Gis as a Tool in Local Policy-Making

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Abstract
Geographic Information Systems combine geodata with other types of information and generate maps for better recognition of local problems and more effective solutions. GIS directly supports variety of local activities (land-use and urban planning, economic development, infrastructure, transportation and emergency management, educational planning, tax assessment, environmental monitoring, public information services). Being an expensive technology, GIS needs proper management and organizational support. Uses of GIS and its management were investigated in 15 biggest Polish cities and several minor. Best practices and obstacles for GIS success were presented.

Introduction
Although governments use a variety of information technologies, the use of the Internet has become a key component of enhanced service delivery. No wonder, after all, almost fifteen years of Internet’s public exercise is enough to avail it in the comprehensive manner. However, government web sites are only façade. If this façade is to work fluently, it has to be based on firm grounds. Those are back-office applications, well-developed in public administrations with ICT long and deep experience. Where experience is short and shallow, back-office infrastructure might not fit to bold visions of e-government.

In Poland, strategies of ICT policy and legal regulations determine the standards of Internet use in public information and public services delivery – they don’t refer or refer in a restricted manner to conditions and standards of back-office automation. In the paper, one of the back-office applications is to be discussed. Geographic Information Systems (GIS) are more “sophisticated” and less common tools that MIS (Management Information Systems). Thou, presently they are equally important in public management. GIS can also enrich set of services delivered electronically.

Information resources (both data and technology) play double role in public administration. Firstly, they are strategic assets, regularly managed institutional resources. Secondly, information and ICT are important tools to manage other institutional resources (human, financial, substantial) and achieve internal and external goals. The paper distinguishes the double role of information and ICT in respect to GIS.

Approximately 80% of information collected at the local level of administration is referenced spatially. Therefore GIS technology is the most effective instrument to “capture, manage, and call upon land-related data for solving complex planning and management problems”. The number of local governments that are interested in acquisition of GIS for their jurisdiction is increasing. However that increase is limited by shortage of financial resources, lack of ICT professionals and sufficient knowledge how to use GIS technology in local decision-making.

In the paper GIS is discussed as particular technology in reference to other ICT technologies (Management Information Systems, www technologies) exercised in local public management. Subsequently, organizational aspects of technology – institutional arrangements, cooperation with public and private institutions – will be conferred. The cores of the paper are examples of successful GIS implementation and use in selected Polish municipalities. That is supplemented by some reflections on GIS technology as issue of management. Several obstacles to GIS success are considered.

1 The paper is based on research proceeded by the author in the years 1999-2001, on 15 local administrations in the biggest cities (from 115.000 to 795.000 inhabitants) of Poland.
3 Ibidem.
GIS technology

Geographic Information System is a computer technology that combines geographic data and other types of information to generate visual maps and reports\(^4\). GIS is based on mathematical principles of topology and georelational data structure. The latter “links the location of specific manmade or natural spatial features that can be depicted on map – schools, roads, and sewer lines, for example – in one data base with a companion data base that identifies their characteristics or attributes”\(^5\).

GIS is a set of tools that enable combining digital map with non-spatial characteristics and relationships associated with geographic objects. The latter are described by attribute data placed in databases originally created for MIS. Mentioned tools are:

- Automated mapping technology – manipulating map information
- Database management – managing attribute data
- Land records information – providing the cartographic and attribute data
- Topological data structures – providing definitions of spatial relationships among points, lines and polygons
- Spatial analysis capabilities – retrieving, manipulating and displaying map and location-related attribute data\(^6\).

GIS organizes and displays data in overlapping layers. Combining digital map with particular attribute data generates the following possible layers:

- Zoning layer
- Utilities layer
- Topographic layer
- Parcel layer
- Planimetric layer
- State plane reference grid
- Geodetic survey control layer\(^7\).

The set of layers can be presented in a more helpful way for local decision-makers and administrators. According to their needs layers can be grouped into:

- geodetic reference grid;
- geographic characteristics of an area: elevation, waters, parks, soil, etc.
- land use and owners: residential, commercial, industrial, etc.;
- transportation and communication: various networks within an urban area and links to points outside the area;
- utilities and services: energy, water-supply, sewage, telephone installations, waste disposal, etc.;
- social and economic characteristics: age, employment, income, and other basic demographic characteristics of the population.

The basic feature of GIS is that the system displays the data collected from local databases originally built and still accessible for MIS applications. Those data are constantly updated through online transaction processing. To make them also useful for GIS they are to be processed to “data warehouse” – the system of online analytical processing\(^8\).

