GIS users who do not necessarily need the kind of information included in geodetic base maps.

4. LOCAL MODEL

The other model of the dissemination of GIS was called by us a "local model". This is because it is fuelled with local initiatives developed spontaneously without state's intervention. Basically there are three reasons for these developments:

1. The growing awareness of local authorities and growing recognition of the need for GIS development.
2. Local governments, dependent on local electorate, perceive the need to improve widely understood services.
3. A reaction to the lack of decisions on central level.

In this section we will discuss some case studies and point out the advantages and disadvantages of this approach.

4.1 Case study: Plock region (voievodship)[5]

4.1.1 Regional level

4.1.1.1 The scope of the system

After several meetings with potential users (Staff from Departments of Planning and Environmental Protection) it was decided that to meet the needs at this level of administration, a computer map at the scale 1:25000 with the information typical to standard topographic map at this scale should be created. Eventually, information converted into digital form included waters, land use, human settlements boundaries, roads, rails, forests, wetland etc. Sixty-nine paper map sheets were digitised and checked during the period of eight weeks and now the GIS is in constant use in planning (road planning and maintenance, utilities analysis and planning, land planning) and environmental protection[6] (water resources analysis and pollution monitoring).

4.1.1.2 Practice of GIS implementation: training and institutional change

The staff of Planning Department was trained by the company which delivered the GIS package. The problem did arise already at the preliminary stage, even before the use of GIS has really started. The problems were of basic nature:

1 the fear of the "unknown" resulted in bad attitude towards the whole idea;

2 the lack of computer experience even deepened these feelings, as it seemed easier and quicker to do things usual way, than "to fight" with computers;

3 the difference between the appearance of paper maps and computer maps was difficult to accept, and was often considered as a proof for the thesis that computer maps are "all wrong". For example the idea of having the names of places in a separate information layer and displayed, was hard to acquire;

4 the data had to be input manually, and the slowness of the process was discouraging; as the Department does not have extra money for data

input, it has to be done by its very personnel, that considers itself as too highly qualified for this sort of work.

In fact almost no institutional changes have been made so far as a result of the introduction of GIS in the Department. Only some people were assigned to new duties connected with GIS. After a few months' period of accustomization, the system is beeing used now in planning.

Another problem of an organisational nature emerged, when the Planning Department tried to get data in digital form from voievodship's Statistical Office in P³ock. These data are processed in Warsaw and voivodship Statistical Offices have data only in unaggregated form, as they do not do any data processing themselves. They can get aggregated data from Main Statistical Office, but only as a printout or they have to pay for them as any other organisation. The initiative has arisen to change regulations in this field to enable the use of ready digital data by different users within administration of voivodship level without charge.

The development of digital map had an important impact on the data resources in the Planning Department. The rigors of computer work forced certain ordering of data, clearing of inconsistencies in records, finding missing information. The main result of the starting phase of a project was improvement in information availability and its proper inventory.

This project was meant to be a starting point for creating more detailed computer maps in towns located in the voievodship. The rationale here was to create coherent spatial databases which would ease communication between planners at voievodship level with those at local level.

4.1.2 Software

There was a problem of choosing the best software. The market for GIS software is well developed in Poland so there was no problem of buying a good system but rather to find an appropriate one.

Since many Polish local and voievodship planning agencies usually have little or none computer experience, GIS software has to:

1 Be easy in use (no typing commands)
2 Be intuitive (GUI)
3 Be customized to the Polish language
4 Have a powerful relational database with built-in Structured Query Language
5 Be multiplatform and expandable in future
6 Have good communication with other existing software since it has to import and export Dbase, Excel, FoxBase, Lotus, ASCII, DXF etc. files
7 Be relatively cheap
8 Have on-line help, manuals, reference books, tutorials etc. in Polish

The package which perhaps best meets these requirements was MapInfo for Windows which eventually was implemented at the regional level.

4.1.3 Local level: Sierpc

When the first stage of creating GIS at voievodship level was finished (i.e. all graphical data were available in numeric form) the next stage of the whole project begun in Sierpc[7] a medium-size town typical for the region. The town provides standard municipal services, including maintenance of streets and pavements, water, sewer, storm pipelines, electricity and gas lines. Property ownership is divided among 4000 parcels delineated on the town's base maps 1:500.

