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THE USE OF GIS IN URBAN PLANNING

INTRODUCTORY TRAINING WORKSHOP

TRAINING MATERIALS

Volume 2: Urban Planning and GIS: Implementation Issues

Contents:

2. IMPLEMENTATION ISSUES

2.1. Introduction

With the dramatically evolution of information technology urban planners, policy makers, and citizens now have more powerful means and analytical tools to study, monitor, analyze and visualize spatial data, plans and alternatives futures for their cities. Over the last four decades, expensive, fragile, remote and hard-to-use big and slow (mainframe) computers, with limited abilities, have been replaced by small, inexpensive, and easy-to-use desktop computers, with relevant supported devices, that get faster, cheaper, more powerful, and easier to use every day. The development of fast, high-resolution, true-color display and output devices has spawned spectacular advances in GIS technology and visualization techniques. Equally dramatic improvements in the capacity and speed of data storage and communication devices, from local area networks (LANs) to the Intranets and World Wide Web (Internet), have made a wealth of digital spatial information readily available to practicing planners in the smallest planning Organization, agency and firm.

The introduction of computers into planning is a part of a more fundamental transition from the profession's traditional concern with the design of the physical city to a new focus on the quantitative techniques and theories of the social sciences. Planning has become a rational process that applies scientific knowledge and techniques to the management of public affairs and the design of activities, flows and land uses.

The dominant perception of planning changed from an image of "planning as design" to "planning as an applied science".

The "applied science" model defined rationality in instrumental terms as finding the best means (technology, actions, policies, etc.) for achieving desired ends, and planning as an iterative process (see relevant diagram 1.2 for ideal planning process) of defining problems, identifying goals, generating alternatives, and evaluating available alternatives with respect to designated goals. Computers and more specific GIS technology plays, unambiguously, an important role in this task by collecting and storing the required data, providing systems models that could describe the present and project the future, and helping to identify the best plan from the range of available alternatives.

GIS is a central component in the world's environmental information structure, and it will continue to play a primary role. These systems are a main component of information technology, which creates new communications environment, new rules in our work and sets new standards in productivity, and these create **new inequalities**, the inequalities of information age:

> *The gap between the "Have" and the "Have-Nots" of the information world is increasing; there is a huge difference between the information capabilities and wealth of the developed Western world and that of Developing World. The gap should be closing, not becoming wider. Developing nations need good, reliable information for survival and progress* (Prof. Davis B. , 2001)

Therefore it is more than obvious that we have to speed-up our efforts for importing and using this technology in our functional working environment, and this not only because it is the new, the modern and the "must", but mainly because is the only way for emerging the new inequalities.

2.2. The process of developing a GIS project

The opportunities offered by GIS technology in many ways represent a challenge to traditional institutional structures, organisational roles and urban management practices.

Advantages of using GIS

- Attainability for a continuous planning process,
- Broader field for planning applications and potentialities,
- Ability to provide many alternatives plans,
- Simulation and scenario construction,
- Better data accuracy,
- Better visualization capabilities,
- Easier process for updating the data,
- Better potentialities for an "in-depth" spatial analysis,
- Better monitoring capabilities,
- Integrated data-management environment,
- Better and more organized archives,
- Ability for temporal archives,

  and more … and more …

- **Support the decentralization process.**

Challenges in using GIS

The use of GIS, within the Municipal functional / working environment, requires the following changes and supporting actions:

- Functional changes in the working environment (new organogram),
- Having GIS competent employees in the municipal organization and competence among users and partners in the organization
- Financing of hardware, software, data collection and operation
- New legislation framework for data handling and publication,
- Standardization of GIS data
- Coordination between the different administrative levels (Local, Regional, State, planning, cadaster etc), within the municipal organization (urban planning, building, infrastructure) and between the municipality and its consultants in urban planning
- Establishment of a continuous (lifelong) training process,
- Establishment of a continuous update process (S/W & H/W),
- Modernization of data acquisition methods (GPS, satellite images, etc),
- Better Telecommunication infrastructure (broadband).

GIS, anymore, is not a simple software but it is the core of an information environment for supporting decision making and planning process.

In general, a GIS for Urban Planning (or Urban Information System) has to include (offer) three distinctive usage levels:

Database management

- Data acquisition,
- Data checking,
- Data transformation,
- Data update,
- Accuracy levels,
- Open source.

Spatial analysis, monitoring and decision Support

- Data development and utilization,
- Specialized applications,
- Urban monitor, analysis and planning,
- Networks monitor, analysis and planning,
- Planning and management of Municipal properties,
- Planning and management of building permits process,
- etc. …