The number of map layers that system can generate depends on quantity of data in the data warehouse. Usually, over hundred map layers will do for effective service delivery and management of local community. Although basic layers can be complete, GIS “lives” with reality it describes – new kind of data introduced to the system can be “translated” into new map layers; for example the number of spatial planning layers can be indefinite.

GIS presents complex abilities. The most simple is searching out objects and displaying them. Reporting attributes of locations (cubature, area, fittings, use, users or inhabitants, owner, etc.) is another ability. System can display


\(^6\) W.E. Huxhold: 26-27.

\(^7\) J. O’Looney: 42.

geographic features selected according to defined criterion, or combined criteria. Furthermore, any assortment of map features may be added or deleted. Those are basic operations offered by “static” GIS. More opportunities are given by dynamic GIS model that presents changing conditions of local environment (for example, spread of fire or flood).

GIS would constitute one of the basic elements in local decision support system. Ideally, such system would provide a framework for the integration of database management systems (DBMS), management information systems (MIS), knowledge management systems, as well as applications for group problem-solving. Local DSS would help to analyze complex issues referred to local space (spatial planning, crisis management).

Elaborating GIS, achieving fluency in its use, as well as growing public interest in information generated by the system, made GIS administrators to bring into play WWW technology. GIS browsing applications (for example VistaMap) used so far are being replaced by standard Internet browsers. That opens up abilities of GIS to the broader public9.

GIS institutional arrangements

GIS project is a complex and expensive venture. There are few local administrations that are able to precede it by themselves only. Usually, they need external support from public and/or private institutions. However, proper internal arrangement is equally important, as “without a solid foundation for data maintenance on a regular basis as a part of the operations-level functions of the organization, a geographic information system will not be an effective tool for use by managers and policy-makers”10.

J. O’Looney presents GIS organization as a continuum from “within local government” arrangement to “beyond local government” arrangement11. Early GIS is developed by single department that decides on hardware, software and basic needs supported by the system. This arrangement is frequent in Polish municipalities, where either geodesy department or information systems department deals with GIS. The co-operation between the two is rare, however appears and it is defined by O’Looney as shared GIS dominated by single department. In this particular case “some decisions and access are provided across department lines”12.

More advanced GIS is multidepartmental: decisions on system’s development are guided by interdepartmental group and the system is managed by separate department. This arrangement has been observed in Bydgoszcz municipality where the goal-oriented team had been appointed to prepare and accomplish GIS project. Public enterprises (transport, water-supply, heat, gas-works, etc.) and services (medical, police, fire departments), as well as regional authorities were invited to participate in costs and decision-making concerning the system13.

Multi-agency GIS is characterized by shared costs and responsibilities. Several units of local government or nonprofit group are responsible for maintenance of the system. This arrangement is present in Krakow municipality where goal-oriented communal enterprise has built the system, manages it and delivers related services either to public or private entities. Also the GIS project was an effect of broad co-operation between geodetic services, municipal and regional authorities. In the contract signed in 1993, Krakow Mayor and governor of the Mlopolaska region committed themselves to participate in GIS development14.

O’Looney presents one more option, previewed – in 1997 – as future GIS organization. Public-private multi-agency GIS is based on more than one unit of local government or nonprofit group and one or more for-profit groups. Account shortages in local budgets, growing demand for geographically-oriented information (real-estate tax) and opening-up of public services for competition, makes public-private partnership very attractive for local managers. Recent regulations on PPP open up also this option for local government in Poland.

Organizational context of GIS heavily depends on national regulations concerning maintenance of geodetic resources. In Poland, those resources are state-owned; however their preservation is commissioned to local administration on provincial and regional levels. Those cities that perform duties of provinces (they constitute one – communal and provincial – government) are to uphold geodetic resources either. According to national regulations, they are obliged to build and maintain GIS, therefore they have no other way than either create dedicated unit or give one department responsibility for implementation and management of GIS. Obviously, those local governments – on communal level – were not commissioned geodetic tasks don’t feel forced to undertake activities concerning GIS building, that doesn’t mean that they stay idle. Number of urban communities build their GIS, mass of rural communities – don’t.

Decision on GIS adoption – if not forced by the law – depends on three main factors:

1. accessibility of financial resources

9 Ibidem.
11 J. O’Looney: 19.
12 Ibidem.
2. accessibility of expertise
3. expected benefits.

In rural communities and best part of urban all three factors are restricted. Competing demands and limited resources often prevent GIS building, even in big, well-off, urban communities. Therefore, local authorities welcome any declaration of cooperation that come from other public institutions, especially if it brings additional financial resources. Such cooperation requires the establishment of legal contracts for sharing costs, quality assurance, internal control standards and degree of access to the system each partner has. At present, joint ventures are the most common way of organizing institutional environment for GIS adoption in Poland.

