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Development of a GIS/LIS Implementation Plan for the City of Gdansk

Poland

September 1993

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ABSTRACT

The City of Gdansk is currently developing a GIS/LIS (Geographic/Land Information System) capacity to support the diverse activities and functions of various government agencies. In order to ensure the relevance and sustainability of this integrated urban information system, a logical development methodology has been outlined in a comprehensive GIS/LIS Implementation Plan. This plan describes the essential inter-related and inter-dependent stages of the implementation process. This will require the systematic resolution of many important technical and institutional/organizational issues. These are discussed in detail with practical approaches offered to specific problem areas. The plan and methodologies presented offer an incremental and sustainable GIS/LIS implementation model which is both relevant and replicable under the prevailing conditions in Poland. This model forms a framework which could help focus GIS/LIS activities in many sectors and consequently, expedite the creation of effective land information systems at the local (gmina), regional (voivoda) and even national levels. Ultimately, these systems should form an integrated information resource(s), providing timely, accurate information to a diversity of users. This would contribute greatly to resolving the complex land related problems facing Poland, which are certainly impeding important elements of the reform process including privatization.

EXECUTIVE SUMMARY

Certainly, the land resources of Poland present some of the most contentious and complex challenges facing the current reform process. However, the land, if correctly managed and mobilized, can offer Poland an economic resource with tremendous development potential. To realize this potential, effective land management is essential and will inevitably involve the implementation of automated land information systems (LIS) using various GIS technologies and approaches.

These activities are presently occurring throughout Poland at all administrative levels: the gmina (local), voivoda (regional) and national levels. To date, these LIS initiatives have been largely uncoordinated, highly variable in their effectiveness and confronted with a diversity of problems which must be addressed and resolved. A pragmatic and focussed program of external technical assistance could provide sustainable solutions to many of these obstacles. The problems impeding effective GIS/LIS implementation are quite ubiquitous to Poland, and are typified by the findings of the Gdansk GIS/LIS technical assistance mission. Therefore, the results and recommendations made in the light of this mission are highly relevant to many GIS/LIS programs currently underway in Poland. Certainly, the implementation plan presented offers a logical framework and process for rational system development which could act as a model for GIS/LIS activities throughout Poland. The plan's features and approach are compatible with the local conditions and land management needs confronting Gdansk, which are not uncommon in the rest of the country.

The work plan presented offers solutions under two broad categories which are essential to the success of any GIS/LIS implementation process. These issues are TECHNICAL (related to hardware, software and data) and ORGANIZATION-INSTITUTIONAL (related to personnel, training, procedural and institutional matters).

The implementation plan was developed after extensive data collection in various city agencies and close consultation with personnel both directly and indirectly involved in the LIS development project for Gdansk. The following points summarize the status of the LIS implementation in Gdansk and offers specific recommendations which emanate from stages outlined in the implementation plan. The recommendations are designed to ensure:

1. The present system in the City of Gdansk migrates in incremental phased stages towards an integrated GIS/LIS environment designed to support key city functions and "business" processes.

2. The city's investment to date in hardware, software, staff expertise, data verification and automation are protected and better focussed towards the LIS development process.

To achieve successful GIS/LIS implementation in Gdansk, the city should adopt the proposed implementation planning process as a logical framework for future activities in this field.

A number of issues will be subsequently highlighted which are immediate needs in order to progress in the LIS development process:

Technical

1. The present system in Gdansk has concentrated on data review and inventory. This has involved the widespread automation of maps using CAD technology. In order to create a true GIS/LIS environment, the project should move towards a topological data model and related software tools. This is essential to give the graphics spatial "intelligence" and facilitate data analysis and applications development.

2. The City of Gdansk LIS will require an integrated multi-databases environment. This will necessitate the adoption of a RDBMS or Relational Database Management System within the city. This will require a complete database design and development process.

3. Once task 1) and 2) have been executed, the LIS will be required to support a number of core applications to perform various functions including maintenance. Where possible, these should be derived from existing application(s) templates developed in Poland for similar LIS projects e.g.Lodz. This will require an application design process as outlined in the implementation plan.

4. Data verification and conversion are ongoing processes which must continue in order to develop the database(s). However, conversion and/or automation should be rationalized through the adoption of well defined procedures and techniques to improve efficiency. This will avoid data duplication, redundancy and introduce essential quality assurance.

5. The hardware and communications environment in Gdansk must be designed, selected and established. This should emphasize industry standards, high cost/performance ratio, sustainability and adequate functionality. The LIS hardware environment should optimize data sharing and access to information resources between users.

Institutional

1. In order to effectively manage the implementation of an LIS in Gdansk, and service the information requirements of various client agencies, a formal organizational structure should be established. In Gdansk, this will be a private-public partnership which will manage all GIS/LIS operations on behalf of the city. This will involve formalizing agreements between partners in both the public and private sectors. Such public-private cooperation appears to provide a viable and cost effective model for LIS development in Poland.

2. The city should begin to define and standardize certain administrative practices and functions. This is necessary to support key "business" processes and integrate these into an overall GIS/LIS strategy. In Gdansk, land information management related to the privatization of land is a critical "business" operation in terms of revenue generation. Elements of this process include:

- Land disposition
- Detailed planning
- Development permitting
- Deed creation and management
- Technical infrastructure planning and management

LIS implementation should focus on supporting these activities and related "business" processes such as privatization as priority application areas.

3. The operation of a multi-agency GIS/LIS will require the establishment of various procedures and protocols, especially for information update and database maintenance. These procedures should be designed, documented and implemented to protect the value and ensure continued integrity of the information resources managed by the city.

4. Technical training is an immediate need in Gdansk as part of the GIS/LIS development process. Immediate priority areas include:

- Topological data model and software tools
- Database design and RDBMS
- Data conversion and automation
- Applications design and development

5. The City of Gdansk should establish a basic core technical staff within the public-private LIS management enterprise to administer the development and operation of the system. These staff functions should include:

- Operations Manager
- Network/Systems Manager
- Geodetic/Quality Control Specialist
- Database Administrator
- Applications Specialist
- Communications/Process Specialist

6. Funding mechanisms and means (both internal and external to the city) should be defined in a long term budgetary strategy. This should guarantee core development and long term funds for sustaining the GIS/LIS operations.

7. External technical assistance will be needed and most effective at critical junctures in the implementation process as defined by the plan. Short term, isolated assistance is neither recommended nor effective. Any external technical assistance should be periodic and focussed input as part of a continuum of monitored activities in a long term support strategy.

8. The City of Gdansk should pro-actively present the local GIS/LIS initiative as a component in the national strategy to modernize the LIS of Poland. This will ensure that the local activities are not isolated but contribute to and benefit from a coordinated and integrated nation wide approach which is central to both land and public administration reform.

Conclusion

The GIS initiative at the City of Gdansk is presently at a critical stage of development. Fundamentally, the operation should now begin to move from an automated mapping/ inventory process to a database driven/applications oriented environment. This will require application of a more advanced GIS data model involving topology linked to a relational database management system (RDBMS).

Furthermore, a number of organizational, procedural and institutional issues should be addressed in order to design a fully integrated GIS/LIS system with data and applications which can service the many information needs of the city. This design process will have to be dynamic and flexible in order to reflect the many reforms occurring within the city structure. As much as these changes may effect the system design, so the capabilities offered by the evolving LIS may begin to influence the future design of government functions and procedures.

Fortunately, the political will to support the GIS/LIS program is not lacking and with some timely external technical assistance, positive results are possible in the medium term. This political support is not only local, but appears to come from the Surveyor General who increasingly perceives these efforts in GIS/LIS implementation as potential models replicable throughout Poland. The development of an effective LIS implementation model would be most beneficial since many municipalities are currently implementing systems independently with only modest success. A key strategy maybe emerging in Gdansk with the creation of public/private partnerships to manage and support GIS/LIS development and operations.

Although this will require a high degree of consensus and coordination, the role of the private sector will be critical in terms of management, technical support and the many other holistic demands of GIS/LIS. Clearly, any system must be operated as a cost/profit center for the city, supporting many entities which share a common need for various (spatial) information resources. This is a unique model in Poland although increasingly common in the "West" where GIS/LIS systems within municipalities are operated like businesses, fully integrated with government operations. The City of Gdansk has made impressive progress in the automation of information resources (maps), creation of some databases and in particular, in the continuing verification of land records which will be fundamental to the final integrat-

ed database(s) and applications. The recognition by the city that GIS/LIS should be operated as a "business" in support of other key "business" functions is extremely important. This will ensure the system is both productive and sustainable, and not simply another "layer" of government bureaucracy or technology driven experiment.

With respect to the GIS/LIS implementation process as outlined in this report, the City of Gdansk is progressive and receptive to external technical assistance, which will be needed in some important areas. This should provide U.S. AID with many opportunities to offer productive technical assistance which can both guide system development and indirectly influence a national GIS/LIS modernization process. Indeed, the growing level of GIS/LIS development activities in Poland and their importance more than justify the consideration of a long-term resident advisor on these issues. Such a sustained commitment could have a profound impact on the efficiency of urban/land management practices and increase the potential for economic revitalization in Gdansk and other cities throughout Poland.

Development of a GIS/LIS Implementation Plan for the City of Gdansk (A Potential Model for Urban Sites in Poland)

1 GIS/LIS Database Issues

1.1 Introduction

Land records systems are an essential part of the administrative infrastructure required to support government services related to land management, property taxation and urban planning. Geographic Information Systems and Land Information Systems (GIS/LIS) technology offers state-of-the-art data processing tools for integrating and managing maps, planning documents and property ownership records in ways that can significantly facilitate these vital government services at both regional and local levels. Typically, a GIS/LIS designed to support business processes involving the transfer of land ownership, property tax assessment and land planning and development requires the following minimum data coverages:

- geodetic records (land survey information)
- parcel maps
- physical infrastructure maps
- land ownership or title records
- zoning districts
- demographics

As part of the overall effort to evaluate the feasibility of improving the existing land records systems for the City of Gdansk, it was necessary to inventory and assess existing sources of data that may be used as input into an integrated GIS/LIS database environment. This inventory is described in **Appendix A**.

1.2 General Recommendations relative to GIS/LIS Database Development and Management for the City of Gdansk

1.2.1 Database Management Technology

The City of Gdansk has invested significant resources toward the automation of both cadastral maps and related land records using AutoCad software tools and a custom database management system. Although these software systems will improve map and records management capabilities relative to the manual systems currently in place, the technical platforms selected for data automation have several inherent limitations relative to data analysis and database management functions. The limitations are not to be taken lightly and will constrain the ability of the City to use data processing tools to manage its data resources in ways that will effectively support strategic business processes.

The problems associated with the current direction the City has undertaken to automate maps and records about land fall under three major areas of concern. First, AutoCad software is not recognized in the industry as a GIS technology platform. AutoCad was designed to automate processes for producing and maintaining map products. In essence, AutoCad is merely a design and drawing tool and provides no sophisticated information processing capabilities other then to generate and display map information or detailed designs at selected scales. It does not provide a topological data structure which is needed to support the spatial data analysis functions provided by GIS technology. For example, because of the limitations of the AutoCad data model, a data coverage stored in AutoCad format cannot be integrated and analyzed with other disparate spatial data coverages to support typical GIS applications such as facility siting, vehicle routing, resource allocation, districting, facilities management or environmental planning.

A second important concern is that the software currently being used by the System for Land Information unit to convert textual land records does not interface with commercially available GIS software at its present level of development. Integration between GIS software and database management software is required in order to link spatial data such as street centerlines with the textual information about street segments (e.g. number of lanes, speed limit, pavement type, date of last maintenance, etc.). Integration between spatial and textual data, and interfaces to their respective data processing tools are required in order to fully support GIS/LIS functionality.

Lastly, the City's current database management software system (DBMS) is not supported by an established DBMS vendor who can provide long term technical support and maintenance services which will protect the City's investment in database development. The use of a commercially available DBMS e.g. ORACLE, will insure that the City's database management capabilities will continue to evolve and improve as enhancements or new developments in DBMS technology are made available through commercially supported products.

Given the constraints of the existing database management technology platform, it is strongly recommended that the City invest the time to properly evaluate and select appropriate GIS/LIS technology that will support its strategic business processes. Procurement of a proven GIS/LIS technology platform should take precedence over the continuation of the current effort to convert cadastral maps and related land records using the existing software and DBMS platforms.

The AutoCad software provides excellent tools for computer-aided design and detailed drawing functions. It is emphasized that the City's investment in this technology has not been wasted as the City currently has and will continue to have business applications that require effective design and drawing tools. Interfaces between CAD and GIS systems (such as the ArcCAD product), will further strengthen the City's information processing capabilities. In order to protect the City's investment in map automation, consideration should be given to select a GIS/LIS platform that will build upon the work that has already been accomplished

with AutoCad and provide software tools for migrating the digital data to a GIS topological data structure (e.g., Arc/INFO).

1.2.2 Database Design

Once an appropriate GIS/LIS technology platform is selected, the City should focus its efforts on the development of a comprehensive GIS/LIS database design. Database design specifications should be developed that will facilitate the integration and management of those spatial data and related textual records which impact strategic business process involving detailed planning, land disposition, development permitting and facilities management. **Figure 1** provides a conceptual schematic that illustrates how an integrated GIS/LIS with relational database(s) can be utilized by the City of Gdansk to support key business processes associated with land privatization.

For the most part, the current state of land records for the region indicates that there are no effective data management and quality control operations in place to perform the following fundamental database management functions:

- insure data accuracy and currency
- maintain referential integrity or synchronization between related data sets
- protect vital government records from losses due to disaster
- reduce data redundancy
- eliminate the substantial duplication of data maintenance operations that currently exist between and within the various branches of local and regional governments.

The primary emphasis of the database design effort should be to establish a technical "blue print" for the development of a strategic database environment that will remedy the existing data management problems and provide employees with the flexibility to access, combine, manipulate, analyze and output information in ways that will support the business functions of government. In this manner, both local and regional governments will be able to manage information as a corporate resource that can be used effectively for planning, management and decision support. GIS/LIS database design tasks should be accomplished in step with the structured GIS/LIS planning and implementation methodology detailed in this report to insure that the functional database requirements are properly defined and documented.

Data conversion procedures and operations should also be planned and developed specifically for the purposes of populating the physical database design. Therefore, further data conversion work by the City of Gdansk should be suspended until the physical GIS/LIS database design specifications are fully developed. In addition, administrative procedures for maintaining spatial data coverages and related textual records should be clearly defined, documented and ready for implementation before GIS/LIS data conversion activities are place into full production. Furthermore, the custom software tools needed to support data maintenance operations must be fully developed, tested and ready for production before data

GIS/LIS Conceptual Design

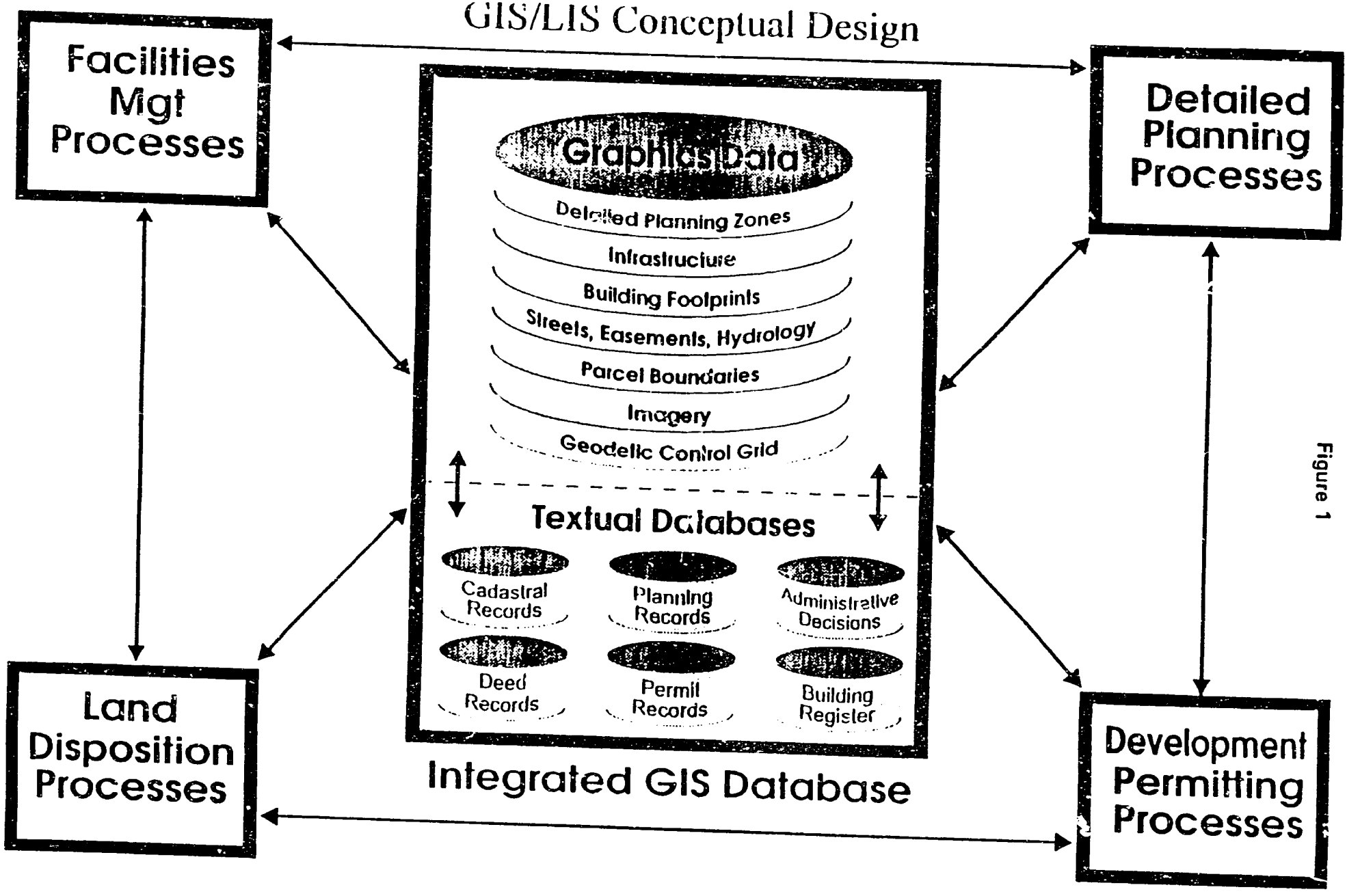


Figure 1

conversion operations are initiated. GIS/LIS data conversion is very labor intensive and the time and resources required to develop a GIS/LIS database can be high. Data conversion costs typically comprise anywhere from 50 to 70 percent of GIS/LIS implementation costs. In order to protect the City of Gdansk's investment in data conversion, data maintenance procedures and software should be fully operational prior to data conversion so that information can be kept up-to-date once it has been converted into the database.