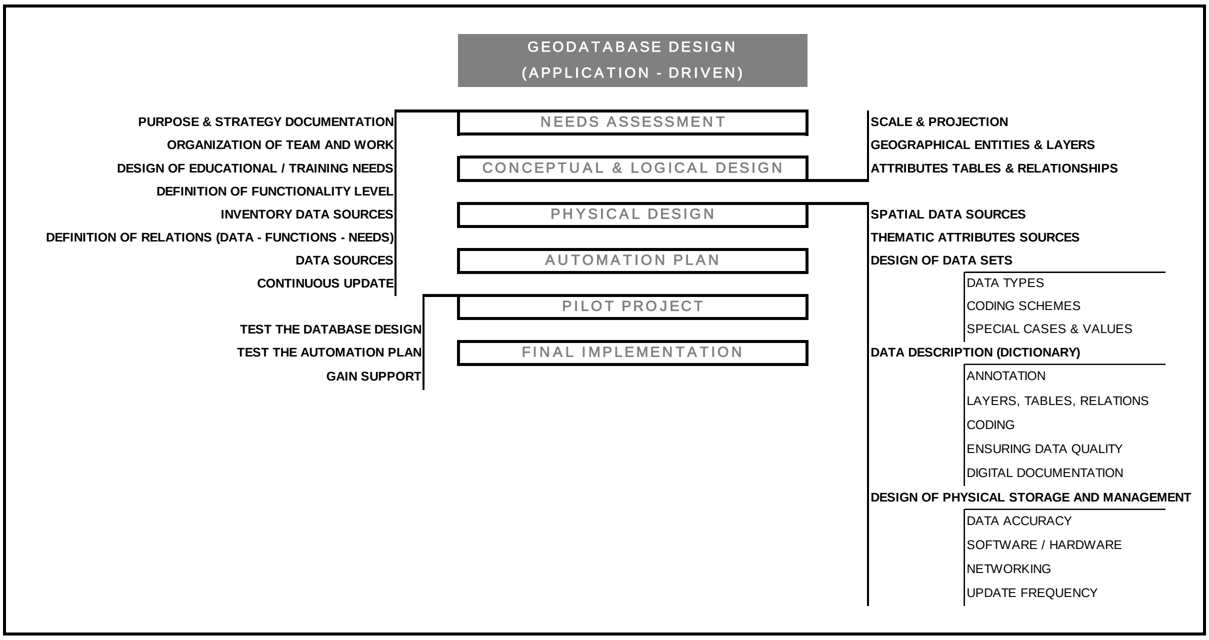
Information

- Thematic outputs, such as: maps, tables, figures, etc
- Special outputs and applications: Internet applications and data.

A typical scheme of developing and implementing an Urban Information System is sketched out in the following table:

- ✓ Feasibility Study,
- ✓ Concept design,
- ✓ Development of a "Pilot application",
- ✓ Improvement of Awareness,
- ✓ Personnel Training,
- ✓ Extended development and implementation,
- ✓ Continuous data and system update process,
- ✓ Modernization of functional framework,
- ✓ Political support,

Additionally, the following diagram presents an alternative approach with more detailed methodological steps and issues.



Source: ESRI

All the above issues are crucial factors for defining technical specifications for implementing a GIS environment within an Organization, as a Municipality is.

Therefore the technical specifications have to describe in detail and to provide information about the next three distinct phases of developing and operating a GIS:

INPUT

- Digitization process of necessary data (accuracy level, etc.), and/or
- Provision of necessary digital mapping structures,
- Data input from existing and new urban plans, topographical/cadastral projects, existing/updated map sheets, aerial photographs, satellite images, etc.
- Data compatibility (input/export from/in different format)
- Non-graphical data input, such as arithmetic or textual tables, etc.

PROCESSING

- Data structure definition (with spatial or not reference),
- Database development and data coding,
- Editing process for graphical and not-graphical data,
- Mapping processing abilities,
- Cartographic transformations – representations,
- Analytical abilities,
- Visualization abilities,
- Specialized applications

OUTPUT

- Mapping creation process automation (dynamic way, outputs, devices),
- Tools for mapping synthesis (labels and annotation handling, etc.),
- Reports and charts creation,
- Internet publication (formats and abilities).

2.3. GIS creation practical issues

As a general – typical rule, first we create the geometry and then (or in parallel) we create the thematic information.

GENERAL PRACTICAL STEPS

- DEFINITION OF PURPOSE & NEEDS ....(for whom and why?)
- RESEARCH FOR PRIMARY SOURCES .... (what exists?)
- CHOICE OF MAPS' FORMAT..............................(Raster, Vector or both?)
- DATABASE DESIGN...(What I really need?)
- DECISION UPON BASE MAPS...................... (Compatibility, needs' cover)
- DEFINITION OF LAYERS ....(overlays)
- PROCESS ORGANISATION...(How?)
- CREATION OF LAYERS ....(Entities choice)
- THEMATIC INFORMATION ....(Attribute tables)
- SPATIAL ANALYSIS & THEMATIC CARTOGRAPHY ....(Information)

CREATION OF A VECTOR LAYER (MAP)

- DEFINITION OF SPATIAL ENTITIES......................(poly, lines, points, etc)
- DECISION UPON TOPOLOGY .... (polygonal, linear, point, etc)
- DIGITIZING..(rules)
- GEOREFERENCING... (tics / control points)
- EDITING, ERROR CHECKING..(accuracy)
- LABELLING ....(increase readability)
- CODING SYSTEM..(IDs, primary info)
- TOPOLOGICAL RULES ....(spatial relations)
- EDITING, ERROR CHECKING.......................................(topological rules)
- FINAL GEOMETRY ....(or initial?)
- CREATING OR JOINING ATTRIBUTES .... (database operations)
- EDITING, ERROR CHECKING, ELABORATION ....(Compatibility between geometry and thematic attributes)
- FINAL DIGITAL MAP LAYER ....(shape, geodatabase, etc)

2.4. Needs assessment and requirements analysis

When a municipality plans to establish or develop its GIS technology it has to assess the needs and its realistic capacity to respond in the needs. This assessment needs GIS expertise.