GIS as supporting tool for local management

Before getting maturity, use of GIS in local administration was limited to “map query”. The most frequent applications were to display the location of spatial objects that respond to specific criteria or report the attributes of selected geographic features15. Even then, however, GIS proved its usefulness in activities not directly related to principal goals of the system. The system, due to its capacity of linking data from different sources, contributed to maintenance of data integrity. Through day-to-day operations, GIS can verify reliability of information managed by variety of departments, constituting at the same time “centralized framework for integrating databases”16.

The nature of GIS as supporting tool for local management is placed in its ability to integrate data horizontally across the organization (tax records can be related to business activity’s records) and vertically up the organization levels (tax assessment data can be summarized by aldermanic district)17. Therefore, GIS supports different types of activities performed by local councils, decision-makers and civil servants. Those activities range from decision-making, through implementing to monitoring the results of decisions. Or being more specific: problem-solving, planning, managing, service delivery and control.

GIS usually have positive impact on organizational decision making, as it eliminates data redundancy and facilitates a systemic approach to problem solving. GIS ensures accuracy of the data and presents information in user-friendly format18. “For the most part, public sector policy makers are required to analyze problems that are presented as a narrative or as a series of numerical tables” 19. Though, frequently, problem can be better understood if visualized on a map.

Visualization assists exploration and in this respect GIS supports local planners who can test any idea by “alternately tightening and relaxing conditions and assumptions”20. Many factors can be included in analysis (soils, property ownership, land values, topography) to compare alternative sites or routes for new infrastructure. The same can be analyzed by council committee that makes preliminary choice and recommends it to the whole council. In this respect, visualization supports communication from policy group to decision-making body. After the final decision is made, it is communicated to the public. Gaining public support for new project can also be supported by GIS-generated expertise.

GIS improves service delivery reducing response time for processing requests. The most direct effect is observable in maintenance of land record and delivering related services. In Krakow municipality, GIS improved efficiency of servants updating the record by 15%. Land record is also linked to personal record and corporate bodies’ record. The link is used in property transactions, making them quicker and more reliable21.

Through its easy access to data, GIS can stimulate improvements in the performance of local government tasks. The latter are wide-ranging. Indeed, it is hardly to find out any local responsibility that couldn’t – directly or indirectly – be supported by GIS use. GIS applications spread across the following duties22:

- land-use and urban growth planning
- economic development
- infrastructure and transportation management
- health care

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17 W.E. Huxhold: 23.
18 J.L. Brudney, M.M. Brown: 86.
21 A. Pawłowska: 211-212.
22 J. O’Looney: 4, 60.
In the following part, examples of GIS use in several mentioned fields will be presented. Those examples originate from activities of local administrations in Poland, mostly placed in big cities.

Land-use and urban development planning. Those activities, although named as first, are only recently being supported by GIS. System has to get a certain grade of maturity to be used for land-use planning. However, it can help planners “consider, understand, and manage” such aspects of urban development as:

- the density of development in relation to the existing and planned infrastructure
- distances between land uses: residential, commercial and industrial zones
- the network of auto routes and sidewalks
- land for green space or parks
- land to be left undeveloped or set aside for various uses
- preservation or development of neighborhood integrity, safety and communication
- preservation of historic sites and sacred places.

Land-use planning and urban development frequently cause social conflicts concerning facilities location residents consider undesirable. Usually several subjects are involved in the conflict: local government, group of residents, a developer and sometimes one or more interest groups. Each of sides of the conflict may use GIS to support its idea to locate or not locate facility in defined place. As it is assumed, for GIS provides objective, not partisan information, its use can help to resolve or minimize social conflicts. Furthermore, it is assumed that there is an objective reality on which all parties can agree. This assumption – however – might not be accurate. Every party would exhibit different side of information, stressing diverse aspects of the problem. Local government is interested in efficient service delivery that would suit local community and minimizing related social conflicts; residents want facility far away from their neighborhood to minimize inconvenience and possible downfall of their property value; a developer is interested in locating facility in area that provides the least cost and most benefits; interest groups stress those aspect of facility location that reflect their particular views, knowledge or interests. More and better information doesn’t necessarily mean enhanced conflict resolution. It only means that parties have extra “weapon” to fight their interests. Therefore, I believe that neither GIS nor any other information technology is particularly helpful in resolving social conflicts or in winning the public for particular land-use projects.