2 GIS/LIS for the City of Gdansk - Applications and Procedures

2.1 Introduction

Even the most general survey of the City of Gdansk and the government structure(s) will indicate the extent of a serious problem. Namely, the city is overwhelmed by disaggregated growing information resources which are integral to many "business" processes, but no integrated information system exists to rationalize data handling and management. The term "system" should not be interpreted as relating to technology alone. More importantly, the city lacks many clearly defined procedural mechanisms which are required to expedite certain functions. Because of this deficiency, "indigenizing" GIS/LIS technology into the government structure will be all the more difficult. While data automation is proceeding rapidly, the city must begin to carefully review and where necessary re-design certain key "business" processes to facilitate the creation of efficient database management systems and support GIS/LIS applications. This process will move system development from a purely inventory (data capture/automation) mode into the analytical domain where GIS/LIS applications can enable various functions, processes and ultimately, support decision making.

Figure 2 presents a theoretical model on how three major functions of GIS (inventory, analysis and visualization) can support various modes of decision making. Firstly analyses, which may involve a spatial analysis including a complex database query. For example, a user may want to know how many vacant lots exist in area x with an area over y acres and a value of less than z dollars, located less than 200 metres from a road. The results of such an analysis can produce results which actively support a decision i.e. to develop a property or not. However, even after complex GIS analyses it is important to realize that uncertainties always remain; and any decision(s) should not be made solely by the "system" but externally; by responsible, informed parties. Therefore, a more influential strength of GIS in decision support is in its unique capability to visualize spatial features, relationships and processes. Under these conditions, rather than actively influencing decision(s), the ability of a GIS to structure processes, understanding and general thinking about various issues should not be underestimated. However to facilitate this decision support role, the GIS should operate within an appropriate institutional/organizational framework typified by "networking" of users, logical information flow, structured decision making and so on. This is an essential component of the implementation process although unfortunately, the least tangible and most complex element. These issues alone can be rather problematic when implementation plans are being developed (see institutional issues).

This section will outline the importance of understanding some "networking" issues; how various "business" processes function; how information flows through the city government structure during a process, and where in the "decision" network does this information have a potential positive impact. Some key applications will be identified together with their ability to support various processes and functions. The importance of procedures to maintain both databases and applications will also be outlined. Focus will be placed on a pilot Land

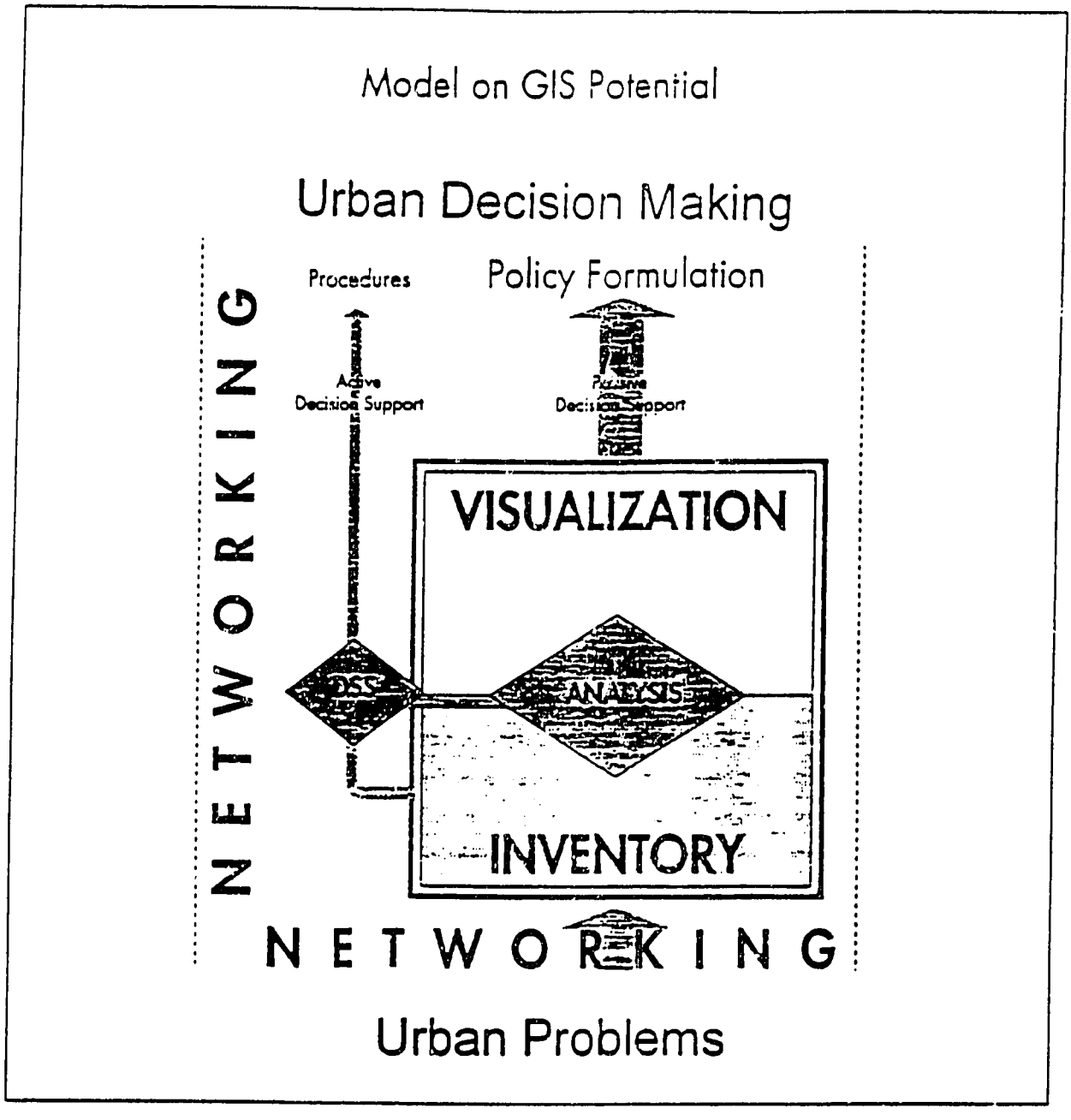


Figure 2. A Model outlining the potential of GIS in support of decision making (Adapted from Simonett, 1992)

Information System (LIS) implementation in Lodz and the potential relevance of certain core applications derived from this project to the Gdansk GIS/LIS.

This is especially important since these applications were specifically designed to meet the diverse needs of urban land management in Poland. Finally, benefits, products and potential output from various applications will be discussed.

2.2 Understanding City "Business" Processes and the Potential Role of GIS/LIS

"Business" processes can be defined as those functions/operations carried out by the city, which usually involve a number of agencies and inter-dependent procedures, whose results can directly impact the financial status of the city. An obvious example of a "business" process in Gdansk would be the disposition or privatization of "municipalized" land.

In the past year, 25,000 properties were transferred from the state to city ownership (municipalized). Although this transfer process is complex, the Court of Justice presently receives 2000 requests per month for the issuance of legal deeds to these properties. A task which is an essential prelude to actual privatization. The creation of a legal deed document requires the collation and review of numerous records, the majority of which are stored manually and dispersed throughout various city departments. With no automated information system and/or application supporting this process, the Court of Justice can only process 400 of the 2000 deed requests per month. This creates up to a 7 month delay between the decision of the city to actually sell land and the recording of a legal property deed. Such a delay not only retards revenue generation for the city but is potentially discouraging for any outside investor(s) interested in acquiring land assets for development. Quite simply, while no integrated land information system exists, the potential for attracting large scale private investment in the land resources of the city are severely limited.

Figure 3 illustrates the numerous inter-dependent stages of the land privatization/ disposition process in the City of Gdansk. Although this diagram may be simplified, understanding the major features of this process can greatly assist in the development of both database designs and subsequently, the GIS/LIS applications required to support this important process. **Figure 4** shows a conceptual applications design where an integrated GIS/ LIS environment is used to support the land privatization process. Key features include:

1. User access to the system and database(s) via a menu driven interface.
2. Ability to navigate the privatization process logically using the application.
3. Ability to perform queries and analyses on multiple integrated databases.
4. Ability to compile and output required information in diverse formats.

The task of defining and visualizing the inter-related components of various "business" processes in the city is essential. Firstly, this will ensure that any future applications developed are driven by the needs of the processes they are required to support. Secondly,

Figure 3. Land Privatization Process in the City of Gdansk (Schematic of Multiple Stages and Agencies Involved)

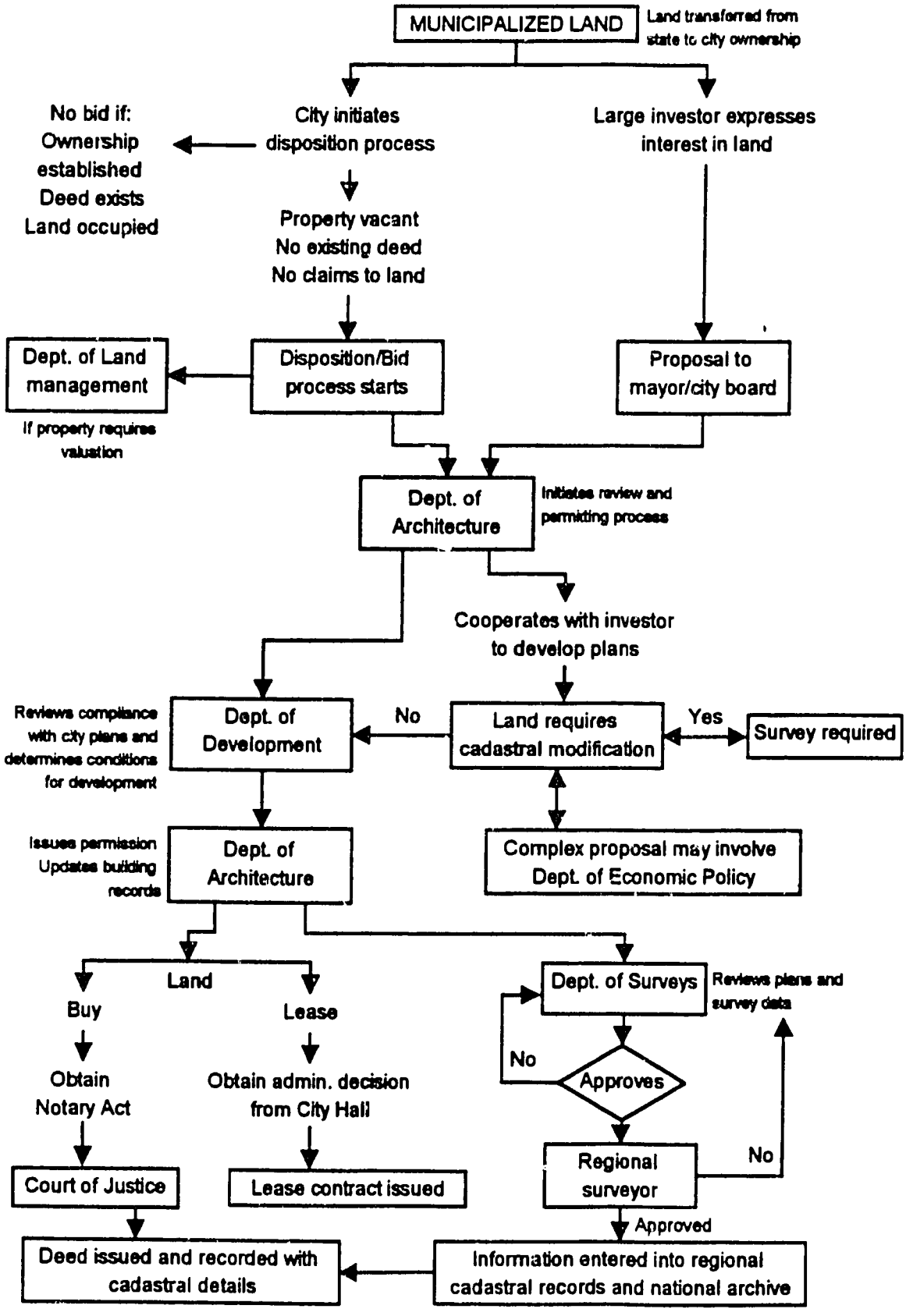
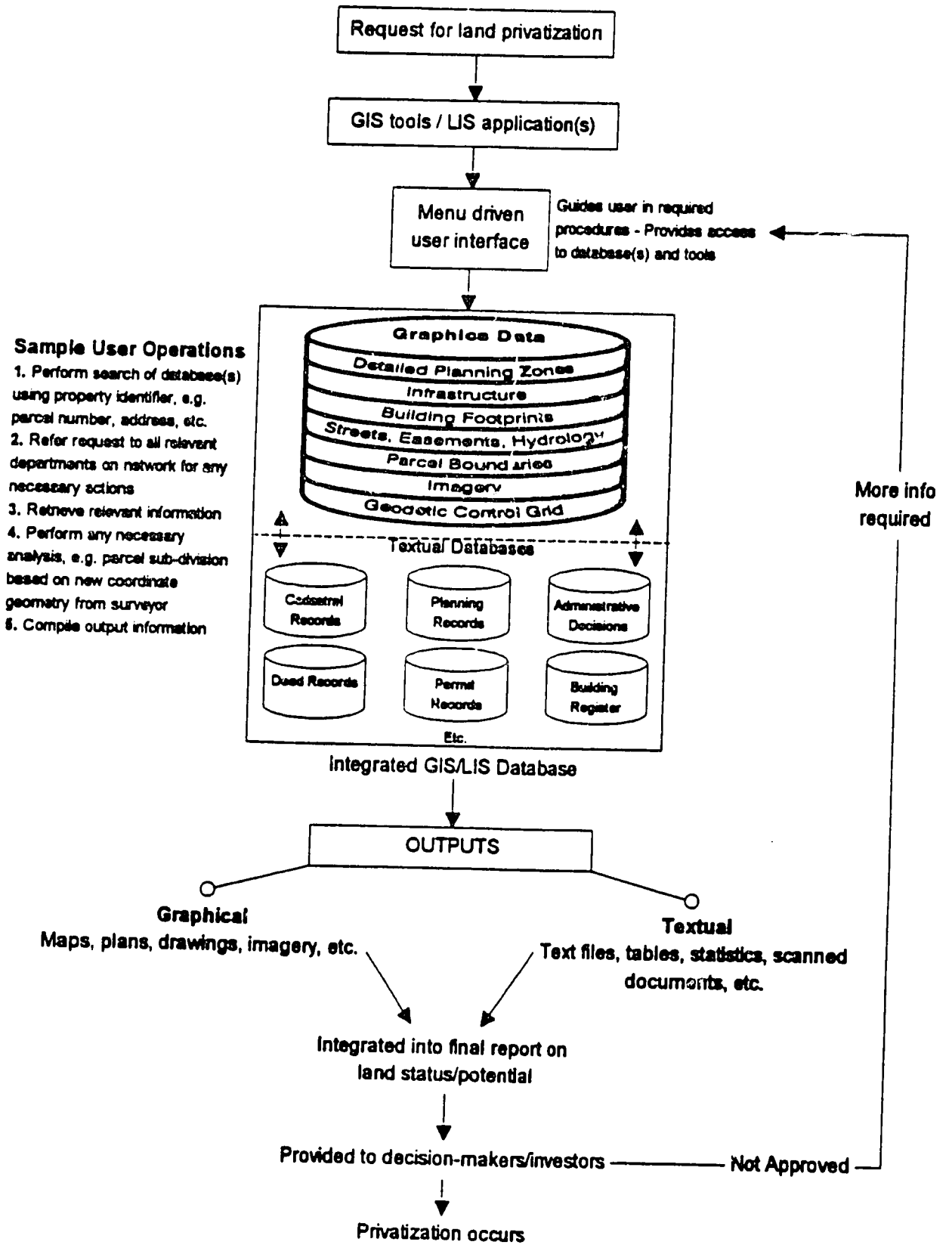


Figure 4

Conceptual Application Design

(Using GIS/LIS to assist land privatization process)
Potentially a single user transaction



inefficiencies, redundancy and the inadequacies of the processes themselves will be revealed, hopefully prompting some re-design or rationalization of the procedures themselves.