To begin the needs assessment, interviews of prospective users are conducted. The interviewees should include management, supervisory, and operational level personnel of departments and agencies that may use or contribute to the GIS. Based on the results of these interviews the needs of potential GIS users and other factors affecting feasibility can be identified. That is in close relation to the developmental character of the municipality / community (urban, rural, etc.) These needs and other factors typically include:

- Specific functions the GIS can support (eg. urban plans, building permits, cadastral surveys, pipeline networks)
- The necessary data types to perform those functions,
- The source agency (ies) for the data,
- The products and client services to be created,
- The existent (if any) and necessary automated systems in performing the functions, and
- The related issues to GIS that the Municipality uses and needs.

The individual user needs should be analyzed to identify GIS needs common to several potential users as well as those needs which are specific to potential external users. Doing so can provide further focus on priorities as well as key issues must resolved for GIS implementation to be feasible in the eyes of the potential users.

Typically in urban planning, the first priority is the management and monitoring of city's master plan, detailed urban plans and building permits, but this is not a rule, it depends of municipality's priorities.

The needs assessment / feasibility study activities sometimes include conducting some form of cost / benefit evaluation. Before starting this evaluation, time should be taken to scope the effort properly, such that staff and other resources needed for system design are not unduly sidetrack to justifying the system from a strictly cost (money) perspective.

After established the top down perspective and identified user needs, a thorough analysis should be made of the data, systems, operations, functions and organizational / institutional structures which will comprise the GIS.

The amount of the necessary data is related to the size of the Municipality and to its administrative level and character (urban or rural municipality). Additionally, the amount and the flows of necessary data, that is a crucial factor among others, must be considered in determining hardware, software and communications requirements. Among these are functions performed by specific users, physical location of user offices, external users, existing computers, communications and software resources, and overall information system development strategy for the Municipality. More detailed analysis of factors such as data base size, transaction rates, data security, and other performance needs of user should be conducted to establish minimum requirements.

GIS is not only a program in a computer, it must consists an information environment for the functional and other needs of the Municipality in order to improve the urban planning process.

Characteristics of necessary data and information:

Availability: .... Does it exist, and where is it?

Quality: .... Is it any good? Can we depend on its quality?

Coherence:............... Does it agree with or correspond to other data?

Standardization: .... Are we talking the same "data language"?

Accessibility:............. Can we get to it, and can we afford it?

2.5. Designing Spatial data structures

A major track of GIS development involves building the spatial data base. This track can take a long time to complete and many options are available for pursuing it. Answers to many of these options will be resolved through preparation of the conceptual design, for example:

a) Which automation tasks will performed by the GIS organization's staff?

b) Which by an automation vendor? and

c) Which data may be acquired in digital form?

Also, the map layers and attributes needed to support priority applications will be identified during the conceptual system design task. However, other options, such as accuracy specifications, detailed automation procedures, data integration procedures, and the physical data base design will need to be addressed at the beginning of this track.

A major aspect of this track is also to identify the various geodata layers (map layers) for urban planning. The layers are directly depended from the character and the size of each city and the type of desired applications, but a typical schema is as follows:

TYPICAL LAYERS OF A SMALL - MEDIUM SIZE CITY

A typical integrated geodata layer structure, for a medium size city, contains at least the following layers:

1. MASTER PLAN (ZONES, such as: year, legislation, etc)
2. MASTER PLAN (BLOCKS / PLOTS - polygons)
3. MASTER PLAN (BLOCKS / PLOTS – lines)
4. GENERAL MASTER PLAN (ZONING)
5. DETAILED URBAN PLANS
6. ROAD AXES
7. RAILWAY
8. BUILDINGS
9. BUILDINGS' DETAILS
10. PEDESTRIAN AREAS – PAVEMENTS

11. CADASTRAL (Boundaries, Fences, etc
12. CONTOURS LINES
13. BANKS
14. TRACKWAYS, PATHS
15. RIVERS, STREAMS, etc
16. PIPELINES
17. OTHER LINES
18. TRIANGULAR POINTS
19. ELECTRICITY PILLARS, NETWORK, etc
20. TELECOMMUNICATION PILLARS, NETWORK, etc
21. MANHOLES (pluvial or others)
22. OTHER POINTS

Additionally to the above layers a set of raster layers can support the whole structure. These raster layers might be aerial photographs, satellite images and other raster maps - thematic oriented.

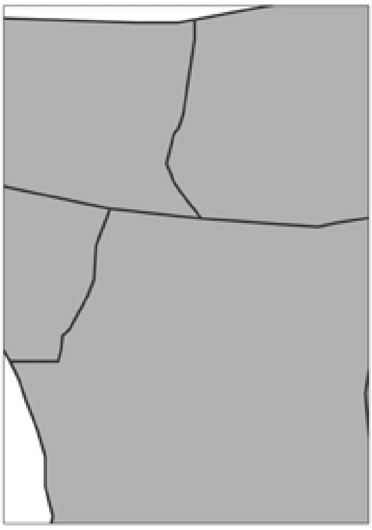
In this point it has to be clarified that typical applications, such as land uses, is a matter of choosing the proper layer (e.g. buildings) and to develop the proper database for this. Of course the above catalog is an indicative one, and according to the desirable application has to be enriched or not (e.g. with soil maps, more topographical details, etc.).