No matter how discouraging that account might be, it doesn’t neglect utility of the system for local planners that is proved by every case of GIS in investigated cities. Everywhere the GIS occurs it includes number of map layers displaying land-use plan.

Nice example of GIS use in historic sites preservation was found in Zabierzow – small community in Małopolska region, where archeological spots were discovered. Quite frequently new building sites result in archeological discoveries. Remains of aged sites create “underground landscape” that is to be preserved as national heritage. However, it also has to be taken into account when planning new constructions. GIS enriched with information on archeological remains may greatly support local planning and decision-making.

23 Ibidem: 91-92.
GIS is also exercised to preserve the unique landscape of the city (GIS can also present physical objects in three dimensions) that was experienced in Szczecin municipality.

**Economic development.** GIS technology is frequently used as a tool for attracting new business. Usually it concerns site location. Many industries and services look for areas that have developed some special capacity regarding certain business-related functions. GIS expertise can present convincing displays of demanded capacity; it can provide accurate, timely and user-friendly information on desired locations. Indirectly, GIS is an evidence of innovative local government that is also considered by business managers.

Due to suitable institutional arrangement[^26], GIS in Krakow can deliver commercial services to corporate identities earning money for its maintenance and for local budget. The following principles of payments for GIS services were established:

1. Services delivered to central and local administrations participating in GIS contract[^27] and are indispensable for performance of their duties are free.
2. Communal enterprises cover 50% of costs.
3. Private persons and corporate bodies cover 100% of costs[^28].

Beside standard GIS services, for which price list is established, exceptional services can be delivered. The price for those is negotiated. Such exceptional services have been already delivered to corporate bodies, such as General Motors, BP and Motorola; of those, BP developed the net of stations and Motorola established its factory in the city.

**Emergency management** – is the most frequent goal of GIS declared in local projects. GIS uses can range from simple displays showing where stormwater will go, where the nearest hydrant is, what’s the best route to get to accident – to animated displays of how a storm, fire or flood will proceed under various circumstances. GIS “can direct emergency management responses based on a previous assessment of areas and resources that need protection”[^29]. In particular, GIS can be applied to the following activities:

- positioning of potentially dangerous objects (gas repositories, chemical factories, etc.)
- identification of threat
- identification of endangered area, nature of threat for people and property
- defining preventive actions
- identification of scale of resources indispensable to fight danger
- planning of emergency action
- cooperation with monitoring systems
- simulating emergency situations and activities for training.

In Poland, the most grave and the most common emergency situations are floods. Every year, number of big cities is subject of rivers’ overflow. Some local authorities make attempts to prepare both emergency services and population to possible threat. Rzeszow municipality prepared animated GIS model of nearby river overflow, visualizing those sites that would possibly be flooded by growing wave of water. The system demonstrates:

- objects that, if flooded, might cause danger for people and environment
- people and property that have to be evacuated
- organizational units responsible for emergency action in specific neighborhoods.

Static, however equally useful information can be generated by GIS in Szczecin that had already been working long before 1997, the year of “catastrophic” floods in Northern Europe. Szczecin is placed in almost a mouth of Oder River. Emergency services decided to base their preparations for possible flood on GIS expertise. The number of map layers

[^26]: Auxiliary communal enterprise (gospodarstwo pomocnicze) is organizational unit “extracted” from local administration but still controlled by local government; its income goes in half for its maintenance – in half to local budget.
[^27]: See the following section of the paper.
[^29]: J. O’Looney: 73.
was generated, demonstrating different natural circumstances and possible options of emergency actions. Fortunately for the city, it wasn’t flooded; still we are unable to evaluate the results of such prepared emergency management.

Particular emergency situations might occur in Silesia region that is coal-mining area. Besides frequent underground emergency situations, there is high possibility of crump that applies to people and sites on the ground. For this reason, as well as for possible, more “ordinary” emergency situations, Dispatcher’s Office (DO) has been established in Bytom. That office is an organizational unit of municipal venture – Geographic Information Center. The Center is responsible for utilities management, local roads, transport and lightening management. For rich hardware and software of the Center, also DO had been placed there. However, in the future the Office will be transformed into Provincial Center of Emergency Management that is demanded by law and applies to every provincial administration. DO uses only the part of GIS – so called “emergency map” demonstrating information on “events” that disturb life in a city. Those events are: accidents, utilities’ failures, fires, natural disasters, but also scheduled repairs. DO records event data and automatically informs responsible services. Progress of event and emergency action is systematically notified in the system. Responsible services can be either passive or active users of the system (authorized or not authorized to enter new data). DO applies also Internet communication, especially to inform the public on: DO’s activities, preventing threats, emergency and rescue procedures, resuscitation.