For the City of Gdansk, this mission identified four priority "business" processes which should be addressed in the near future, in order to commence the GIS/LIS application design task (which will be complimented by relevant technical training). In order of priority, these include:

2.2.1 Land Disposition (Privatization)

As illustrated in the previous example and diagrams, this is an information intensive process requiring the completion of a number of inter-dependent procedures including the establishing the status of land parcels and the final creation of a deed. This process should be executed efficiently with accurate, current information regarding the land and various assets (buildings), through a GIS/LIS application. Privatization of "municipalized" land is an important source of revenue for the city to support government operations and public services. Supporting this process through the GIS/LIS should be considered a priority.

2.2.2 Issue of Permits for Development

The present delays in issuing of development permits (a sub-process of privatization) is largely due to inefficiencies in accessing and collating the information required to complete this process. An application designed to allow efficient access to an integrated database containing the relevant information will greatly expedite permitting procedures, which is a precursor to all development activities and investment in the city region.

2.2.3 City Planning Procedures

An efficient planning process is strategically important to the future of the city in terms of economic growth, environmental protection and other "quality of life" issues. The present planning process (General Plan and more detailed "local" plans) are created largely in isolation from the actual transactions and processes occurring in the city. To a degree this is a remnant of the old centralized planning philosophy which should now become more empirical, reflecting actual changes over time in the city (land) structure. The implementation of a GIS/LIS would allow a more holistic to planning through the integration of diverse data sources (both spatial and non spatial). The ability of a GIS to "visualize" an urban area alone, can impart to planners a critical appreciation for spatial relationships and (geographic) factors affecting urban growth.

Access to an LIS database and GIS driven planning applications, will obviously provide the tools and essential information to develop the various comprehensive plans at different geographic scales. Today, numerous generic GIS based planning applications exist which could be readily customized to fulfill many of the planning support requirements in Gdansk.

2.2.4 Infrastructure Management

Responsibility for the function and management of various utilities (water, sewer, gas, heating, electrical, telephone) are gradually being transferred to new organizations consisting of public/private or wholly private enterprises. Knowledge of how the infrastructure (utility) networks interconnect with and service both buildings and land is important to effective infrastructure management, maintenance and planning. With serious deficiencies in the technical infrastructure, access to an integrated database would provide critical information required to support service improvements, cost recovery and operation of utilities as cost/ profit centers for the city. Although AM/FM (Automated Mapping/Facilities Management) applications are highly specialized, again, many exist in generic formats which may be customized to serve the technical infrastructure of Gdansk.

Since substantial elements of infrastructure management are being privatized, this should move some of the financial burden of AM/FM applications development to the private sector allowing the city to concentrate scarce resources on addressing other application areas.

Clearly, other "business" processes/procedures within the city may benefit directly from the implementation of a GIS/LIS e.g. public safety, transportation management. As mentioned earlier, to optimize the benefits which can be derived from such a system, will require a clear understanding of how existing processes and procedures operate. This provides the opportunity to establish a database(s) which can support various "business" processes through applications developed using GIS technology.

However, this will not be straightforward since many processes are currently being established, revised or eliminated as part of the ongoing reforms. Therefore, any designs to develop applications should be made cognizant of the present dynamic situation.

2.3 Applications for Management and Maintenance of a GIS/LIS Database

It should be apparent that applications designed to support various processes occurring in the city are the "end products" of GIS implementation. These applications provide the "window" or interface to users who wish to access and navigate the database(s), as well as the ability to invoke various GIS tools to perform analyses, visualization, output products, submit queries and many other operations.

In order for these applications to yield meaningful results, the GIS/LIS database(s) including both graphical and attribute elements, should be maintained and updated (explained in more detail in the database section). Since the Gdansk system will involve multiple agencies, this will require clear procedures and protocols for update and database maintenance. These procedures should be documented and implemented to guarantee the information managed by the system is both contemporaneous and has integrity. To date, the level of effort on these issues has been rather minimal with the primary focus on data collection, review and subsequent automation.

Nevertheless, the present effort under way to review and correct the land records for the city is also extremely important and should be accelerated. The procedures that are being executed today, should be viewed as precursors to GIS/LIS core applications which will facilitate these quality assurance and update procedures to the land information base (both graphic and textual). Some of these "maintenance" applications have been developed using ARC/INFO software for the Lodz pilot project (see **Appendix B**). These maintenance tools should be assessed and where appropriate applied as part of the core applications capacity in Gdansk. An key feature of these applications is their ability to manage changes in the databases which occur over varying time periods. For example, certain applications may be designed to deal with daily transactions while others focus on longer term activities such as archive, periodic database review and storage. These temporal application issues should be considered by Gdansk in the design and implementation of various core applications.

2.4 Application Development Process

Application development in a GIS/LIS environment can be an extremely time and labor intensive operation. Apart from the actual programming of applications, there is usually an extended application design phase involving a user needs assessment, programming and pilot testing. If necessary, this may result in re-design to optimize functionality and performance prior to full (user) implementation.

The application development process can be summarized as follows (see **Figure 5**):

1. A design team is organized with responsibility to manage the process.

2. A number of core application areas are identified e.g. supporting the privatization process.

3. Design team interview key users to assess user needs, examine processes and determine functional requirements for each application.

4. These requirements are embodied in a scope of work which outlines the design specifications for the user interface(s), logical workflows and application function sequences, system capabilities, file and tabular data descriptions, output formats and layouts (maps, charts, graphics, summary statistics), query and graphics display functions on screen and for output.

5. Design phase concludes by determining design for the user interface which will create the functional "front end" to the application.

6. Programming begins (using macro-language such as ARC/INFO's AML) on the user interface and related application tools. This is a cyclical process starting with the design and proceeding to actual coding.

Application Development Process

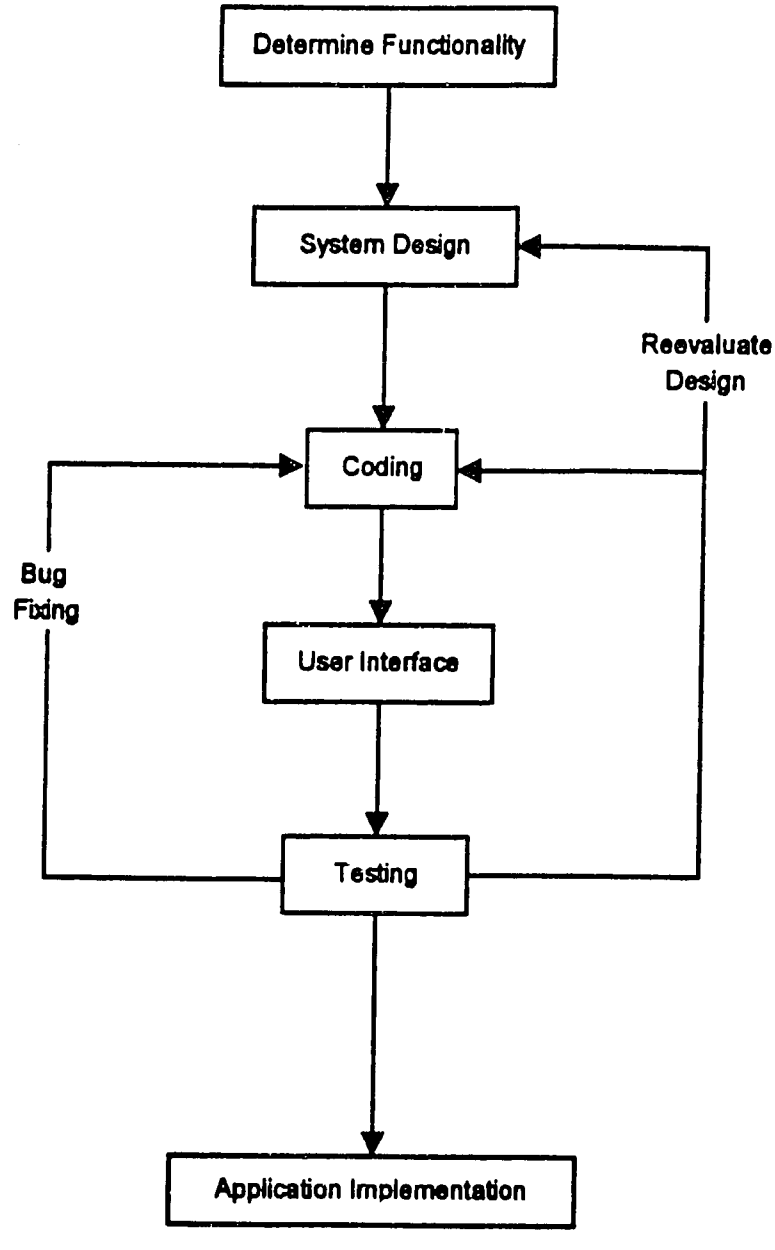


Figure 5: Application Development is a cyclical process where application is conceived, designed, developed and tested with constant user input.

7. This is followed by a comprehensive testing program which eliminates any code "bugs" and tests the functionality of the interface and application tools with the end user(s). During this stage, problems and limitations are inevitably uncovered which require re-coding, re-design of the interface and even modifications to the application design. The aim is to create a bug free application which fulfills the functional requirements of the user(s) efficiently.

8. The final application with user interface is gradually implemented at the user site with any required training and/or instructions manual/documentation depending on the complexity of the system.

This application development procedure has been simplified although the basic model is valid for most applications design and development processes. Inevitably, these require formal training which is recommended for Gdansk, even though some core applications will be directly transferable from the Lodz LIS pilot project. This training will provide skills to not only design and develop applications, but also to customize and maintain existing systems.

Fortunately, numerous applications share generic functions and user templates. For example, different applications developed to manage property parcels will almost certainly include tools for the sub-division, merging and re-alignment of boundaries while at the same time managing the related parcel information. In addition, there are available a variety of generic GIS tools which facilitate the all important tasks of maintenance and update of both graphic and attribute elements contained in an integrated GIS/LIS environment.

For Gdansk, the movement from a CAD environment into a topological data model will facilitate the development of numerous applications using macro-languages (ARC/INFO's AML) which supports the adaptation of GIS tools into specific applications. More importantly, once a topological environment has been established, Gdansk will be able to benefit from a whole suite of applications which were developed for the Lodz pilot project. After reviewing these applications in detail, it is obvious that most have direct relevance to the Gdansk project as potential CORE APPLICATIONS. Namely, those which will be support the integrity and maintenance of the integrated database environment.

Integrating these applications with an established GIS/LIS database environment will provide functions that can yield almost immediate benefits; essentially "boosting" the productivity of the entire system. However, in order to benefit from these applications, the database design process will have to examine their structure, in order to determine how to optimize the database <-> application integration in Gdansk. Some modification may be necessary, but this will require a far smaller level of effort than engineering such applications from the outset.

2.5 Recommendations

1. Identify and prioritize certain core GIS/LIS applications and their functional requirements.

2. Analyze and document high priority "business" processes to better understand what will be required (functions) to support GIS/LIS application development.

3. Interview users and assess functional requirements for key applications. This will require a documented design process for user interfaces, logical information and process flows, application tools and functional design.

4. Review, adapt and apply relevant core applications (see attached list) from Lodz pilot study to Gdansk system environment.

5. Where necessary, develop and/or adapt core GIS/LIS application based on results of design process.

6. Adopt proposed implementation work plan as a guide to stages in applications development process; this includes pilot test of applications based on user response and interaction with database environment, "phase" in implementation etc.

7. Appoint core staff member(s) with sole "applications" responsibility; provide training in applications design and development; consider sub-contracting applications development where appropriate.

3 Institutional and Organization Issues

3.1 Introduction

It is increasingly being recognized that the central problems connected with GIS implementation are of an institutional rather than technical nature (Simonett, 1992). While the technology (hardware and software) have developed and matured dramatically over recent years, precious little effort has been expended on resolving the complex institutional issues which are inherent to GIS.

In most cases, agencies and/or organizations implementing GIS concentrate on the technical aspects, while overlooking the need for an institutional framework which will accommodate and support the GIS. Such a framework should promote an environment where a number of important processes can occur, namely:

1. Data sharing
2. Integration of data and resources
3. Decision making processes supported by the system using applications, output and products.
4. Procedures for the maintenance, update and sustained operation of the database(s) and system.

If they are to be successfully implemented: Geographic Information Systems have to be embedded into the existing institutional, organizational and cultural framework, or, as expressed by Taylor (1991), they must be "indigenized." This is especially true in countries experiencing profound and rapid changes in various sectors such as Poland. However, before GIS is indigenized, there must be a systematic attempt to define an appropriate institutional framework and the functions destined to be supported by the GIS.

This section is devoted to outlining an institutional framework for the City of Gdansk which will be capable of sustaining the GIS and delivering benefits to a wide variety of users. The institutional framework presented was developed in close consultation with key members of the GIS unit in the city.

3.2 Present Context for GIS/LIS Development in the City of Gdansk

Presently, GIS operations are being conducted in an semi-autonomous unit (System for Land Information) under the supervision of the Office of the Mayor (President). The Mayor has personally endorsed the GIS initiative recognizing its importance to numerous branches of city government and various reform processes. This unit is composed of staff from a number of private contractors (GEOBIS, OPGK, GDANSK-BARCELONA ASSOCIATION) and the city itself. Essentially, resources from both the public and private sectors are cooperating on the present data automation and inventory tasks. Direct supervision of the

unit's operations is the responsibility of Mr. Jan Szczegielski, a Surveyor with many years' experience in the City and Voivoda (Geodetic) administrations.

Although the present unit can be described as "semi-autonomous," there has been a sustained effort to cooperate with a number of agencies both inside and outside the city government structure.

The importance of collaborating with such agencies will be outlined later. Those agencies within the city government include:

1. Dept. of Architecture
2. Dept. of Development
3. Dept. of Land Management
4. Dept. of Surveying
5. Dept. of Communications (Roads)
6. Dept. of Municipal-Public Works (ROMS)
7. Dept. of Finance

At the regional or "Voivoda" level, the City of Gdansk has formal cooperative agreements with:

1. The Regional Voivoda Office of Documentation, Geodesy and Cartography (WODGiK).
2. The Court of Justice.

External collaborating agencies for GIS/LIS implementation include:

1. SAUR NEPTUNE Water and Sewer Company
2. Gdansk Gas Company
3. Gdansk Heating Company
4. Polish Telecommunication Company
5. Gdansk Power (Electric) Company
6. Gdansk Radio Transmission and Communication Company
7. Polish Cable Television

Similar to the Voivoda level organizations, these utility agencies have signed a formal memorandum of understanding/agreement with the city government, while a number of local banks/financial institutions and private GIS Service contractors have also expressed an interest in the GIS development project. Formal agreements for cooperation and/or funding should be forthcoming from these entities in the near future.