In practice, the data in some of the layers is completed or partial or non existing, depending on the development phase and the reference plus unitary area of the relevant database. Accuracy and age of the data may vary in different parts of the municipality.

VISUALIZATION OF TYPICAL LAYERS OF A SMALL - MEDIUM SIZE CITY

The following visualizations are based to GIS of the Greek city of Thiva (well known from the ancient period as Thebes) with population size approx. 25.000 inh. The GIS of the city of Thiva developed for the Municipality by the Laboratory of Spatial and Regional Planning (Department of Architecture, University of Patras) to support Urban Planning and monitoring purposes. The following presented layers, are referred to a part of city center, and are a subset of a total of 65 different layers.

Building regulation zones, permitted coverage (%)



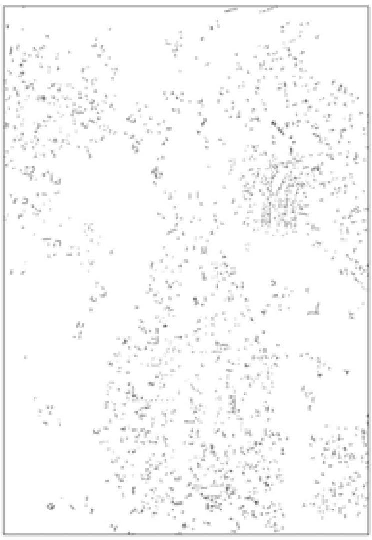
Fire protection zones

Building permissions' lines

Building ratio for each block,

Road Axes

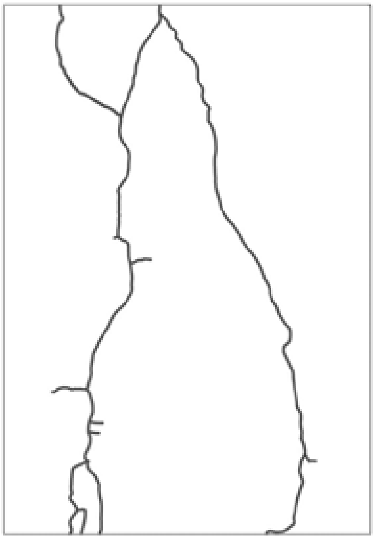
Buildings



Buildings' auxiliary lines,

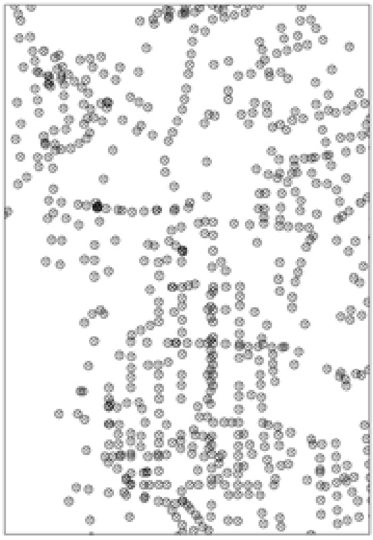
A combined detail from the previous 2 layers

Boundaries, fences, etc.

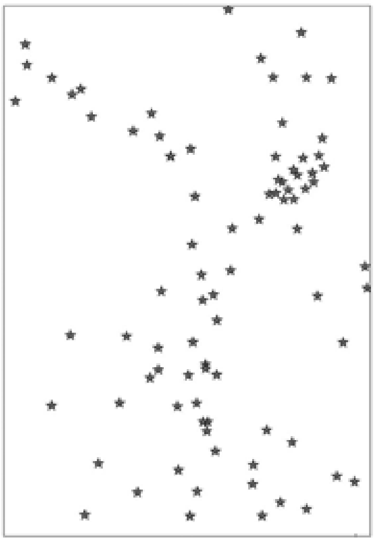


Streams,

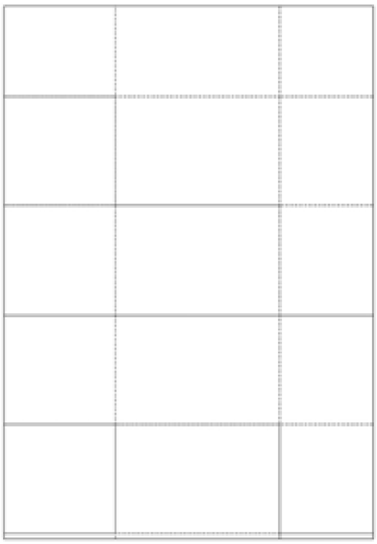
Banks



Electrical pillars



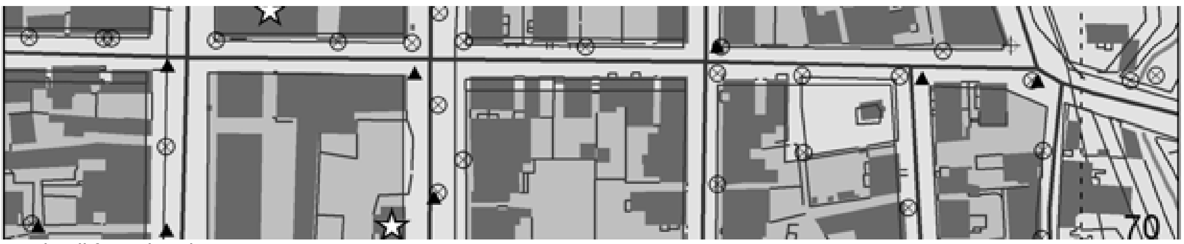
Points of interest (monuments, churches, etc,)