4.1.3.1 The scope of the system

Although it should be recognised that most potential GIS users do not initially know precisely how the system will work and what they will ultimately be able to do with this tool, planners from Sierpc have numerous ideas about its possible uses, and they were really enthusiastic about its implementation. Also

they well calculated their financial resources against the costs of digitising. Several meetings between Sierpc Planning Department staff and IMAGIS, a GIS company, were held to discuss their needs, the availability of data, how the data might be corrected, the possible uses for the system and its future capabilities which could be developed over a longer time. It was decided that during the first stage of implementation parcels and building from the town centre (75% of all parcels and 90% of all buildings) should be digitised. During next stages of implementation the rest of parcels and buildings will be included as well as utility lines and other information. At the moment more than 70 paper maps at 1:500 are already digitised and data base concerning parcel and building is being built.

This computer map of Sierpc town centre was developed as a fully functional pilot project to give the Planning Department staff a fully operational graphic and text databases with advanced graphic display, SQL possibilities for planning and modelling, with easy access to other databases. The staff of the Planning Department was trained and the expansion of the system, with the inclusion of a new information layer and additional attribute data will follow.

Sierpc has taken the opportunity to develop a GIS which is affordable even with today's Poland's economic turmoil, and which is easy to use, expandable, and customized to Polish language. Here the choice was easier to make because MapInfo had been already implemented on higher level and it was working well.

4.2 Local approach: advantages and dangers

In our opinion the implementation of the GIS where it is needed most, without any external pressure, but also without external support has both advantages and disadvantages. We will try to specify them below.

4.2.1 Advantages

Projects at local level:

1. Are more realistic in scope as they reflect needs perceived by practitioners of local planning offices, utility companies, environmental protection etc.
2. Cheaper and faster to implement because information included into digital map layers are only those which are really needed.
3. Are more likely to be successfully implemented in existing conditions (equipment availability, personnel qualifications and attitude).
4. Allow for selection of appropriate software.
5. Will be implemented only by enthusiastic team with sound leadership (given the amount of problems to be overcome).
6 Allow for tailor-made training.

4.2.2 Dangers

The local approach carries also many dangers, resulting mostly from incompetence:

1. Even basic concepts are often misunderstood, for example differences between raster and vector data (the idea of digital map being a product of scanning is widespread in Poland).
2. The choice of software is often incidental, resulting in implementation problems.
3. The financial risk of wrong decisions is high.
4. This approach is characterised by mostly chaotic implementation of different and often accidentally chosen off-the-shelf GIS software by local governments.
5. Transfer of data between various units and upwards the hierarchy may be difficult due to software incompatibility

5 CONCLUSION

We have discussed two models of the introduction of GIS in local authorities in Poland. Although their aim is the same to create a computerised system of data acquisition, processing and management in spatial context - they are fundamentally different. They reflect two rival attitudes towards basic rules of GIS implementation: how, where, by whom and for what sake GIS in administration should be created.

Both local and central approaches have their advantages and limits. Existing experience proves that the best method of implementation of GIS in administration has to involve closer co-operation between local and regional levels rather than integration of activities on higher levels. This cooperation can hardly be incorporated into the centralized model. However where GIS is being introduced spontaneously it was a lot easier to create a teamwork and spirit of cooperation as well as find responsible leaders of the problem.

Even if "standards" of GIS will be imposed or "advised" by Central Agencies, the real job is to be done on local level. Town managers would rather believe and follow the real life examples which work at local level than listen to theoretical considerations about data interchangeability between different levels of administration. It is hard for those who pay for their Geographic Information System (City Councils, Town Managers) to understand why they should first wait for "standardisation" decisions from the higher levels of administration, and then be obliged to give away data collected and be limited in any way in their use by separate institutions like "base GIS units".

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DISCLAIMER

The views and opinions presented in this paper are of the Authors and not of their employers.

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NOTES

1. The distinction is being made here between governmental administration responsible to the parliament and self-governing administration which is elected locally and to some extend independent from the governmental administration. The latter may take over some of the tasks of the governmental administration, in particular where it is necessary to bring some functions down to the lowest level of administration.

2. At the moment it seems that Arc/Info with Oracle is favoured by the central administration.

3. Wegener and Junius (1991) reported on similar process in Germany.

4. Goraj and Zaremba (1993) state that 45% of the area of Poland is covered with good quality cadastral information and that for 14% of the area this information need to be replaced. For 65% of the area it is impossible to create geographical part of LIS based on existing information.

5. Plock region (voievodship) is located in central Poland about 100 kilometres north of Warsaw. Its capital city, P³ock, situated on east bank of Vistula River is inhabited by around 120 thousand people. Area of the whole voievodship is approximately 5100 sq. km.

6. Plock houses the largest in Poland oil refinery as well as a number of pipelines.

7. Sierpc is located in Plock Voievodship, 35 kilometres Northeast from Plock and 122 kilometres north of Warsaw. Lying 500 meters west of E77 road it occupies a land area of approximately 30 square kilometres. Approximate population is 20 thousand.