The pro-active efforts made to engage numerous agencies to collaborate in the development of the GIS/LIS in Gdansk is a very positive development forming the foundation for a true public-private GIS/LIS joint venture. Exactly how these (and other) agencies will interact, cooperate and what will be the primary responsibilities of each have yet to be

determined. In an attempt to classify and elaborate on some of these functions, a schematic was developed which illustrates the "organizational relationships" and the institutional framework for GIS/LIS implementation in Gdansk (see **Figure 6**).

3.3 Institutional Framework for GIS/LIS in the City of Gdansk

To its credit, the City of Gdansk has recognized that the development of an integrated GIS/LIS is a task which will require the support (financial and technical) of both the private and public sectors. Such private-public partnerships in government are not uncommon in the developed world and are slowly being implemented with respect to GIS/LIS development. In Poland, Gdansk appears to be a leader in developing this type of a collaborative venture, especially in GIS. The reasons behind this approach are compelling:

1. The City of Gdansk has recognized that many of the data "layers" they plan to automate and manage in the GIS are of direct value to the private sector. For example, an automated sewer/water network with various analytical capabilities would be of immense value to both city planners and to "Saur-Neptune-Gdansk," the private company responsible for managing the system. The same applies to many local utilities and undoubtedly promoted the creation of an early agreement between the city and 8 local utility companies to share the substantial cost of data automation and conversion.

2. Unlike other traditional government activities and services, the effective operation of a GIS should be geared towards timely and accurate information products and/or output. GIS demands adherence to strict procedures and production benchmarks, more readily sustained in a private rather than public sector environment.

3. The financial burden and level of effort required to automate the data "layers" for Gdansk to create an integrated database are too expensive for the city to absorb. Therefore, private sector core funding should be secured and guaranteed.

4. As suggested earlier, GIS functions most efficiently when fully "embedded" within the prevailing decision making structure of agencies/government; rather than acting as an adjunct facility or additional "layer" of bureaucracy. That said, GIS is also a long term commitment requiring sustained effort and stability in operations. Therefore, it is essential to protect the GIS/LIS from political turmoil and transition, both of which are too common in the Polish context. The public-private GIS enterprise proposed for Gdansk is designed to ensure some political autonomy and stability for a system which will support government and yet remain beyond the political fray.

3.4 Defining an Institutional Framework for GIS/LIS in Gdansk

Because of the holistic nature of GIS/LIS implementation and the reliance on numerous, inter-related components, it is essential to first, visualize an organizational structure as in **Figure 6**.

Gdansk GIS/LIS Organizational Relationships

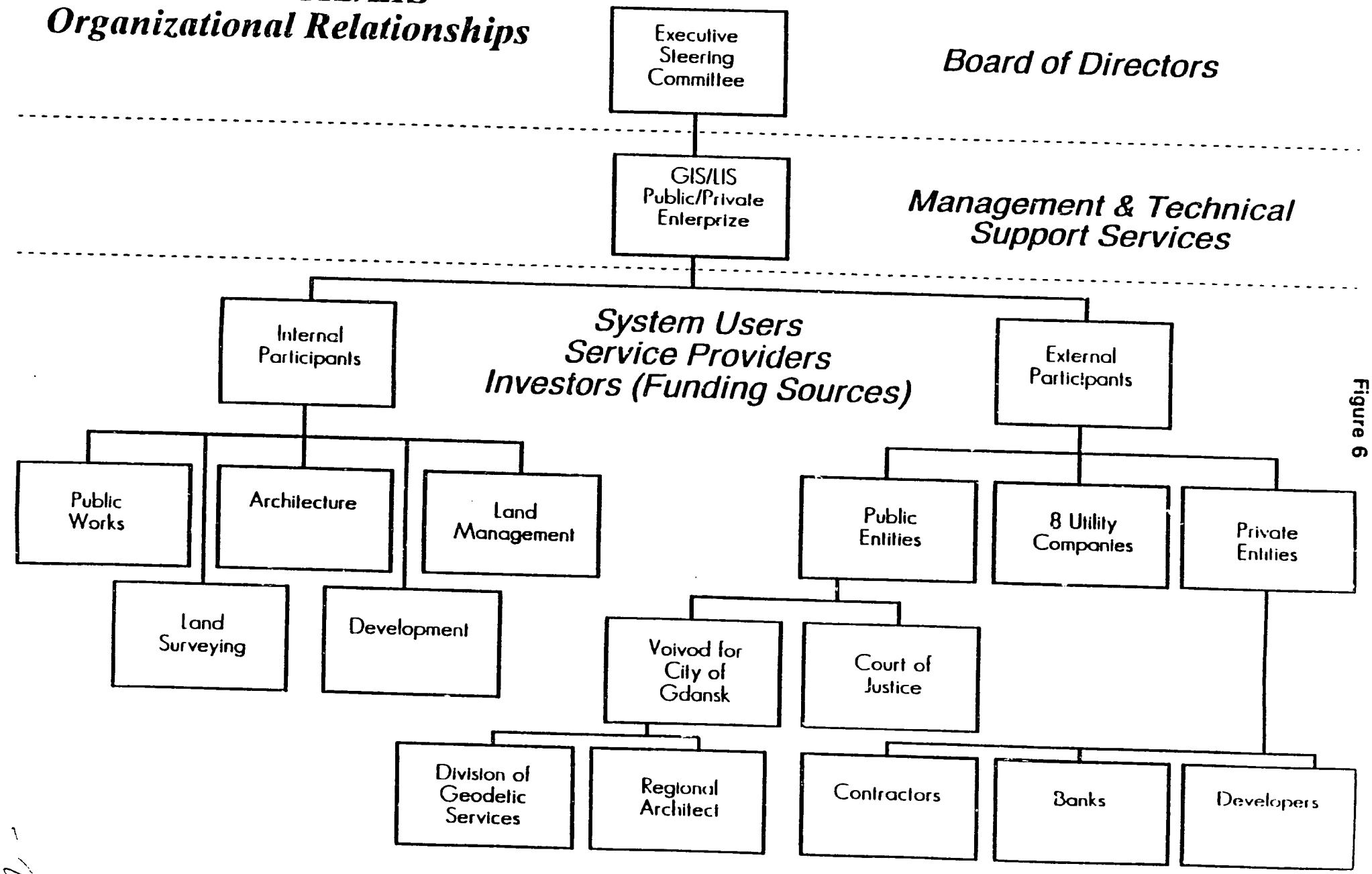


Figure 6

At the head of the structure for Gdansk will be a "Steering Committee" consisting of senior members of the city government and representatives from each of the major participating agencies. This committee will be responsible for establishing overall policy and direction for GIS/LIS operations including fees for services, procurement, awarding of contracts and disbursement of public funds for the system development. It is essential that these policies and procedures are established in advance, documented and agreed upon by all parties.

The GIS/LIS Public-Private Enterprise (PPE) will have overall responsibility for system management and technical support. Management duties will include the essential task of updating and maintaining the various databases. While this responsibility may be eventually decentralized to the users themselves, in the initial stages of system development, update information will pass from the users/clients to the PPE for quality assurance, review and entry as updates to the respective databases (See **Figure 7**).

While overall database management will be the primary responsibility of the PPE, each client-user will be required to provide regular updates for their database(s). Again, this requirement should be clearly outlined in procedures prior to implementation. However, the users will have full read/view/display access facilities to their databases (and others); this will include the use of specific applications designed jointly by the PPE technical staff and the end users themselves.

Aside from management responsibility, the PPE will have a cadre of technical staff capable of maintaining hardware, software and applications. They will also be responsible for some data automation although this may be sub-contracted where appropriate. An essential service provided by the PPE will be the ability to review various technical options, objectively screen vendors and sub-contract various services from private sector including GIS/LIS consultants and service agencies e.g. NEOKART GIS Ltd., Warsaw. Training is one such service which will be a periodic although ongoing requirement. The PPE will assure the end users with quality support and reduce the risk of negligent advice, products and services which are all too common in Poland today.

With respect to the legal status of the PPE, it is envisaged as a Limited (Ltd.) Stock company partly owned by the city (approximately 30 percent share) and other investors. Apparently, the legal/regulatory framework for establishing such an enterprise does exist although approval will require the consent of the city board.

Participants in the Gdansk GIS/LIS can be divided into two broad categories namely, those agencies which are either internal or external to the city government structure. This division is important since it helps to more clearly define the respective role of each agency. Under these two categories, participants can be classified as either service providers, system users and investors (funding sources). These functions are not mutually exclusive and any agency may have one or more of these roles.

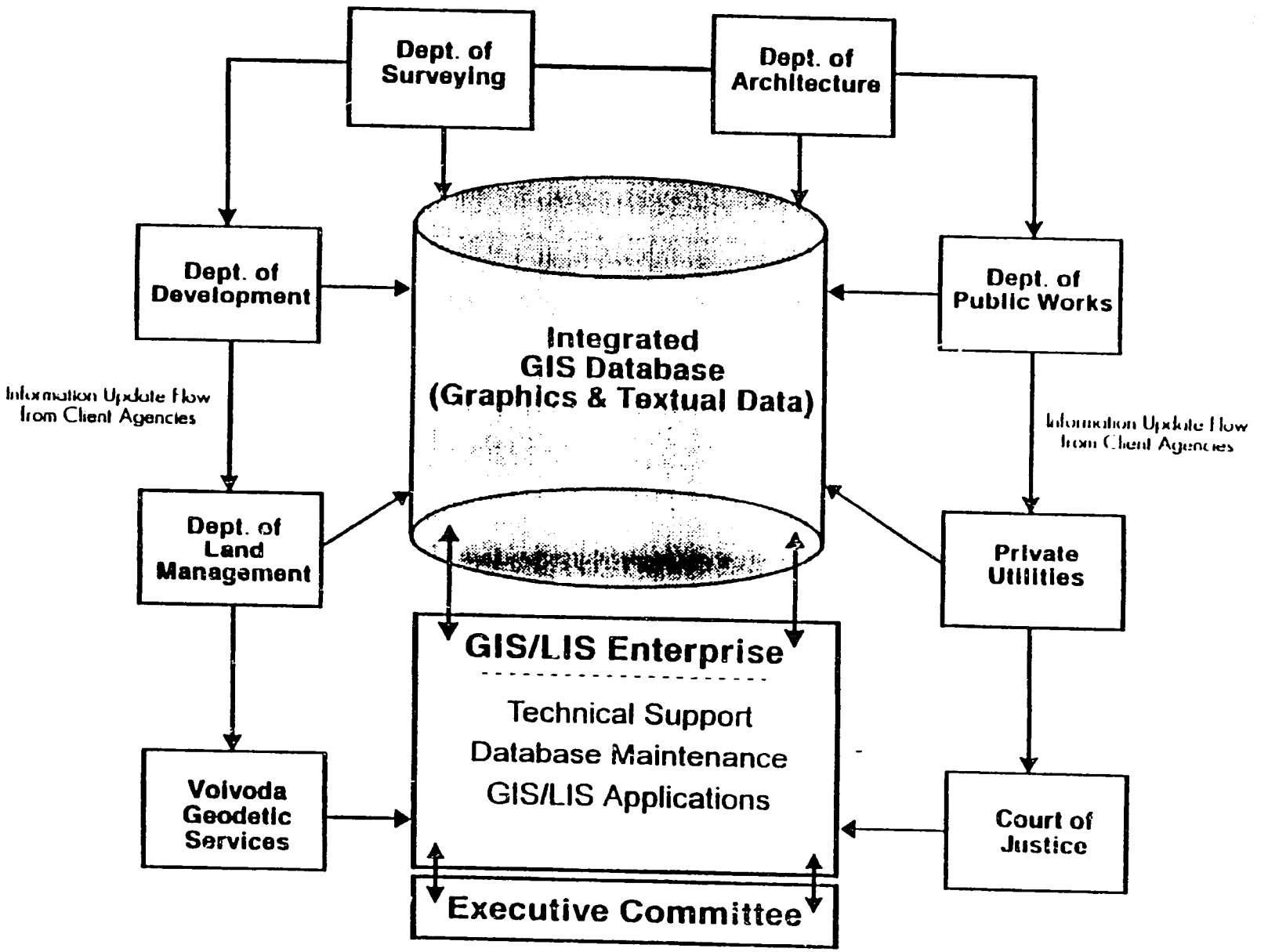

Dept. of Surveying
Dept. of Architecture
Dept. of Development
Dept. of Public Works
Integrated GIS Database (Graphics & Textual Data)
Information Update Flow from Client Agencies
Information Update Flow from Client Agencies
Dept. of Land Management
Private Utilities
GIS/LIS Enterprise
Technical Support
Database Maintenance
GIS/LIS Applications
Voivoda Geodetic Services
Court of Justice
Executive Committee

Figure 7

22

With respect to Internal Participants, the city departments identified in the schematic are recognized as important for the GIS/LIS because of the data resources they collect/maintain, the functions/decision making they perform in the city and/or their willingness to play an active role in the development of the system. This list of departments is not exhaustive, although their participation at the inception of system development is vital.

In the process of determining an organizational framework, the functions and operations of each of these city departments were examined separately. The inter-dependence of their respective activities became most apparent. For example, in the process of issuing permission for development, the Department of Architecture may be required to seek information from the Dept. of the (City) Surveyor, Dept. of Development and WODGiK (Regional Surveyor of the Voivoda). Without automation and full integration, presently, this process is especially inefficient and time consuming. This is just one of many similar "business" functions in the city which are impeded by an inability to access timely, accurate information from an integrated database supporting various GIS/LIS functions.

3.5 Internal Participants

The internal participants in GIS/LIS development are all constituents of the city government and can be classified as system users. Their importance to the GIS/LIS is derived from two perspectives. Firstly, the large amounts of spatial data they presently maintain; secondly, the functions they support which directly impacts the single most important economic resource in Gdansk namely, the land.

Briefly, these functions include:

3.5.1 Public Works

Gathering and compiling information on the technical infrastructure of the city. Responding to requests for maintenance and services to public buildings, infrastructure and property. Supporting a network of regional service centers (ROMS) distributed throughout the urban area.

3.5.2 Architecture

Agency responsible for issuing development decisions. Decides how land and buildings should be sub-divided and modified in cooperation with the owner and surveyor. Supervises building and (re)-construction.

3.5.3 Land Management

Maintains information on tax/value zones for the city, used in determining land taxes, value and emerging property markets.

3.5.4 City Land Surveyor

Maintains cadastral (boundary) records and conducts field surveying/verification. Issues administrative decisions regarding properties in the city. This agency cooperates closely with the Regional Surveyor and Geodetic Office (WODGiK).

3.5.5 Development

Overall responsibility for urbanization and planning policy development for urban growth. Supervises investment into these activities for the city.

3.6 External Participants

This diverse group of participants constitute system users, service providers and investors from both the public and private sectors. The major public entities include:

3.6.1 The Regional (Voivoda) Office of Surveying and Geodesy (WODGiK)

This agency is mandated by law to maintain and update the cadastral records for properties in the city. In addition, the agency maintains comprehensive archives of both cadastral (boundary) and technical infrastructure maps at various scales for the entire city. Institutionally, this office forms an interface between local city authorities and central government on land issues. With respect to GIS/LIS development, this link is extremely important since implementation policy developed by the Surveyor General of Poland will be expressed through the activities of these regional agencies.

In future, the regional offices may be required to play an "intermediary role" in GIS/LIS, by encouraging certain "standards" in GIS/LIS while at the same time supporting the needs of local programs.

3.6.2 Regional Court of Justice

Once again, this agency provides regional representation to the central government-Ministry of Justice. Among many functions, the Court of Justice is the sole source of legal deed documents for properties and therefore, plays an indispensable role in the entire privatization process. The Court of Justice has embarked upon a rapid process of records automation. The selected system (FENIKS-ORACLE) will be directly compatible with the GIS/LIS system in the city, while at the same time conforming to requirements dictated by the Ministry of Justice for the digital recording and maintenance of deeds.

Among the external participants, a number of public/privately owned utility companies (listed earlier) have committed as full partners in the GIS/LIS development process. The commitments of these agencies is designed to :

1. Shorten the length of time for the development of the databases and systems.

2. Coordinate and rationalize investments into the completion of task 1.

3. Cooperate on the verification and automation of the technical infrastructure data for the area. This will include the merging and integration of information from the utility companies, the city and the Voivoda who all maintain information on technical infrastructure. This single coordinated operation will significantly increase the value of the information and reduce costs by eliminating a high degree of duplication and redundancy.