Grid

Triangular points

A mapping synthesis with all the previous mentioned layers



A detail from the above map

Additionally an **integrated Municipal Information System** (that is a wider information system that forms a decision support environment) must contain at least the following information:

1. GEOGRAPHY – GEOMETRY – TOPOGRAPHY
   Data with spatial significance.
2. CARTOGRAPHY
   Collection of basic thematic maps (digital or not / olds or news).
3. STATISTICAL FIGURES
   Quantitative - statistical information.
4. BIBLIOGRAPHY
   Information articles, monographs, projects, reports, and other bibliographic records.
5. PHOTOGRAPHS
   Photographic illustrations or other relevant data on important items such as specified views, monuments, buildings, etc.
6. CONSIDERATIONS
   Analysis and documentation of problems concerning specific areas of the city.
7. DEVELOPMENT
   Possibilities and potentialities for intervention projects in the city as well as evaluation of consequences of such projects.
8. ACTIVE AGENTS
   Description and documentation of programs, projects and works under construction carried out by public bodies.
9. LEGISLATION
   The relevant legislation that affect the whole development and planning process of the specific area.

DIGITIZATION PHASES OF A GIS DEVELOPMENT PROJECT

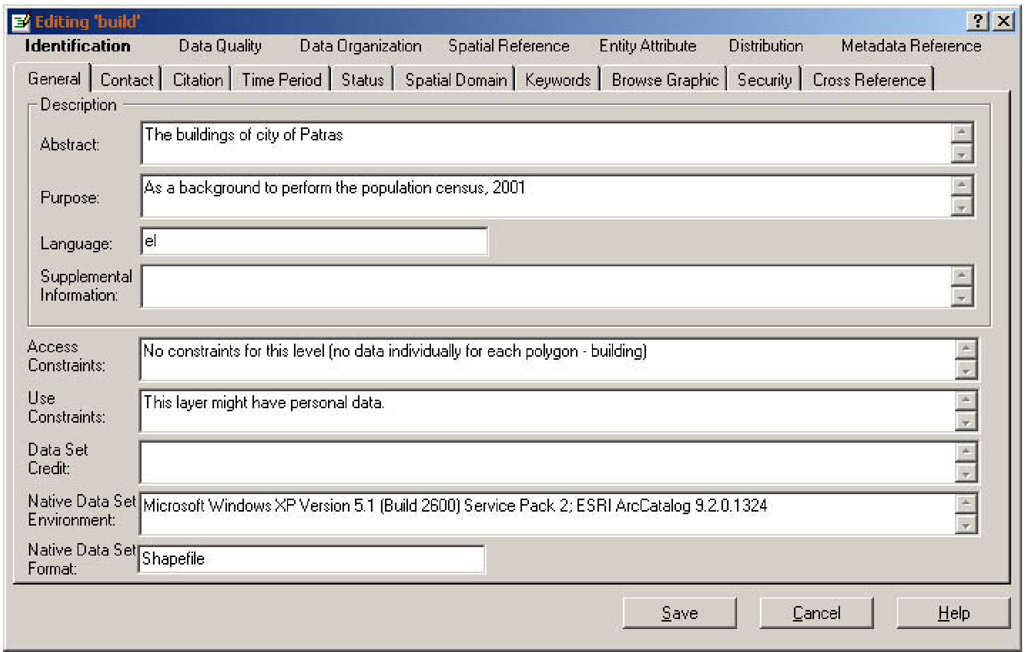
The following phases compose a typical procedure for digitizing[1] the various data in order to develop a GIS application for a small - medium size city / urban area (in brackets is an indicative map scale):

1. TOPOGRAPHIC MAPS (1:25 000)
2. CADASTRAL BASE MAPS (1: 2500 – 1:1000)
3. GENERAL MASTER PLAN (1:5.000)
4. MASTER PLAN AND BUILDING REGULATIONS (1:2.000)
5. DETAILED URBAN PLAN (1:1000-1:500)
6. BUILDING PERMITS (1:200)
7. WIDER AREA (1:50.000)
8. SPATIAL DATA OF SPECIAL INTEREST (Public places, tourist places, etc)
9. URBAN AND BUILDING LEGISLATION (if possible with spatial reference)
10. CADASTRAL AND TAXATION
11. OTHER SPECIALIZED DATA (Buses lines, Disposal collection system, etc)