\textit{School districting and educational planning}. In 1996, the reform of school system had been initiated in Poland. Instead of existing two levels (8-years’ primary school and 4-years’ high schools), three levels (6-years’ primary school, 3-years’ grammar school and 3-years’ high school) were introduced. Simultaneously, local authorities took over responsibilities relating schools’ management. Hitherto 8-years’ primary schools were to be divided into two levels. Number of circumstances was to be taken on account in deciding if school was to stay primary or had to be converted into grammar. In Szczecin, the process was effectively supported by GIS. Map of school districts was correlated with population record. Age of pupils living in a district was determined. If they were in majority between 7 and 13 or earlier, primary school was established. If pupils in majority were after 13 or were about to reach that age, authorities decided to place grammar school. Analysis made by the way of school system reform revealed new educational needs that could be faced by local authorities.

\textit{Tax assessment}. A very important source of local income is real estate property tax. In majority of cases, it is tax ad valorem. This is still absent in Poland but right about to be introduced. Tax assessment necessitates reliable, complex and instant data. Such data is delivered by GIS. In many instances, local administrations exhibit their achievements in building their land records and related GIS layers. Zgierz municipality (56 000 inhabitants) started to create its GIS already in 1990. Exceptional were early attempts to relate GIS with databases managed by other public institutions (police, judiciary), constructing electronic land and mortgage book and creating Real Estate Center. The center would integrate all information and functions related to real estate property tax. Due to electronic connection with notary offices instant information on proprietors and mortgages is accessible.

\textit{Site selection and environmental monitoring}. As already has been mentioned, local authorities frequently face problem of balancing variety of competing interests. Environmental protection is often in conflict with efficiency and equity. Public managers learn that “maximizing economic or environmental efficiency alone will not result in successful management of locally unwanted land-use (LULU) issues”. Therefore, Gdansk municipality decided to stress environmental issues in its GIS in upcoming years. Therefore, the following information is being included into the system:

\begin{itemize}
  \item decisions concerning environmental protection (for example on landfill sites)
  \item record of water contamination
  \item record of permissions concerning contamination
  \item air-pollution monitoring
  \item measurement of noise volume
\end{itemize}

30 A. Dobński (2000): „Wykorzystanie zintegrowanego systemu katastralnego przez miejskie centrum dyspozytorkie”, in J Śląskie Forum GIS. Zasilanie i wykorzystanie SIT w praktyce zarządzania kryzysowego, Katowice: 41. Provincial Center of Emergency Management is an equivalent of “911” in US.
31 Ibidem: 45.
measurement of volume of electromagnetic field

record of natural objects.

The very part of environmental information will be presented to the public through municipality’s Internet site, as already has been done with many of existing 110 map layers of GIS34. Location of highways close to resident areas is a very frequent cause of LULU conflicts. The project of Wroclaw’s beltway raised strong objections of local inhabitants and ecologists. Authorities decided to study more carefully the problem using combined GIS and modeling technology. Simulations concerning traffic intensity and respectively volume of noise and smog dispersion were made. Respective threats for local population were analyzed35. Gathered information became a good point of starting public discussion on issue.

Public information services. It is emphasized that GIS delivers reliable and instant information. Consistency and competence in customer services is valued highly by citizens and corporations. GIS also supports “G2G” communication and data interchange. Usually, three groups of GIS-users are distinguished:

1) public institutions, that can be either passive or active system-users, but always they are basic users of GIS. System is exercised by variety of administrative levels and public facilities; they have an access to the system through intranets or Internet; they use the system in its entirety or only its defined part

2) business – corporate users of GIS, that have restricted access to the particular part of the system, on the basis of legal contract; an access is through Internet

3) local community – all others that need geographic information on the locality; not restricted access to only a piece of GIS services; in several cases, system would proceed administrative services to the public directly and completely through Internet36.

It is important to note that demand for GIS information and services has increased for last decade due to growing number of transactions on real estate market. For example, in Lodz there are 85.411 plots and 176.770 proprietors. Any legal action related to land property demands one or more administrative operations. In the years 1995-2000, almost 100% increase of GIS services delivered to other institutions and to the public had been observed in the Land Record Department of Lodz municipality37. Hardly to imagine, how 112.000 operations could be performed yearly, in a reasonable time and acceptable costs without ICT support.