A number of participants in the Gdansk GIS/LIS organizational framework will be drawn from the private sector. This important element recognizes that the private sector does have an important role to play in system development and can contribute substantially to the overall process. In terms of financing for system development, the prospects look positive. The financial and technical commitment by the utility companies to the project should set a precedent for other active investors from the private sector. Among these, the banks, lending institutions and land developers should all have a high level of proprietary interest in a system which promises to deliver accurate information about many aspects of the land.

In particular, banks issuing financial credits against property ownership should be able to guarantee the integrity of the ownership and other details. Furthermore, land developers and investors will only make commitments to investment in the city if the relevant information is made available and accessible about the land, buildings, infrastructure, relative location, development planning etc. The present inability and delays in providing this information is certainly stifling the potential for outside investment from developers in Gdansk.

Because of the diverse demands of GIS/LIS development, the City of Gdansk should recognize that even with full commitment of the agencies listed above, all aspects of the implementation process cannot be fulfilled internally. Therefore, the city should look to a external GIS/LIS technical service providers in the private sector with actual experience in delivering technical support.

Unfortunately in Poland, only a few private sector companies have developed the requisite skill and experience to offer the necessary services. A leading company in GIS/LIS implementation in Poland is NEOKART Ltd. located in Warsaw. Having reviewed their corporate capabilities, it is apparent that they can offer services in applications design, system programming, training, system design, data automation and project management. The most important aspect of NEOKART is the considerable experience they have gained in conducting a pilot implementation of a Land Information System (LIS) in the Lodz Voivodship (financed and coordinated by the Surveyor General of Poland). This effort has been quite unique in the Polish context as an example of how to merge national LIS policy with local needs. The merits and weaknesses of this project are discussed in another section. However, NEOKART have now acquired considerable "hands on" experience in the many

aspects of GIS/LIS implementation which should be directly input into the City of Gdansk LIS initiative.

The most direct mechanism to ensure that their experience is transferred to the city is to secure NEOKART as a formal external participant in the organizational structure. While no private sector entity has all the required skills for GIS/LIS implementation, the benefits of actual project experience cannot be ignored.

At present, the above institutional framework exists only partially, and has not been clearly defined and/or ratified. This process should begin in earnest since the technical demands of GIS/LIS implementation may quickly overwhelm the present somewhat informal structure that currently sustains various operations e.g. data automation and verification. The time period required to formally establish the GIS/LIS Private-Public Enterprize (PPE) has been estimated at 4-5 months. Although the Mayor and Treasurer have agreed to the idea in principle, formal approval will require the full city government (Boards of Directors). During this time, the GIS unit should work towards anticipating and documenting the scale of future needs, and attempt to define how the various tasks/responsibilities will be assigned to each of the participants. Obviously, this effort should be undertaken with the full collaboration and participation of each agency. This process will begin to establish the proprietary interests of each participant and impart a sense of "ownership" in the entire system development process.

This task will be partly driven by the conceptual database design which will begin to define the composition of each of the databases. In addition, this will establish how they will be maintained by the users supplying data to the system through established procedures.

3.7 Funding GIS/LIS Development and Operations

In countries such as Poland with severe financial constraints, funding GIS/LIS initiatives can be extremely difficult. The situation is further complicated by a simple truth; while most municipalities are lacking in adequate funds for GIS/LIS development, they also cannot afford to ignore their obvious need for a GIS/LIS and the benefits which can be derived from the implementation of such information management technology.

Since GIS/LIS demands substantial core and continued operational funding, the formation of public/private enterprises (PPE) as described earlier may be the only viable option for many municipalities wishing to establish a GIS/LIS capacity. Initially, some core (start up) funding may be derived from central government and/or external donors (allowing donors to "seed" initiatives). However, this is NOT a strategy for sustained funding and should only occur if a long term implementation and financial plan is presented by the recipient. With respect to the funding issues, there are a number of elements which should be considered both in Gdansk and other potential sites throughout Poland.

3.7.1 Adequate to Tasks

Above all, it should be evident that funding should be adequate to the tasks required of the system. If the necessary funds cannot be generated, then goals and objectives should be prioritized and scaled down to an achievable level. This will maintain a degree of pragmatism, credibility and avoid frustration among organizations and individuals involved in the GIS/LIS initiative. Over extension of resources is a frequent problem in the implementation process and should be avoided through careful planning.

3.7.2 Adequate Ratio Between Technology and Operational Costs

A good indicator to judge a GIS facilities operational ability is the rule of 20:80 ratio between technology and operational costs (Rhind, 1991). If hardware and/or software exceed this 20 percent limit of the overall budget, it is usually a clear sign that the facility is overstocked with technology and probably not capable to run efficiently. Above all, personnel, training, technical consulting but also data (automation, update and maintenance procedures) should be central demands in any GIS financing strategy.

In the specific case of Gdansk, a great deal of emphasis has been placed on the apparent need for digital ortho-photography for the entire urban area. While this is an excellent information resource for areas which have not been adequately mapped (not the case in Gdansk), this cannot be considered as a cost effective alternative for visualizing and mapping certain features in the urban landscape. Again, the 20:80 rule will apply. If a budget is made available for the actual capture of the aerial photography, than this may only constitute 20 percent of the entire funding required to automate, interpret, manage, analyze and archive the digital photography. Furthermore, training costs for specialized staff and the additional technology needed beyond regular GIS/LIS requirements, should be carefully considered. Although aerial ortho-photography does offer a great deal of information, the costs versus benefits for Gdansk are not clear at this time. Cheaper and quicker alternatives should be considered such as recent high resolution satellite imagery (10m, 5m and 2m), which is more than adequate to support mapping (1:25,000 to 1:5,000 scale) and various planning activities. Also, Gdansk has many other urgent needs which could be adequately addressed immediately, without resorting to the additional level of technical complexity imposed by digital aerial ortho-photography.

3.7.3 Sustained Core Funding

While initial "start up" costs may be easy to obtain, sustained funding must be planned for and guaranteed in the medium to long term. The diagram showing the proposed organizational structure for the GIS/LIS operation in Gdansk does identify a number of potential core funding sources (investors). These include the City of Gdansk itself through central budget contributions and funds from individual departmental budgets, the public/private utility companies, banks and other private investors. While core funding provides for many of the

initial costs (for data automation, soft/hardware acquisitions), operational costs will have to be covered by charging maintenance and/or usage fees to various users.

In Gdansk, a preliminary funding model has been developed. This proposes that the city pays for the procurement of hardware, software and funds some of the necessary core technical staff. As for the "base map" development and data automation, this will be funded by various investors (e.g. utility companies) with the base information acquired through mutual agreements with data sources such as the WODGiK. Officially, the city will "own" the automated "base map" layers which will be provided to the initial investors free of charge. Update/maintenance fees will be charged according to various applications and use. Fees will also fund the needs of individual (users) agencies to develop additional complimentary data layers or specific applications. Clearly, deriving funds from the charging of user service fees is attractive, but can be a complex and contentious issue. The mechanisms to obtain and manage these and other funds should be established at a high management level, namely, by the GIS/LIS Steering Committee. However, the funds themselves should be locally managed by the PPE, which will have the overall responsibility for day to day operations of the GIS/LIS.

While most of the funds for GIS/LIS development in Poland will have to be derived locally, central government funds may have an important role to play in the overall nation wide process to modernize LIS (as expressed in the document on this subject released by the Surveyor General—see **Appendix F**). The role of central government, specifically the Surveyor General, should be in providing municipalities with guidelines and certain recommended standards on GIS/LIS development. These guidelines should outline which elements of GIS development are most important to the overall national strategy to modernize LIS, and explicitly state why local participation is essential to this process. Some financial incentives (in the form of seed grants) may be made available to encourage local GIS/LIS initiatives to conform with these guidelines. However, these guidelines should be applied with consent and not by the decree of central government. Elsewhere, experience has shown that central planning and/or attempts to control local GIS/LIS development policy have failed. However, central government can promote a generic model for implementation with standards (on data sharing, transfer formats etc.) and guidelines. This model should embody the needs of a national LIS program, while at the same time allows local jurisdictions the freedom to develop systems which help solve their unique problems. (See **Appendix C.**)

Some elements of such a model are emerging in the Lodz Pilot Project (funded by the Surveyor General). These initial results should be more objectively assessed in order to determine which aspects of this approach are appropriate for other regions of Poland currently attempting to implement various forms of GIS/LIS. The implementation of GIS/LIS by local governments/authorities should be viewed as an integral part of the de-centralization process in Polish public administration reform. The creation of integrated information management systems at the municipal level will greatly empower decision makers, and could provide accurate data to central government describing local conditions and needs.

The technology to make this a reality is readily available and sustainable. However, the major obstacles remain the institutional and procedural frameworks to facilitate an integrated environment.

3.7.4 Cost Recovery

Possibilities of cost recovery should be evaluated in the formulation of any GIS/LIS implementation plan. Realistic cost recovery is only possible in a very concrete, project oriented environment with well defined deliverables, products and prices. In Gdansk, early plans have been formulated to develop products which can actively attract investment to the city. This includes compiling information derived from the GIS/LIS into periodic catalogues outlining land investment opportunities throughout the city. Certainly, a catalogue containing visual maps of available land, buildings, technical infrastructure, transportation networks etc. would be very compelling to a potential investor.

Secondly, it is hoped that the system will provide an information service to organizations and individuals in both the public and private sectors. For an established fee, casual users should be able to access various information resources managed by the GIS/LIS. These clients may include realtors, developers, lending institutions and external donors interested in funding development programs in the city. Obviously, such a "service" orientation will require careful planning, design and investment. However, the importance of an integrated GIS/LIS to provide easy access to various information resources should not be under estimated. Such accessibility to information should be a key goal of the entire implementation process and this function alone is capable of promoting "open" government, securing broad political support from a wide variety of potential users.

Indeed, many of the benefits to be derived from a GIS/LIS cannot be adequately measured by traditional methods of cost recovery and/or cost benefit analysis. Increased sharing of information resources and greater accessibility to information can lead to better, more informed decision making at all levels. From government down to individual behavior, decisions based on integrated information resources (as supported by GIS/LIS) can have a collective impact which may be extremely profound although difficult to quantify.

3.8 Professional-Staffing Issues

The implementation of a GIS/LIS presents both technical and administrative demands which should be addressed by competent professional staff. However, staff possessing the requisite skills are difficult to find, and even harder to retain especially in the public sector. This is one of the reasons why a Public-Private Enterprise (PPE) is proposed for the City of Gdansk GIS/LIS. This will create an environment where technical staff can serve the city, while at the same time supplement their income with activities in the private sector enterprise. In order to safeguard continued support for the GIS/LIS operations in the city, the PPE will be contractually obliged to supply adequate manpower to guarantee efficient operations. This is essential for continuity of system development and general maintenance.

Because the PPE will be a public-private semi-autonomous agency outside the city government structure, this will prevent political manipulation of the operations; a very real concern in Poland.

Management will have to integrate with the existing government structures while at the same time maintaining a private sector approach; as a profit center geared towards productivity and quality of support for various clients utilizing the system. This will demand a cadre of core professional staff as part of the PPE who may also be supplemented by contractor (sub-) staff as needs become apparent.

The following core staff and functions have been identified as essential to the operation of the PPE which should be capable of providing adequate support to the various users identified in the organizational diagram.

3.8.1 Operations Manager

Responsible for overseeing all GIS/LIS operations, direct liaison with Executive Steering Committee, should have a clear understanding of the functions of city government and of GIS/LIS technology. The present head of the GIS Unit, Mr. Jan Szczegielski is fully qualified to maintain this important position.

3.8.2 Database Administrator

Responsible for management of multiple databases integrated within the GIS/LIS environment. Maintenance of update routines and procedures will be priority function as will security, archive and access issues.

3.8.3 Network/Systems Manager

Maintain hardware and software components of the system-enforce maintenance procedures (sub-contracts). Also, maintenance of physical communications network (via proposed fiber optic link) between users for data sharing and access.

3.8.4 Geodetic/Quality Control Specialist

Ensure quality of data to be entered into the system (graphic and attribute). Quality control on output products from the system. Maintain database integrity.

3.8.5 Applications Specialist

Develop and maintain custom applications to support client (user) needs e.g. parcel maintenance.

3.8.6 Communication/Process Specialist

A unique responsibility to coordinate activities of multiple agencies participating in the GIS/LIS, assess user needs, facilitate information exchange and dialogue between agencies. Promotional activities and public relations.

3.8.7 Foreign Experts

An issue of debate is the value of foreign experts with respect to GIS projects. It is often assumed that the necessary skills are locally available, or can be acquired through short term training and or seminars alone, thus making external consulting assistance obsolete. Certainly, isolated and short term technical assistance is not worthwhile unless there is a continuum of activities; essential to GIS development which should be viewed as a long term approach. Thus, periodic external assistance over extended periods can contribute significantly to GIS implementation through technical experience and objective assessment of various activities as they develop. In Gdansk, it is hoped that the present assistance will be extended with additional focussed short term technical inputs.

However, in order to maintain essential quality, continuity and perspective, these inputs should be guided by a supervising consultant committed to the longer term and cognizant of the unique environment in Poland. This model will provide Gdansk with the necessary technical inputs while allowing continual external assessment of the GIS/LIS development process. However, it should be clear that long term assistance should not imply dependence. The aim will be to transfer the necessary skills and knowledge which provide the foundation for self sustainability. The time required for this to occur is difficult to assess precisely. Nevertheless, a state of sustainability is reached incrementally and is characterized by systems which both output products and support various activities beyond their own operational needs.

The GIS/LIS staff profiles suggested for Gdansk represent an ideal model: in reality staff are required to share multiple tasks with some degree of cross cutting in responsibilities. While some of the tasks outlined can be performed by existing GIS staff at the City of Gdansk, training in the relevant specialized skills will be essential and is an immediate requirement. Details of these training issues will be outlined in the following sections.

3.9 Training Issues

While traditional subject focussed training activities are important, the more relevant issues of continuity, such as motivation, the generation of useful applications and experience are basically un-trainable and have to be developed over longer periods of time in sustainable, institution building processes.

In terms of contents, there are two main facets to GIS training namely the technology and its application. Should training cover mainly technical aspects to allow individuals to use

GIS as a tool, or should it address various application areas? Invariably, any training program should attempt to cover both.

GIS training should be customized to impact specific local problems faced by the City of Gdansk in their GIS/LIS development project. These skills should be broadly focussed towards how the system can effectively provide the information resources to end users. The forms of GIS training should be delivered in three categories:

3.9.1 Sensitization Events

These should be short and designed to introduce small groups at a senior management level to GIS technology. These events are important to sustain the necessary political support to both fund and mandate the existence of a GIS/LIS facility. However, these sessions should not be merely public relations exercises. They should always be held in an objective pluralistic manner, allowing time for open and critical discussions. Given the limited amount of truly objective information on GIS/LIS in Poland, a national LIS implementation seminar for senior decision makers may be appropriate at this time. This event would focus on and outline specific issues which should be addressed in order to ensure effective implementation in the Polish situation.

3.9.2 Training Courses

These are the most common forms of GIS training and are usually focussed on the technical aspects of system development. The intensity of these courses allows the participants to be fully motivated and dedicate much of their time to these activities. Such events should be conducted by resource persons who are fully briefed on the needs and capabilities of the trainees.

By necessity, these training sessions have to be short which limits the ability to adapt them to local conditions. However, such courses should be placed into a longer term framework with repetitive learning activities which are open towards the longer term goals.

3.9.3 On The Job Training

On-the-Job training by expert resource person(s) present at the site are the most viable and sustainable forms of GIS/LIS training. In Poland, the demands for this type of training activities are huge emanating from numerous sites struggling to implement GIS/LIS. This need could be partially addressed by the strategic appointment of a long term advisor in the country to coordinate these essential longer term activities. This model allows not only for the adaptation of GIS applications to the local problem areas, but also includes aspects beyond training such as longer term education and incentives for self motivation. As noted, a continuum of activities is critical. In the short term, this implies expatriate assistance which can be expensive, although less so when one considers the total expenditures on GIS/LIS development in Poland which amount to many millions of dollars and will only increase.

Therefore, training which imparts not only technical skills but also professional proficiency to adapt and integrate the technology is highly desirable even essential. This will ensure that the substantial investments made into developing these systems are realized in tangible benefits at the local, regional and national levels.