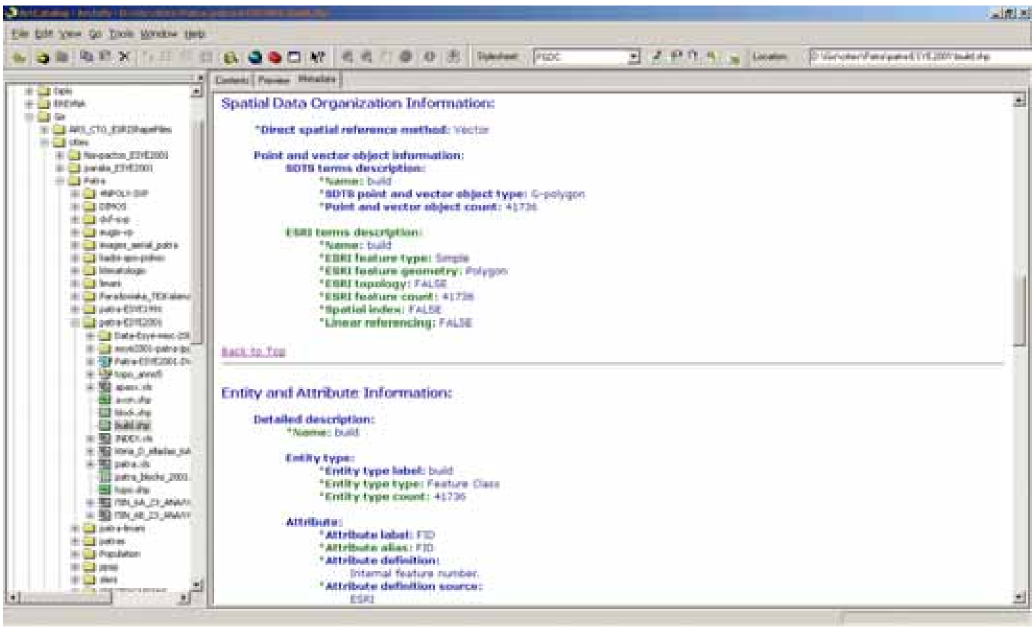
[1] The meaning of “digitizing” includes, apart from the typical digitization process, the procurement of relevant digital data from other external sources, as it is the most common alternative way.

2.6. The importance of Metadata

Metadata is used to facilitate the understanding, use and management of data. The metadata required for effective data management varies with the type of data and context of use. Metadata is structured data which describes the characteristics of a resource. It shares many similar characteristics to the cataloguing that takes place in archives in general, and more specific in our job, to describe the structure of a spatial database. The term "meta" derives from the Greek word denoting a nature of a higher order or more fundamental kind. A metadata record consists of a number of pre-defined elements representing specific attributes of a resource, and each element can have one or more values (*Taylor C., 2003*).



ArcCatalog 9.2 Metadata input form



ArcCatalog 9.2 Metadata information

“Metadata is critical for sharing tools, data, and maps and for searching to see if the resources you need already exist. Metadata describes geographic information system (GIS) resources in the same way a card in a library's card catalog describes a book. Once you've found a resource with a search, its metadata will help you decide whether it's suitable for your purposes. To make this decision, you may need to know how accurate or current the resource is and if there are any restrictions on how it can be used. Metadata can answer these questions.

Any item in ArcCatalog, including folders and file types such as Word documents, can have metadata. Once created, metadata is copied, moved, and deleted along with the item when it is managed with ArcCatalog or ArcInfo Workstation.

In ArcCatalog, metadata is divided into properties and documentation. Properties, such as the extent of a shapefile's features, are derived from the item by ArcCatalog and added to the metadata. Documentation is descriptive information supplied by a person using a metadata editor, for example, a description of and legal information about using the resource. With the default settings in ArcCatalog, all you have to do to create metadata is click the item in the Catalog tree and click the Metadata tab—properties will be added to the metadata automatically.

Each GIS resource has its own discrete metadata document. Metadata documents describing related resources are not interconnected. Metadata for a feature class describes only that feature class—it does not inherit any metadata from the feature dataset in which the feature class is stored.

…

Metadata created with ArcCatalog is stored as XML data, either in a file alongside the item, or within its geodatabase. In a geodatabase, metadata is stored in the GDB_UserMetadata table as a BLOB of XML data.

XML is a markup language similar to HTML. HTML defines both the data and how it's presented. XML, on the other hand, lets you define data using tags that add meaning. Stylesheets are created using XSL. …”