The use of the GIS information by broad public might also pose unexpected problems. Public goals that are to be supported by GIS are not quite predictable; by now, they have neither been regulated by law. An important issue is citizens’ access to information and privacy. Certain combinations of publicly accessible information may allow to discover who owns what, who is paying what taxes on what land, etc. "Information so easily collected becomes attractive to commercial resellers of data38.

Another issue is legitimacy of information generated by personal computer on the basis of data provided by local administration through Internet access. Polish administrative code does not recognize such information that only means considerable changes should be made in legal regulations. The standpoint of courts is also clear: electronic information generated by private person even if based on public information cannot be evidence to the court. And this is an issue even for more ICT advanced administrations and legal systems39.

The partial answer for above troubles is legal liability for providing faulty information. It is a complex issue for local government, as it cannot refuse access to public records that are assumed to be true but they can either be false. Generally, public institutions are responsible for accuracy of information they manage, though errors are frequent as records are numerous, gathered for different purposes, by different institutions and citizens are “mobile”. Therefore, limited liability is applied to public institutions.

38 J. O’Looney: 116-117.
The way every-day activities are performed by local administration build image of local government and its office, in effect increasing or dropping its competitiveness. Satisfaction of citizens, raise in local entrepreneurship and flooding investments are in considerable extent dependent on the way local administration is working. Therefore even small steps in augmenting administrative effectiveness by the use of GIS cannot be ignored.

GIS as object of management on local level

GIS is perceived as an expensive tool, inaccessible not only for small and modestly financed communities, but also for bigger and better well-offs. However, old, new and expected regulations concerning land management, real estate tax and contemporary standards of local policy-making, make GIS essential for local governance. Therefore, an issue of GIS management is fundamental for its future successful applications.

GIS project is not much different than other ICT projects. The difference is that it relies in more considerable extent on data that is gathered in traditional way, i.e. geodetic measurements that are still carried out “manually”. It is estimated, that hardware and basic software costs represent only 20 to 40 percent of total cost of GIS. Other costs are mentioned measurements, converting traditional maps and data into electronic format or eliminating data disparity.

O’Looney distinguishes three dimensions of GIS development:

1) **Technology:**
   - Development in GIS analysis and display capabilities
   - Development in the usability of GIS
   - Development in the cost-capability ratio
   - Development in the accuracy of GIS

2) **Administration:**
   - Development in how GIS data are collected, organized, and shared
   - Development in GIS skills
   - Development in subject matter skills and understanding

3) **Policy:**
   - Development in how to use GIS to assist analysis, visualization, management, and policy development
   - Development in the public ethics of using GIS

Three dimensions of GIS development should be reflected in three stages:

1) **GIS long-range planning**
2) **Gaining organizational support**
3) **Managing the GIS project.**

*GIS long-range planning* should reflect consistency of the project with organizational goals. It is to identify geographic information needs and potential applications: all functions of local government should be analysed to determine those which can be effectively supported by the system; no task that can be better accomplished is to be passed over in a project. Functions are connected to respective facilities, i.e. physical and legal objects located throughout the jurisdiction. Project should identify and include those objects; objects allow identifying information or evaluating of existing geographic information sources.

There are two illustrious GIS projects in Polish local administration concerning the long-range plan of their accomplishment.

Already mentioned GIS for Krakow had been preceded by in-depth analysis of local needs, based on extensive survey. The survey had been sent to all offices of local administration, communal enterprises (facilities), number of units of Jagiellonian University and Technical Academy, revenue offices, police units, geodetic bureaus, architectural and urban planning bureaus, and banks. They were asked if they are interested in GIS services; what kind of information is of their interest; what kind of information they are ready to make available to GIS. After analysing the results of the survey, the following map layers were distinguished as the most desirable: streets and buildings, real estate property, spatial plan.

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40 J. O’Looney: 10.
41 Ibidem: 27.
infrastructure, other layers depending on particular features of respondent\textsuperscript{43}. The main users of the system were identified – they agreed to fund GIS development and in effect transferred over 2,1 mln PLN (437500 EURO) for GIS project accomplishment\textsuperscript{44}.