3.10 Immediate Training Needs in the City of Gdansk

A number of clear training needs were identified and requested by the Gdansk GIS unit. These are essential if the transition is to be made from the present automation of maps (using CAD technology) to a topological data model which provides graphic elements with "spatial intelligence" facilitating analysis and application development. This will require migration to new (topological) software such as ArcCAD and ARC/INFO. This will also necessitate training in:

1. **Topological (Arc-Node) Data Model** - Theory, creation and management of spatial data using topological GIS software. Part of this training may include a "hands on" exercise to convert the present pilot area from CAD files to topological coverages. This would provide technical staff with experience in the procedures necessary to conduct this important task.

Once the graphics files have been converted to topological coverages, the city should apply a relational database management system (RDBMS) to manage the various databases to be supported by the GIS/LIS (See **Figure 1**). This will require:

2. **Training in RDBMS** - Theory and practical application of these systems (e.g. ORACLE) for the management of large, urban databases in a GIS/LIS environment. This should include the conceptual and physical database design processes. (See Implementation Plan section for stages.)

The City of Gdansk GIS/LIS program is still firmly in the data automation/inventory stages. Indeed, maps are physically being reviewed, updated and automated (through manual digitizing) in the city and at the WODGiK. Since this is a labor and time (cost) intensive process, an efficient methodology is essential. Therefore, this effort could clearly benefit from:

3. **Training in Data Automation and Conversion Techniques** - methods and procedures to ensure the time/cost effectiveness of automation conversion and update routines.

After the establishment of a topological data model and RDBMS, this will facilitate the design and development of specific applications to support various processes and functions within the city e.g. land disposition, detailed planning, deed management etc. These applications will require a conceptual design process prior to development using various GIS software tools (see Applications section). Training in this design process will be required in the medium term. The types of applications required, their design and objectives are discussed in more detail in the Applications section.

3.11 Recommendations

The following recommendations are made in the context of the issues discussed in this section:

1. The City of Gdansk should formalize the management structure for future GIS/LIS development in the form a Public-Private Enterprise (PPE).

2. Define which agencies (internal and external) will be partners in the PPE, how they will interact, cooperate and distribution of responsibilities.

3. Consolidate agreement between the city government (Urzad Miejski), the regional office of surveyor (WODGiK) and the Court of Justice. These agencies form the information "backbone" of the GIS/LIS. Coordinate GIS related activities more precisely, agree upon standards to promote data transfer, sharing and application development. Develop standards for automation of data avoiding potential conflict and inconsistencies. Similar details in cooperative agreements should be implemented with utility companies.

4. Define and ratify institutional framework for GIS/LIS development with respect to the city government i.e. relationship and role of gmina in PPE.

5. Secure initial budget, develop long term funding strategy for operations.

6. Accurately assess and document future needs and responsibility of various agencies and/or partners cooperating with the PPE.

7. Develop procedural manual and charter for the PPE.

8. Secure alliance with NEOKART Ltd in PPE for long term technical assistance and external consulting experience derived from the Lodz project.

9. Propose Gdansk as a national case study for GIS/LIS implementation model. Seek closer cooperation and financial support from the Office of the Surveyor General.

10. Implement funding mechanisms and define a cost sharing program between partners and/or investors.

11. Develop prospectus to attract funding from external investors, banks, funding agencies etc. This may be developed in conjunction with CSK Ltd. whose automation of deeds for Gdansk is a crucial element of future database(s), and is most attractive to potential investors.

12. Allocate/hire staff to necessary core positions as defined in this section.

13. Secure long term commitments to periodic external technical assistance from foreign experts with a guarantee of continuity of personnel to supervise this input.

14. Schedule training in:

- Topological GIS Data Model - theory and implementation, focus on ArcCAD and ARC/INFO training.
- RDBMS - theory and practice, focus on the ORACLE RDBMS environment. Include conceptual and physical database design processes.
- Data Automation and Conversion techniques
- Application design and development process (with possible assistance from NEOKART with focus on Lodz project applications).

15. Adopt elements and stages of the implementation planning process outlined in this report. Potentially use this as a basis for a more comprehensive implementation plan document ("Plan Techniczny").

4 GIS/LIS Technology Issues

4.1 Introduction

An important aspect of GIS/LIS planning and implementation is careful consideration for the hardware/software/communications technology platform from which the system is to be built. GIS/LIS implementation is evolving as new technologies are developed and tested. Each year, new solutions are offered by vendors, making GIS/LIS a rapidly changing arena. It is prudent, therefore, when selecting a GIS/LIS technology platform to consider a hardware/software/communications configuration that is well aligned with industry trends and provides flexibility for future changes in technology.

All components of GIS/LIS technology are subject to this fast pace of change, driven by the need to input, process, output and access geographic information in the most efficient and cost effective manner. The costs for hardware/software/communications facilities can be a significant investment for local governments. It is important to reduce those costs by taking advantage of existing technology resources where possible, while at the same time, maximize return on investment by establishing a technology platform that will meet the information management objectives of GIS/LIS throughout the organization.

Appendix D provides an overview of existing technology in place at the City of Gdansk. However, this section highlights the strengths and weaknesses of the hardware/software/communications environment with respect to GIS/LIS. General recommendations for a strategic GIS/LIS technology platform are also provided.

4.2 Evaluation of Current Technology for GIS/LIS

The purpose of this section is to evaluate the strengths and weaknesses of the current technology environment with respect to GIS/LIS implementation. The evaluation considers applications software, hardware and communications which represent the major components of a GIS/LIS technology platform. Each strength or weakness is described in terms of an observation, the impact of that observation on GIS/LIS implementation and key considerations for future implementation planning.

ANALYSIS OF CURRENT TECHNOLOGY
CITY OF GDANSK

OBSERVATIONS	IMPACT	RECOMMENDATIONS
APPLICATION SOFTWARE **Strengths:**		
Autocad and Intergraph's microstation are state-of-the-art software systems that provide excellent automation tools for developing detailed designs and plans for public facilities such as parks, libraries, buildings, and water treatment plants, etc.	The software provides excellent capabilities for processing detailed plans and designs as part of the development review approval processes. The interfacing of both CADD and GIS systems will strengthen the City's information handling as it relates to facilities planning and management operations and other business functions.	The AutoCad & Microstation software should be distributed to engineers, architects and facilities managers to support the design of new public facilities and the management of existing facilities. System interfaces between GIS/LIS and CADD systems should be established to support multi-media applications. For example, GIS could provide the street network analysis functions to support computer-aided dispatch of fire trucks, while CADD could supply on-line access to building floor plans to illustrate the location of entrances, exits, stairwells and other building details which may help fire fighters to evacuate people and property and to fight the fire.
APPLICATION SOFTWARE **Weaknesses:**		
There are not adequate GIS software tools to support the development of a GIS data base and related applications. The Gdansk-Barcelona database software is a non-standard product that is not well-aligned with industry trends and is not supported by an established commercial software company that can provide	Without GIS functionality, City employees will not be able to perform spatial analyses of geographic data, and therefore, will not have adequate software tools to support their business applications. The City's return on investment for map automation will be limited. The City will enter a high risk situation	The City should initiate a procurement process to evaluate and select an appropriate GIS software platform that will best support its high priority business applications. Acquire a Database Management system that interfaces with GIS software products from an established company that can provide a full range of

37.

ANALYSIS OF CURRENT TECHNOLOGY
CITY OF GDANSK

OBSERVATIONS	IMPACT	RECOMMENDATIONS
APPLICATION SOFTWARE **Weaknesses (Cont.):**		
reliable technical support or improved functionality through the life of the system. It does not interface with established GIS software systems.	where the life of the GIS/LIS could significantly diminish if they develop the system with unsupported, non-standard software products. System maintenance costs will be higher and the City will not be postured to take advantage of new software developments as they become available. Custom interfaces will have to be developed with GIS software, and therefore delay GIS/LIS implementation.	software maintenance and support services. Serious consideration should be given to a relational database management system as that is the current trend in the industry and the type of DBMS that has proven most suitable for GIS/LIS implementations.
The Gdansk-Barcelona database software does not provide full DBMS functionality.	The software will not provide adequate tools for managing vital land records in a multi-user, transaction driven environment, thus creating a high risk for data corruption.	The City should evaluate its functional requirements for database management systems, rank the importance of each functional requirement and establish criteria for selecting database management software. Future database development should be accomplished through the use of an acceptable DBMS.
HARDWARE **Strengths:**		
The Workstations and peripheral devices connected to the system for Land Information's PC-based LAN provide high performance solutions for spatial data input, review and editing operations.	The PC-based LAN provides a technology platform and tools to support high volume spatial data input and/or raster image processing and will facilitate GIS/LIS database development. The large format digitizing tablets provide	In order to expedite GIS/LIS database development, additional digitizing tablets can be added to the LAN at relatively low cost to the overall project. Methods for utilizing the scanning device as a productive tool for capturing data from

ANALYSIS OF CURRENT TECHNOLOGY
CITY OF GDANSK

OBSERVATIONS	IMPACT	RECOMMENDATIONS
HARDWARE **Strengths (Cont.):**		
	excellent tools for capturing vector data from the parcel and facilities maps maintained by the regional surveyor. The scanning devices when used in conjunction with software that can convert raster images to vector data provides a state-of-the-art solution for capturing information from either aerial photography or satellite imagery that may be more current than some of the information on the existing maps or may not be carried on the maps.	aerial photography or satellite imagery should be evaluated and developed.
HARDWARE **Weaknesses:**		
The DOS-based Intel 80486 processor currently being used as a file server on the system for Land Information's LAN does not support a multi-user applications environment, and therefore, has limited utility as an enterprise server.	GIS/LIS technology usually involves citywide data and applications that are frequently shared by multiple departments. Both the data and applications are best utilized when stored in a common central repository rather than distributed in pieces across departments. The current file server will not support multi-user access to centralized applications and will require most costly solutions for creating common, automated methods for accessing both data and applications functionality.	The City should implement Unix-based servers that will allow city departments and external jurisdictions to more cost effectively share GIS/LIS applications.

ANALYSIS OF CURRENT TECHNOLOGY
CITY OF GDANSK

OBSERVATIONS	IMPACT	RECOMMENDATIONS
COMMUNICATIONS **Strengths:**		
The existence of the Polish Academic and Research Network (NASK) and the twenty-two kilometers of dark single-mode fiber optic cable laid by the Polish Cable Television Company offer critical building blocks that can be used for a regional data communications network.	Integration of the TCP/IP routing capabilities of the NASK packet switching network and the fiber optic cable could form a citywide GIS/LIS communications backbone with adequate data transmission performance to support high volume transport for the large data packets typically associated with GIS/LIS.	Evaluate the feasibility of routing the NASK packet switching network to the cable television fiber optics, and if feasible, implement as a communications backbone for the regional GIS/LIS network. If the fiber optic cable does not extend to all required locations within the City, additional cable could be extended to those locations or spread spectrum radio frequency technology could be utilized which will provide wireless bridges between buildings that support 2 megabit data transmission rates for up to three kilometers.
COMMUNICATIONS **Weaknesses:**		
There is no comprehensive communications strategy that has been developed to support high volume data transport between departments within the City of Gdansk or between the City of Gdansk and external jurisdictions within the region.	The lack of a regionally integrated network will severely limit efficient access to a GIS/LIS data repository. The GIS/LIS will, therefore, have limited capabilities to support business applications and information sharing.	Develop a comprehensive communications strategy that embraces open systems standards and utilizes a combination of media structures to form a network backbone for data communications between offices in geographically separate locations.

5 GIS/LIS Implementation Plan

5.1 General Overview

The implementation plan summarized in this section provides a model for the design and development of a local government GIS/LIS using structured systems development methodology. Although it was developed for the City of Gdansk, it is intended to serve as a general guideline that can be used by local and regional governments throughout Poland in planning and implementing GIS/LIS technology.

The plan utilizes a phased implementation approach as illustrated in **Figure 8**. Brief descriptions of the primary tasks to be performed within each phase are provided. The phased implementation model divides the work effort into manageable segments, provides for a logical workflow and serves as a checklist of the work items that are important to the success of a GIS/LIS project.

It is recommended that those local governments who choose to work within the parameters of this implementation model, should use it as a framework for developing more detailed plans that are specifically adapted to their unique organizational structures and existing information systems environments. Flexibility is imperative and the various tasks within each phase should be "tailored" to meet the functional and technical needs of individual projects. At the beginning of each project phase, a more detailed workplan and schedule should be developed which takes into consideration the availability of resources, the current level of automation, any existing systems development plans or work in progress and the condition of land records and map information.

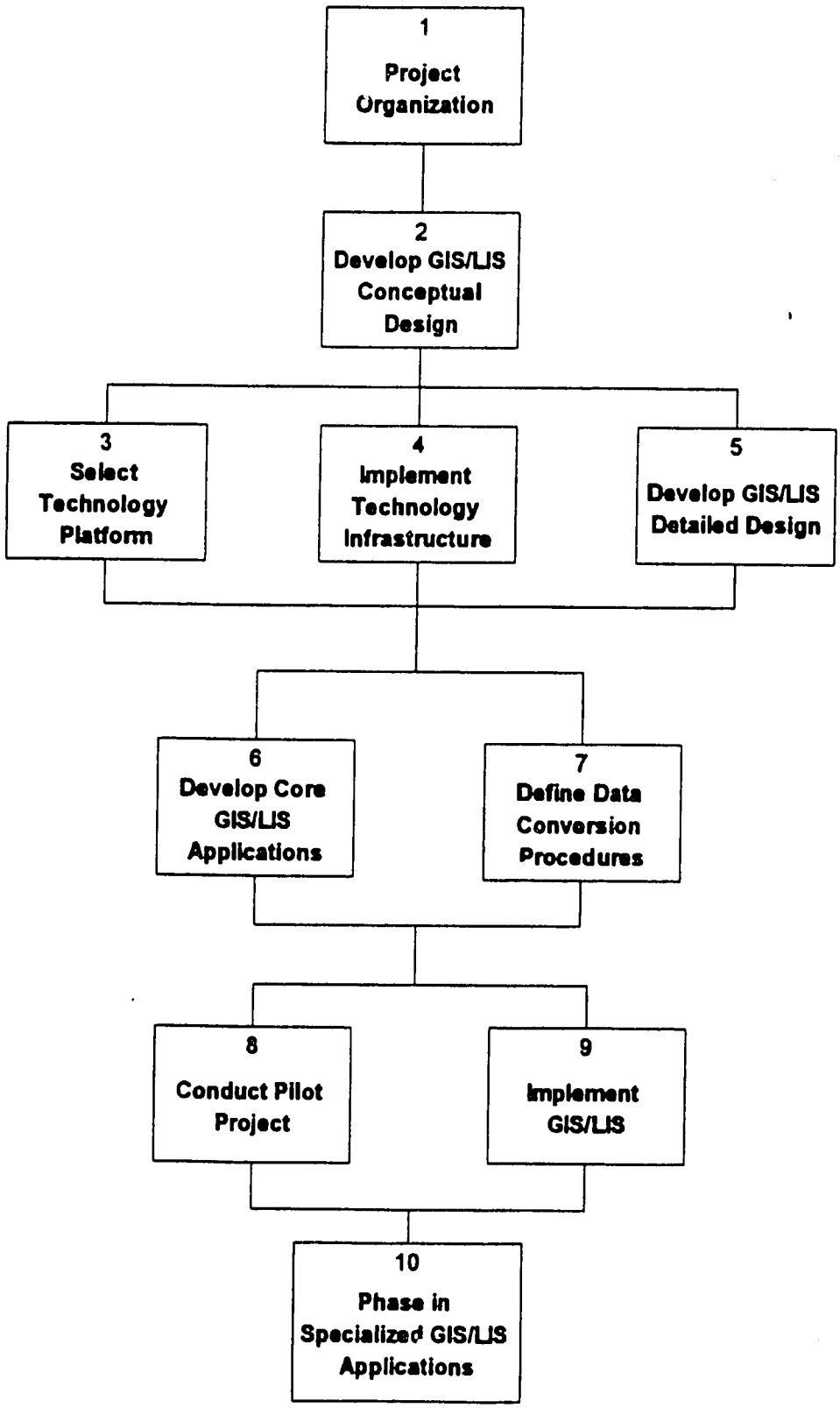
The major benefits of the GIS/LIS implementation methodology are summarized as follows:

- Provides a proven approach for successful GIS/LIS implementation projects
- Identifies the required phases and tasks that must be performed to produce a quality system
- Provides a control mechanism for tracking and managing project responsibilities
- Ensures systems testing, documentation and training
- Minimizes project disruption in the event of personnel turnover
- Facilitates communication within the project team and between the project team, user personnel and management

As a follow-up to this mission, it is recommended that a National Workshop for local governments be organized and sponsored by USAID to provide training in GIS/LIS planning and implementation using the model and methodology developed during this mission. The City of Gdansk could host the workshop during the second quarter of 1994 following the completion of Phases A and B of their GIS/LIS project. In this manner, case study examples

Figure 8

City of Gdansk
GIS/LIS Implementation Plan



of how various aspects of the implementation model are executed could be provided at the workshop.