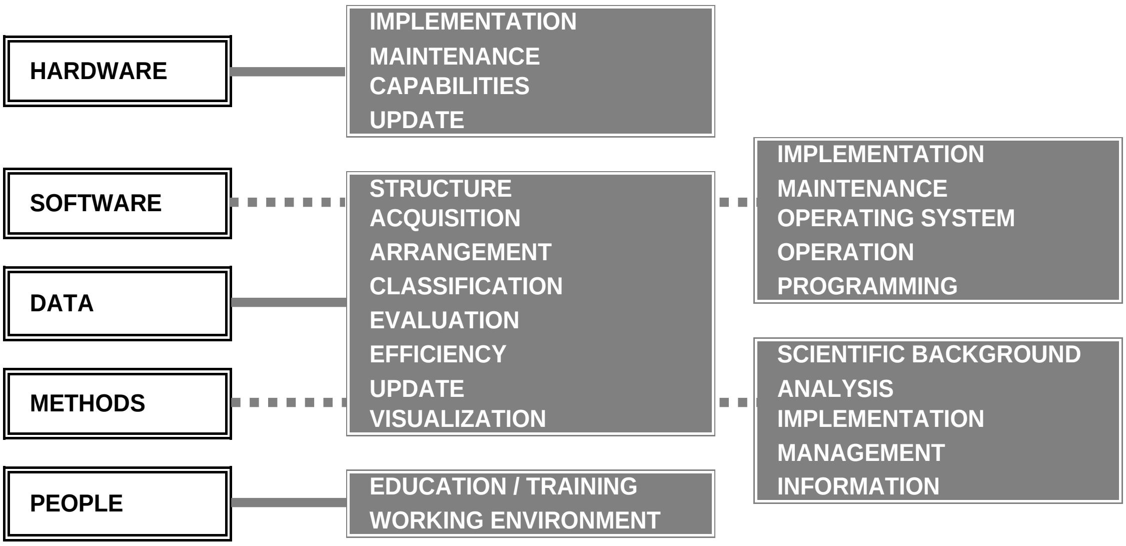
Source: ArcCatalog 9.2 Desktop help file for “documentation of Metadata”

Additionally Metadata information resources must be made visible in a way that allows people to tell whether the resources are likely to be useful to them. This is no less important in the online world, and in particular, the World Wide Web. Metadata is a systematic method for describing resources and thereby improving access to them. If a resource is worth making available, then it is worth describing it with metadata, so as to maximize the ability to locate it. Metadata provides the essential link between the information creator and the information user. While the primary aim of metadata is to improve resource discovery, metadata sets are also being developed for other reasons, including:

- administrative control
- security
- personal information
- management information
- content rating
- rights management
- maintenance
- updating

2.7. Maintenance and updating procedures

Every GIS has the next main components: hardware, software, data, methods for data analysis and management, personnel to run the system, and a set of institutional (working) arrangements to support the other components.



These components define the whole maintenance and updated process and must be successfully coped. A GIS is not just hardware and software, or even these two plus data. Hardware and software are probably the least critical elements of the system, in terms of both cost and insuring reliable results.

Hardware and software pose fewer problems today than no-data, personnel and institutional arrangements.

The hardware and software employed depends chiefly on the wider development of information technologies although in some cases this is defined by the nature of the application itself (e.g. satellite image analysis, orthophotomaps production etc.). In any case they are closest to being “commercial off-the-shelf technology”: known and reliable quantities ("faster-better-cheaper"). Moreover, most hardware problems will be dealt with the H/W vendor, software problems with the S/W vendor, taking naturally into account their charges. In this approach an important factor is the rapid evolution of the technology itself that requires constant funds for the update process of hardware and software in a periodic basis.

Technology's life cycle

	TIME (in months) WHERE THE TECHNOLOGY IS CHARACTERIZED AS			
TECHNOLOGY	**UPDATED**	**USEFUL**	**OBSOLETE**	**USELESS**
NETWORK INFRASTRUCTURE	24 - 36	37 - 84	85 - 120	120 +
WAN	12 - 24	25 - 60	61 - 84	84 +
SERVERS	12 - 18	19 - 48	49 - 72	72 +
WORKSTATIONS	6 - 12	13 - 48	49 - 72	72 +
DESKTOP	6 - 12	13 - 36	37 - 60	60 +
LAPTOPS	6 - 12	13 - 24	25 - 48	48 +
OPERATING SYSTEM	18 - 36	37 - 60	61 - 72	72 +
APPLICATION SOFTWARE	12 - 18	19 - 36	37 - 60	60 +
INTERNET APPLICATIONS	9 - 12	13 - 24	24 - 36	36 +
DATA	The time depends on their reliability			
BANDWIDTH	Increase 300% per year			

Tomlinson Associates LTD, Estimations 2001- 2002

Data are usually the most costly part of any GIS system (especially if data acquisition costs are included), and present mostly technical problems. Data automation problems can sometimes be dealt with by getting an outside technical organization to handle production automation. Then the problem becomes one of quality control and maintaining an assured production schedule. If the decision is made to deal with automation in-house, a major effort will need to be mounted to perform and manage the task.

It is remaining two elements, methods and personnel that require institutional arrangements and political support, which are usually the most critical to GIS success in depth of time.

It is important that new users share with one another the learning process they are going through, their successes and their frustrations, and management should make it a point to recognize those methods which are succeeding and use them as models *(Dangermond J., 1990 in [7])*.

Initial production may seem, to many novice GIS users and managers, to go too slowly, chiefly because so much care must be taken in the technical processes involved. Dealing with this perception usually requires that it be met head on: **yes the process is slow and meticulous**, especially in its early stages, in order to produce a good product. But as new users gain skill and confidence, it will get faster, and once the data are stored in the database, the speed of processing them will increase enormously over CAD and manual technique, and exactly here is the main role of "political support" to establish the proper working environment, within the Municipalities / Communities, in order to accomplish a time-consuming infrastructure work.

User of GIS technology may be driven to undertake new system cycles at any time. The usual reason is, apart from rapid technological evolution, a recognition of additional needs or new capabilities which need to be taken advantage of, which will justify the trouble and expense of a reiteration of the system cycle. Given today's technology it would be a rare GIS which does not get some kind of overhaul about every three or less years. In such successive cycles, many of the same problems will arise as in the first cycle, with luck, the problems will be less severe, due to the support of experienced personnel. If skilled people have moved on other duties within (or outside) the organisation then this is a major problem. The loss of experienced personnel and users of the technology is a major problem worldwide.