GIS in Lodz had been included in complex strategy of Integrated Information System of Lodz Municipality. It is not a separate project but integral part of extensive process. This solution enabled to unite resources, efforts and municipal structures for more effective and efficient process management. No separate goals of GIS were discerned, however long-range objectives were outlined\textsuperscript{45}:

1) **Well-served citizen:**
   - improving administrative services
   - cutting the time necessary to serve the citizen
   - constant information on local offices work
   - secure city

2) **“Healthy” budget:**
   - alternative budget planning
   - efficient tax exacting
   - efficient local revenues and expenditures control

3) **Efficient local management:**
   - current, synthetic information on the city
   - cross-sectional analyses for better decision-making
   - supporting local development
   - supporting correct functioning of the city
   - cutting the time of data transmission between local units
   - cutting the time of decision-making process.

Above project had been accepted by local council in 1997. It was expected to be accomplished in three years with a cost of 11 mln PLN (2,3 mln EURO). Accomplishment of the strategy was based on the following principles\textsuperscript{46}:

1) Dividing strategy into stages
2) Defining those functions of municipality that can be integrated and than based on common information system
3) Defining those functions of municipality that are to be based on local information systems
4) Making use of already existing information resources (hardware, software, networks, and data bases).

Also minor local communities decide to build comprehensive GIS projects, as have been done in Raciborz (63.000 inhabitants). Decision on system construction had been made in 1996, in agreement between local and state authorities. GIS strategy was divided into six stages:

1) needs’ assessment
2) working out of general project
3) working out of prototype applications
4) testing and correction
5) working out of final version of the system
6) implementation of the system.

Already in 1997, two detailed analyses were delivered: “Users’ Requirements” and “General Project”. Both documents applied to land record layer and spatial plan layer of GIS. Hence, project has been started with digitisation of the information most useful for local community\textsuperscript{47}.

\textsuperscript{43} A. Pawlowska: 209.
\textsuperscript{44} “Systemowy import informacji”, Wspólnota 1999, No. 15: 13.
Gaining organizational support. Organizational support concerns:

a) support of local decision-makers
b) support of local enterprises
c) support of local public servants

The easiest way to obtain approval for GIS project from local decision-makers is to demonstrate “that the benefits of using the system will be greater than the costs of implementing it and then supporting it year after year. This can be accomplished by performing a traditional cost/benefit study (...)”\(^{48}\). Cost/benefit study related to GIS project is particularly difficult comparing to studies related to other ICT projects. Initial costs of building GIS are exceptionally high, while benefits are remote, dispersed and generally difficult for estimating. Number of benefits is qualitative, not quantitative and some of them are indirect.

The most difficult to estimate are the costs of converting GIS data from one format to another. Furthermore, costs of creating the digital base map of the jurisdiction are the most significant – they might range from 45 to 80% of total costs\(^{49}\). Initial costs, i.e. costs of creating and implementing GIS, are the highest in first years of GIS building. The costs of maintenance and management of the system are evenly divided throughout years of GIS implementation. About 20% of all GIS costs bear yearly after completing the GIS project refer to development of the system, servicing and users’ training, other 80% is modernization of hardware and software\(^{50}\).

Benefits can be grouped into the following categories\(^{51}\):

- cost reduction: the decrease in operating expenses of administration, primarily caused by savings in time as civil servants perform their tasks more efficiently. It is estimated, that departments operating directly geographic data, after three years of using GIS, save approximately 50% of time for their routine procedures. It is also estimated, that overall savings of local administration resulting from GIS use range from 10 to 12 %\(^{52}\);
- cost avoidance: the prevention of rising costs in the future caused by rapid growth of jurisdiction and local government functions;
- increased revenue: receiving additional revenue from selling data and maps, increasing property tax collections and improving the quality of data used to apply for EU grants.

However, even precise and convincing cost/benefit study doesn’t change the relatively long (app. 10 years) payback period of GIS. It is simply not convincing enough for local decision-makers who face more pressing local needs that have to be satisfied each year. Besides, their term of office is much shorter, why should they invest in the system that will bring results for their successors in the office? W.E. Huxhold suggests that GIS project’s promoters should present simulation of the costs of running local government without using a GIS to the costs of running local government with a GIS. The difference between the two is the profit of a GIS\(^{53}\). Quantitative benefits should be amplified by pilot project that would demonstrate qualitative benefits.

Costs of the GIS building and implementation exceeding local budget abilities can be also covered from other sources, as grant from central government and/or co-financing by communal and private enterprises. Especially agreements with communal enterprises are favourable. Usually they are ready to transfer some financial resources as well as make available important GIS data. In return they obtain free access to the map layers of their interest. This methodology of data and finance collection was exercised by such municipalities as: Bydgoszcz, Katowice, Lodz, Szczecin, Wroclaw\(^{54}\).