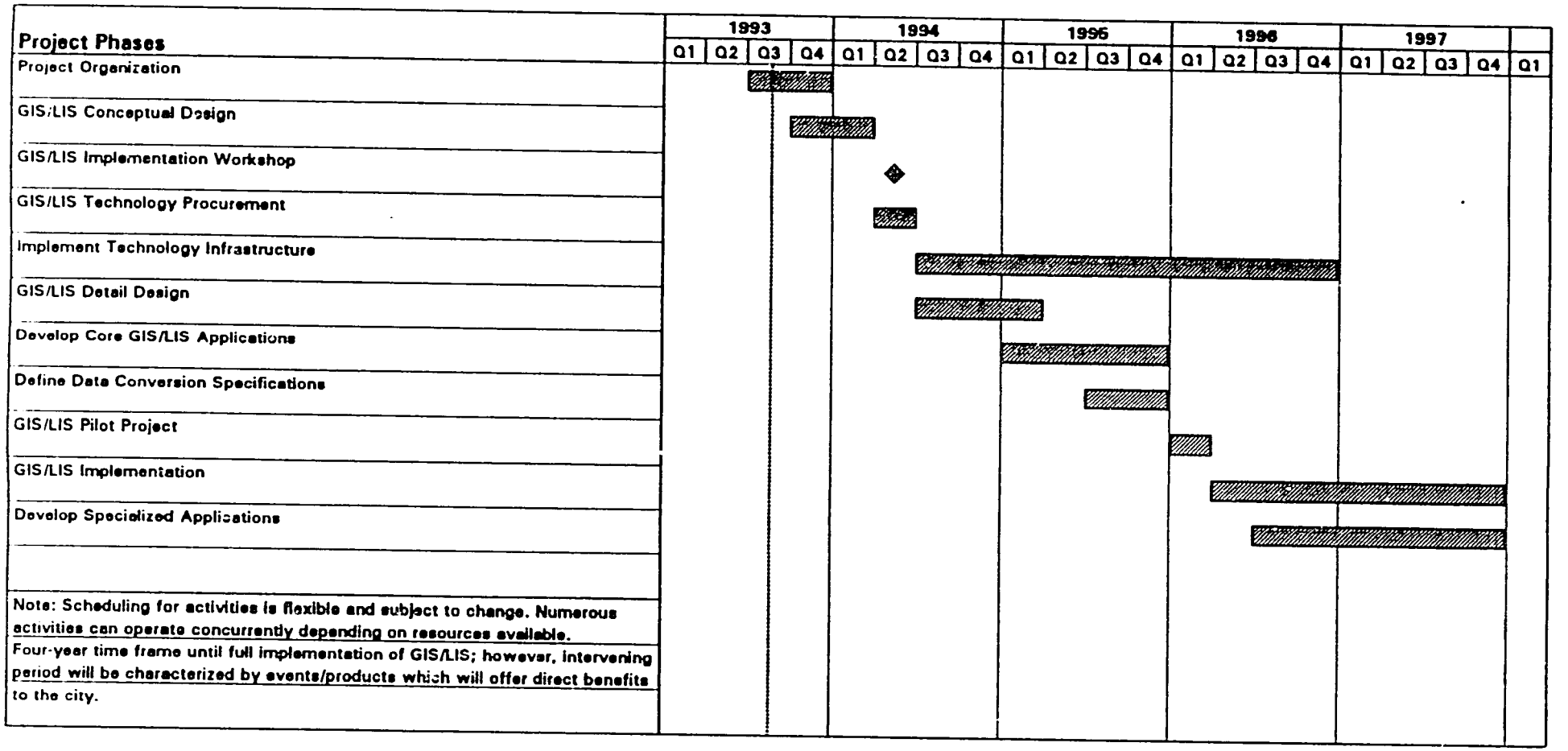
5.2 Project Workplan and Schedule for Gdansk

Figure 9 provides a high-level project schedule for the City of Gdansk and illustrates the level of effort and commitment of time that will be required as the City moves forward with its GIS/LIS implementation project. The schedule should be revised and updated at the beginning of each project phase.

It is recommended that a member of the original mission team continue to provide consultation to the City of Gdansk through the duration of the project to assist with the organization and detailed planning that will be required for each project phase. It is further recommended that technical specialists work cooperatively with the USAID consultant and the City of Gdansk personnel to assist with some of the specific technical tasks to be performed during each project phase. Because of the highly technical nature of GIS/LIS design and development, coupled with the lack of experience and expertise of the City's personnel, this approach will provide an effective mechanism for technology transfer. As the skill levels of City personnel improve through each phase of the project, the need for and involvement of outside consultants and technical specialists will diminish concurrently.

The near term action items for the City of Gdansk are to implement an organizational structure, execute formal agreements with the external participants and establish stable project funding mechanisms. In order to keep the project momentum going forward and to insure continuity through each subsequent implementation phase, the organizational and funding arrangements to be established in Phase A should be fully implemented by the end of 1993. GIS/LIS Conceptual Design - Phase B can be initiated before the completion of Phase A and work could begin in the last quarter of 1993. The GIS/LIS Conceptual Design Phase sets the stage and establishes a foundation for all other project phases that follow, therefore, it is important to provide substantial technical assistance from GIS/LIS consultants at this critical juncture.

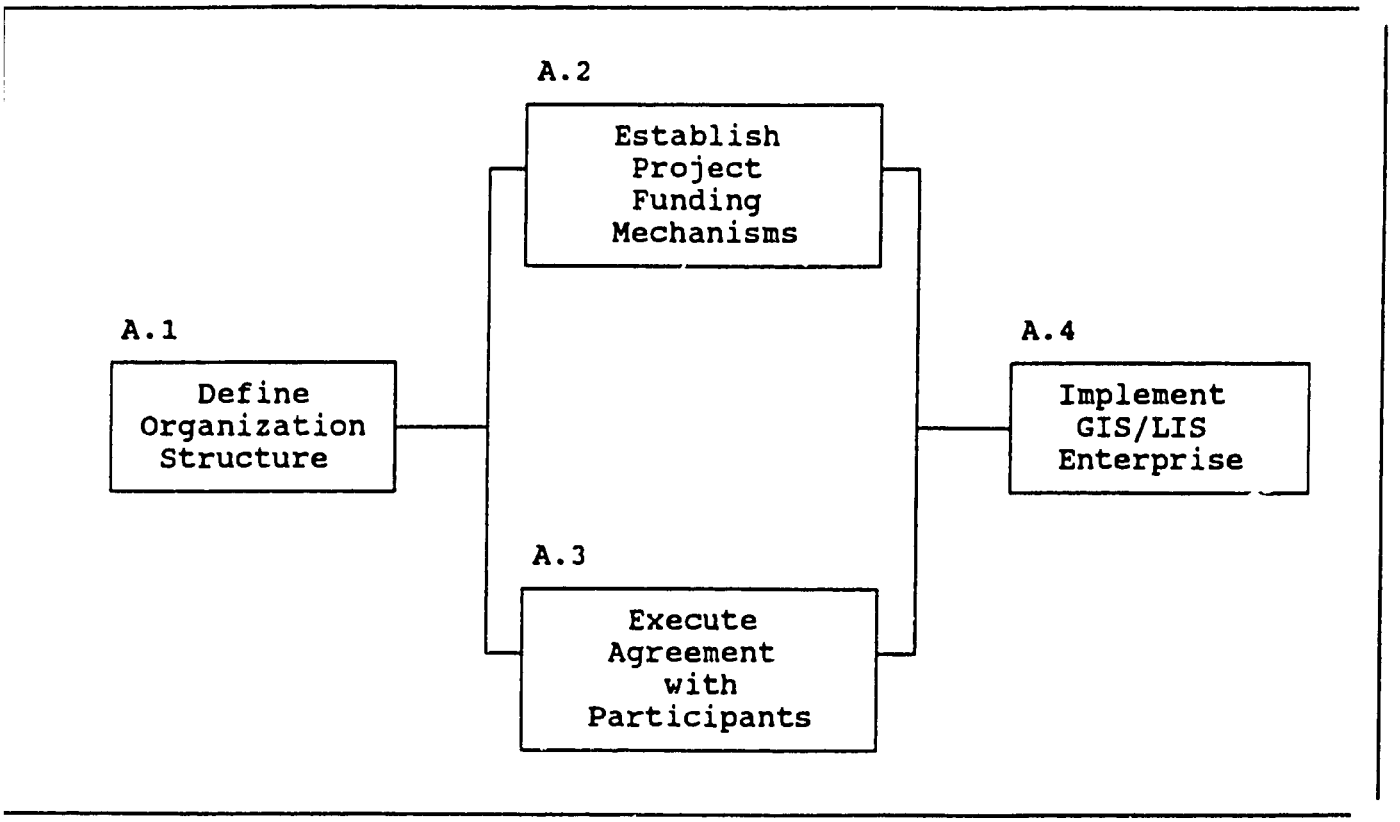
Figure 9. City of Gdansk, Poland
GIS/LIS Implementation Plan



Note: Scheduling for activities is flexible and subject to change. Numerous activities can operate concurrently depending on resources available.

Four-year time frame until full implementation of GIS/LIS; however, intervening period will be characterized by events/products which will offer direct benefits to the city.

A - Project Organization & Administration



Key Activities

A.1 Define the organizational relationships between internal and external participants, identify personnel requirements, and describe the roles and responsibilities for each group contained within the organizational structure. The City of Gdansk has already accomplished a significant amount of this work and it will be completed as part of the initial technical assistance provided by U.S.A.I.D. to the City Gdansk for the development of a GIS/LIS implementation plan.

A.2 Determine the high-level resource requirements for GIS/LIS implementation, identify potential funding sources and evaluate formal cost sharing arrangements between participants. Funding mechanisms should be established in order to sustain planning and develop of GIS/LIS technology and to insure project continuity through all phases of implementation. Cost allocations must be fully understood among the participants before the execution of formal agreements.

A.3 Negotiate and execute formal agreements between external participants. Potential participants include:

- Voivoda for City of Gdansk
- Regional Court of Justice
- Utility Companies
- Local Banks
- Developers
- Technical Services Contractors

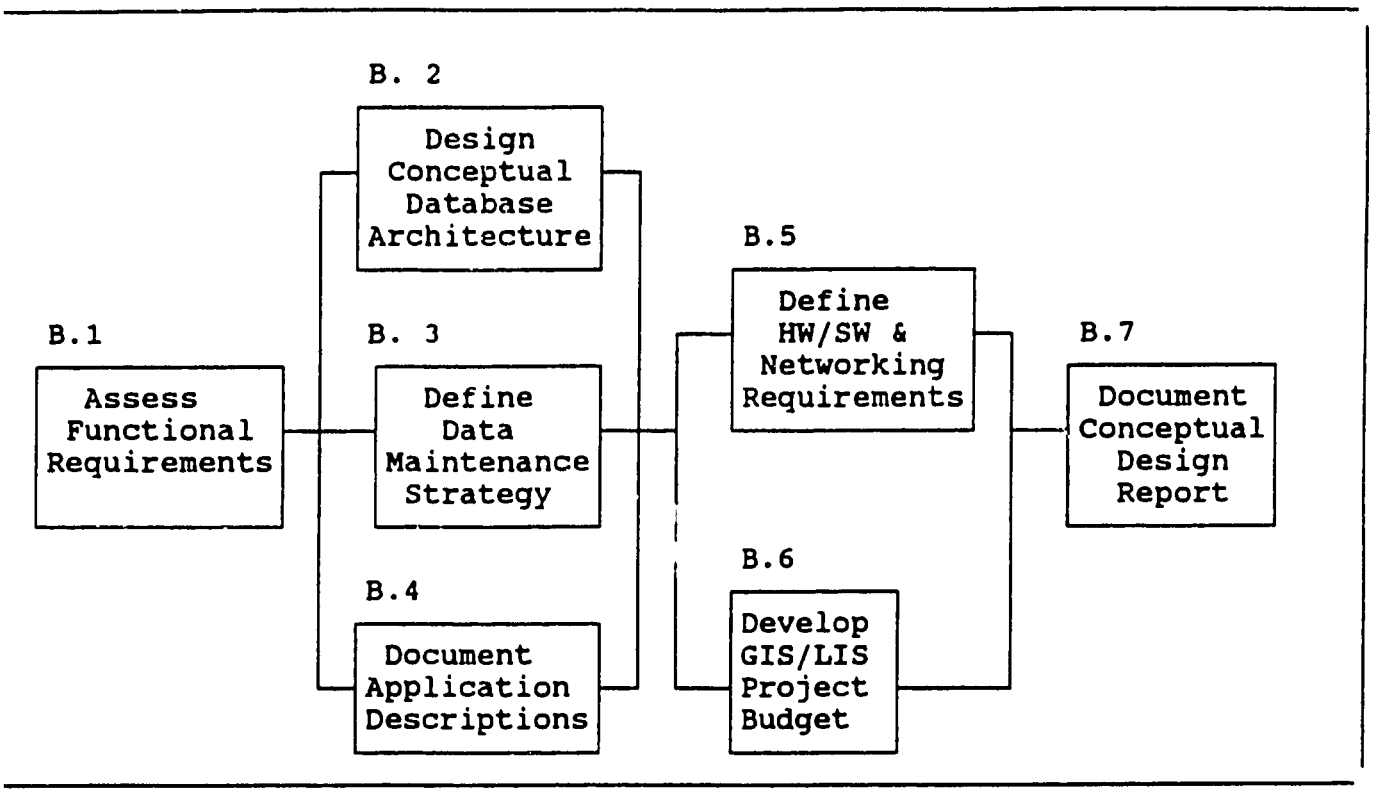
A.4 Organize and establish a public-private enterprize that will provide professional GIS/LIS administration, management and technical support services to the City of Gdansk and external participants. The City of Gdansk and other public entities such as the regional Voivoda do not have the technical expertise in-house to fully manage, design, develop and provide technical support for GIS/LIS technology. In addition, under the existing salary structure for government employees, they cannot afford to pay the salaries required to hire appropriate expertise.

The formation of a private-public partnership is a viable alternative that could provide the flexibility needed to facilitate both technical and administrative operations in an efficient and effective manner.

Project Phase Deliverables

- Project Organization
- Multi-Participant Agreement
- Project Funding Sources

B - Develop GIS/LIS Conceptual Design



Key Activities

B.1 Using survey techniques and conducting interviews with the key departments for each participant organization, the functional requirements for GIS/LIS technology will be evaluated, prioritized and documented. Typical issues to be addressed include:

- Identify and describe strategic business processes that will benefit from GIS/LIS technology, such as building permitting, land use planning and land privatization
- Assess data accuracy requirements
- Summarize the requirements for database content
- Inventory and evaluate existing data sources
- Identify and prioritize GIS/LIS application requirements
- Document hardware/software/data communications requirements
- Define system security requirements
- Determine training requirements
- Evaluate data translation requirements
- Identify system interface requirements

Some of these tasks were performed during the initial GIS/LIS consulting services provided by U.S.A.I.D., however, additional and more detailed work is required in this area.

B.2 General descriptions of the high priority business applications will be documented in order to evaluate what software tools and functional capabilities will be required to support GIS/LIS applications development. This information will also be used as a foundation for the application design and development work to be performed in phases E and F of the project implementation plan.

B.3 Define data ownership and develop organizational strategies for maintaining all data elements to be converted into the GIS/LIS database.

B.4 Design a general framework for organizing information into the GIS/LIS database. The conceptual database architecture will include a thematic layering strategy for geographic data themes and define the relationships between logical groupings of graphics data and textual (attribute) information. Factors to be considered include data requirements, information flow throughout the organization and GIS/LIS application requirements.