2.8. GIS and the Municipal functional environment

In common with any administrative innovation, the ideal conditions, or ingredients, for the "successful" implementation of an information system can be summed up as:

- knowing what is wanted from the system (**who for, what for**)
- obtaining the appropriate resources (including technological tools) for the tasks envisaged (**what with**)
- having the appropriate management mechanisms and processes to design and implement the system to meet the objectives of those it is intended to serve (**how**)

The process of developing and implementing GIS in practice thus depends on having the capacity to evaluate and integrate choices between alternative technological tools with decisions / choices about organizational and service development priorities, in the context of the organizational resources available. This is easy to say, but less easy to achieve. In practice, experience shows that a variety of factors hinder or complicate the coordination and organizational integration of system developments: **the time scale and risk involved in coordinated GIS development.** (*Barrett S., 1992*)

Usually we have to overcome a number of shortcomings that arise during the development of a GIS for Urban Planning. These shortcomings may be:

★ Lack or low quality of completed and updated cadastral maps.

★ Lack of monitoring mechanisms of spatial evolution.

★ No updated and compatible mapping data.

★ Lack of updated land use data and other thematic data.

★ Not a real control over service networks (public transport, electricity, communications, etc)

★ Not well-established structured decision-making procedures, due to the limited official responsibilities the local authorities have.

★ Non-flexible organisational structure.

★ Lack of competent personnel

★ Conflicts of municipal authorities with other authorities in regional or state level.

- ★ Conflicts between different municipality authorities that are involved in the same greater (urban or not) area.
- ★ Weak co-ordination between the municipal organisation units, urban planning agency and cadastral authorities

Additionally, the functional environment, consisting of the municipal services, is very poor concerning that the municipal services are performing mostly administrative functions with limited planning authority and land use and building control, having little experience in handling digital spatial data. Also they lack professionals to support the development of a GIS and last but not least they have limited funds or/and state support.

These general findings result in difficulties inherent in the analysis of the feasibility and achievability for developing a GIS. In this context **a GIS development process is a novelty**, going beyond the technical dimension of easier and more efficient management of information.

The introduction of GIS will highlight exploitation areas beyond the narrow context of the existent division of responsibilities between different parts of organizations, as well as cooperation problems, data exchange and utilization, which at the present are not resolved.

In this sense, it should be expected that an effective GIS introduction will be a breakthrough in terms of functionality and decision-making inside the Municipalities, will redeploy functional priorities and will lead to a revision of conventional approaches for the character and the efficiency of provided services.

The introduction of modern technological improvements requires new processes on coordination, decision-making and management, the directors, the department's heads and heads of various sections, must **reconsider their roles and limits** of their responsibility.

The diffusion of new information technologies, among the end-users, notes significant progress, but the cycle of the automated production process varies. It is a common phenomenon of not understanding these capabilities, mainly by the administrative managers, and this causes **an underestimation** of potential applications, or, and this is also very common, **an overestimation** of their abilities.

In addition to the above factors the introduction of GIS can bring **cultural changes** in the functional environment of the organisation, namely the definition of values and procedures under which they operate. Potential, GIS offer and open up new ways in processing of various cases and procedures, including those which seemed to have been problematic in the past. Changing the cultural identity of the body can not be done by administrative or managerial changes "from up", but only through a laborious, time-consuming and systematic process of diffusion and assimilation of all the staff, and particularly by those who have administrative responsibilities.

Finally, we should not underestimate **the uncertainty** that necessarily created, in terms of the effectiveness of GIS, principal in the transitional stage of their operation, from the staff at all levels, which does not have the necessary knowledge of GIS operation. In similar cases of uncertainty the staff is seeking ways to minimize it, either by pushing decision-makers (directors, department head, etc) for weeding out roles, initiatives and responsibilities with clean instructions, either by being limited and remain in their typical bureaucratic duties.

Summing up the above, it appears that the decision on introducing Information Technologies, and mainly GIS, within Organizations of Local Authorities, is not be limited in the procurement and installation of the necessary equipment (H/W and S/W), but it is needed to form **a comprehensive administrative and organizational strategy** for the proper performance and integration of the system to the whole managerial and functional environment.

The option of establishing a separate department, with its own staff, while it may help in principle efficiency of the system and to support and coordinate other departments and agencies, can be really productive only if accompanied by a **planned transfer** of technical know-how through the whole complex of the organization. This is the most difficult challenge for the effective implementation of these systems, which are able to introduce major changes to the functional environment and the efficiency of the organisation and of course to the quality of provided services.

Many of the small and rural municipalities lack personnel and capacity to establish operational GIS unit and services immediately or in a near future. It may however be possible after some years. A more advanced municipality may serve a weaker municipality in these issues. GIS will be important for all municipalities. To day in 2008 every municipality can pave the way for future use of GIS in urban planning by ordering these services from the planning agencies in such format which allows easy use of these materials (existing and updated cadastral maps, urban plans) by GIS in the future.

2.9. References & Bibliography for further reading

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