In some cases local GIS project is being accomplished through agreement with state official in the region (wojewoda). As geodata belongs to the state, it is quite important to manage GIS in accord with governmental expectations. Such close cooperation between local and regional authorities was performed in Katowice, Krakow and Wroclaw.

Close cooperation between different levels of public administration is desirable in big cities that exercise duties of both communal and provincial level of public administration (the latter is responsible for geodata management). What about minute communities that are not forced by law to have GIS or to manage geodata? Frequently they want to develop their GIS to better manage local matters but neither have expertises nor money to do so. Some of communities look for


\(^{48}\) W.E. Huxhold: 241.

\(^{49}\) Ibidem: 242.


\(^{51}\) W.E. Huxhold: 244-245.

\(^{52}\) J. Woźniak: 186-187.

\(^{53}\) W.E. Huxhold: 250.

\(^{54}\) A. Pawłowska: 191, 203, 219, 246, 258.
assistance from academics. Those are also interested in such collaboration as it gives them the field for empirical or experimental research. Already mentioned community of Zabierzow used such opportunity and signed in 1994 an agreement with Technical Academy in Krakow to build jointly local GIS. This project was then included in regional project of GIS building as guide GIS project for small and medium communities55.

It is important for every ICT project to gain the support of organizational staff. The range of GIS use depends on how well civil servants understand the technology and its role, and how the institution adapts to new sources and types of information. Practice shows that GIS benefits are not necessary inevitable. Institutional and human barriers can prevent the realization of performance and efficiency benefits56. Therefore high quality management of GIS project is essential for GIS success57.

Managing the GIS project. The most frequent hindrances in GIS implementation in Polish local administration are:

- unfitted organizational structure, especially of those departments which tasks can be implemented with better support of GIS – often abilities of the system are greater than institutional needs;
- users’ difficulties in defining expectations from the system that further makes difficult determining the range of future GIS functions – the latter might be either too simplistic or too complicated;
- deficiency of clear administrational procedures that makes impossible proper adjusting of GIS operations to requirements of final users;
- dispersion of administrative procedures that makes difficult their description;
- lack of standards and software common for whole public administration in Poland58.

It seems quite obvious that obstacles of GIS success in Poland are mostly of organizational nature – they are neither technological nor human. Even financial constraints recede into the background. Therefore the prime aim of GIS managers should be preparing and performing institutional change for better “technology consumption”. Administrative procedures are to be described and put in order; if necessary, structure is to be reorganized to make clear distribution of responsibilities between institutional departments. Already long ago it had been stated that ICT petrifies structure in which it has been introduced59. Therefore it is indispensable to “put institution in order” before GIS implementation.

Not established software and data standards are usual sources of data incompatibility problems. Those, in turn, limit the amount and type of data available for analysis by the GIS60. This variable is beyond control of GIS managers who can only lobby for appropriate regulations. Recently, government announced that regulations concerning electronic cadastral system (including geodata) would be issued and effective on January the 1st 2005. Possibly, software and data standards will be regulated there. For sure, standards will be normalized in law on informatization of public institutions that is being under way in Polish Parliament.

In the absence of universal standards, it is important to recognize those managerial activities that support GIS success. Those are:

- declaring implementation mission and goals
- management leadership, commitment, and support
- planning/scheduling of GIS implementation
- securing continuous flow of financial resources
- involvement of users in GIS implementation design
- preparation for change
- selecting user-friendly equipment
- ensuring GIS-related communication
- providing access to GIS consultants

57 First GIS project implementation in Lodz before 1996, which ended up with total failure, is a sound example of effects of wrong ICT project management. In A. Pawlowska: 218.
60 M.M. Brown: 195.
Conclusions

Since 2002, the project of public access to public information and services through Internet is being accomplished in Poland. Since July the 1st 2002, every institution of public administration was to have its web site with information determined by legal regulations. Majority of local governments managed to activate their web sites; many didn’t. In this “trendy ride for Internet” nobody asks: what’s behind? For majority of local communities, especially rural – there is nothing; behind Internet site, virtual space is empty. Communities have no information in electronic format or electronic tools to support day-to-day administrative activities. While front office is in an information age, back-office is still in industrial. E-government in Poland will soon face barrier of its development – no access to back-office data and procedures as they still would be in traditional, not electronic format. In many cases, building GIS is not an imperative; many communities will do without it for next couple of years. However, local decision-makers should prevent the situation where absence of GIS is a major impediment for effective local policy-making and e-services.

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