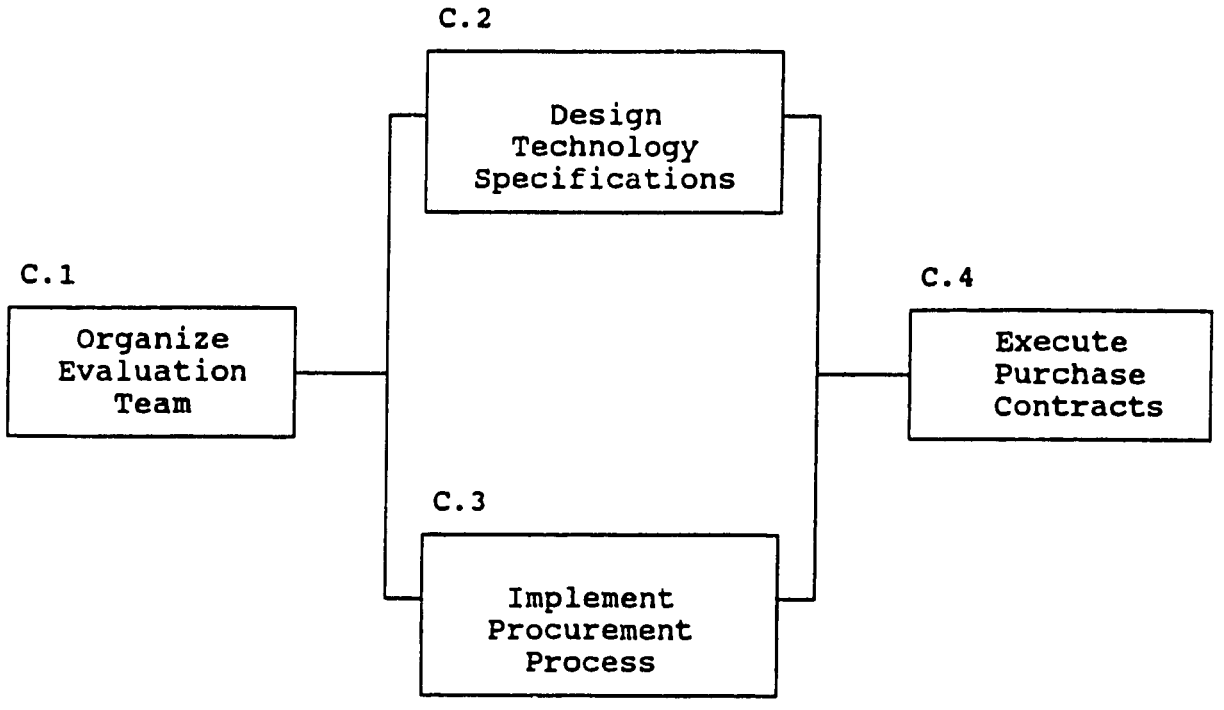
B.5 Develop and document alternative hardware/software/data communications configurations which take into account the utilization of existing technology for which the City of Gdansk and other external participants have already invested capital resources. The kind, number, placement and projected costs of central data processors, computer workstations and other peripheral devices will be fully defined along with a networking strategy that supports the functional requirements of the GIS/LIS; including such operations as data access, data sharing, data transfer, data maintenance, system interfaces and system backup/recovery.

B.6 Develop high-level cost estimates and establish a budget that will support all of the GIS/LIS implementation activities summarized in the project workplan and schedule.

Project Phase Deliverables

- Functional Requirements Documentation
- Conceptual Design Report
- Project Budget

C - Select GIS/LIS Technology Platform



Key Activities

C.1 Organize an evaluation team composed of key representatives from all participating groups and independent consultants with expertise in the use an application of GIS/LIS technology. Establish competitive procurement procedures, evaluation criteria and a procurement schedule.

C.2 Develop detailed specifications for hardware, software and data communications facilities. Define the terms and conditions of procurement. Incorporate both the technical specifications and terms and conditions into a formal request for proposals (RFP).

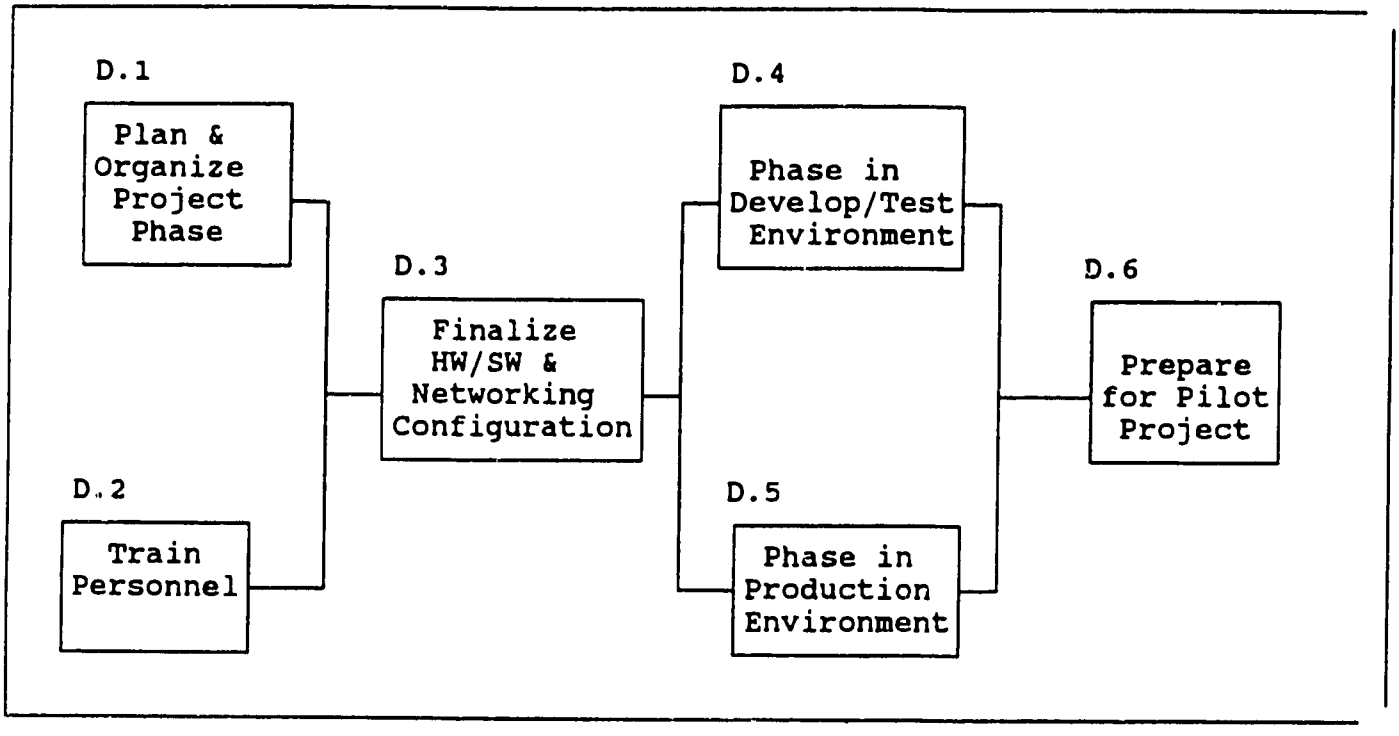
C.3 Publish the RFP and hold a prebid conference to clarify procurement procedures and technical specifications for the prospective bidders. Evaluate submissions of written proposals and determine a "short list" of the most qualified bidders. Conduct functional benchmark tests of the "short listed" vendors' proposed solutions, evaluate the benchmark results and make final selection.

C.4 Define terms and conditions and execute purchase contracts with selected vendor(s).

Project Phase Deliverables

- Technical specifications for GIS hardware and software
- RFP Document
- Purchase contracts

D - Implement Hardware/Software/Communications Infrastructure



Key Activities

D.1 Organize a technical project team, define the roles and responsibilities of the team members and develop a detailed workplan and schedule for the project phase.

D.2 Determine the training requirements of the project team in relation to the GIS/LIS technology platform selected and the technical tasks required to complete the project phase. Obtain training from hardware/software suppliers or other reliable sources.

D.3 Review hardware/software/data communications specifications developed in phases A and B of the project and prepare final design configurations for the selected GIS/LIS technology platform. Final configurations should be developed in cooperation and consultation with selected hardware/software vendors.

D.4 Install, configure and test all of the hardware, software and communications network components required to support GIS/LIS development, testing and implementation operations. Design and implement system partitions for migrating applications software from development and testing environments to staging areas for user acceptance testing to the final production environment. Establish systems administration and backup/ recovery procedures necessary to support GIS/LIS development and testing activities.

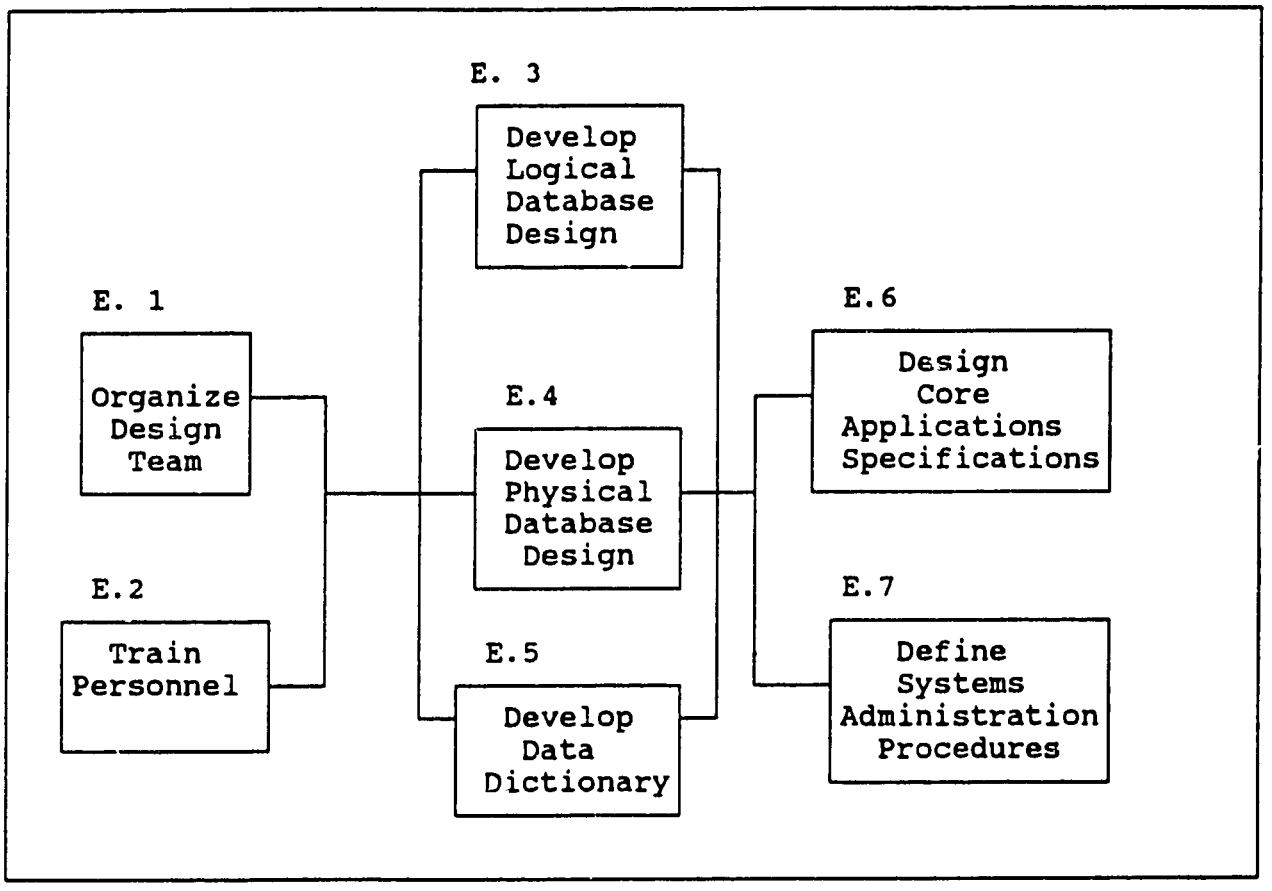
D.5 The acquisition, installation and testing of computer workstations and peripheral devices (e.g. plotters and printers) required to support GIS/LIS production activities will be phased in concurrent with the delivery of data and applications developed in subsequent phases of the project.

D.6 Integrate and test technical systems environment in preparation for the GIS/LIS pilot project.

Project Phase Deliverables

- Trained personnel
- Data communication network operational
- GIS hardware and software installed and tested
- Technical environment established to support GIS development, testing and production operations

E - Develop GIS/LIS Detailed Design



Key Activities

E.1 Organize a technical team, define the roles and responsibilities of the team members and develop a detailed workplan and schedule for the project phase.

E.2 Determine the training requirements of the project team in relation to the GIS/LIS technology platform selected and the technical tasks required to complete this phase of the project. Obtain necessary training from hardware/software suppliers or other reliable sources.

E.3 Review the conceptual database design architecture developed in Phase B and refine the design concepts down to the data entity level. Describe the graphic data elements to be included within in each data layer and determine whether they will be modeled as point, line, polygon or annotation features. Describe all textual data elements (attributes) that will be stored about each geographic feature. Assign data conversion and maintenance responsibilities down to the data element level. Document all design details in a logical database design report.

E.4 Translate the logical data models into physical data files and file types. Prepare entity/relationship diagrams that document the data elements associated with each file and the interfile relationships. Prepare table descriptions that define the record layouts, file structures, indexes and access keys for all required data files. Document all design specifications in a physical database design report.

E.5 Design and develop an on-line data dictionary that will support data conversion quality control operations and database administration functions.

E.6 Interview key users and assess the functional requirements for all of the core applications identified in Phase B. For each core application, a scope of work will be developed and documented along with detailed design specifications for user interfaces, application workflows, file and table descriptions, map and report layouts, and query and graphics display screens.

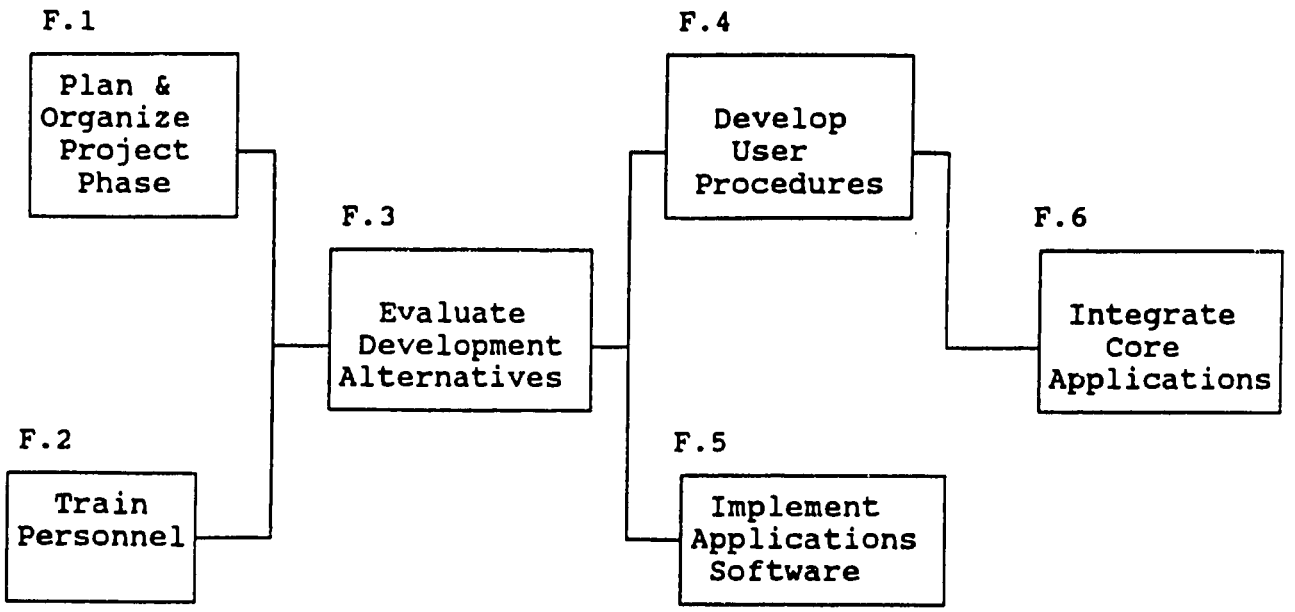
E.7 Develop and document systems administration procedures required to support GIS/LIS production. Specific issues to be addressed include:

- Change control procedures
- Problem Management
- System security and control procedures
- System backup/recovery procedures
- System performance monitoring & capacity planning
- Network management procedures

Project Phase Deliverables

- Logical database design documentation
- Physical database design documentation
- On-line data dictionary
- Application design specifications
- Systems administration procedures manual

F - Develop Core GIS/LIS Applications



Key Activities

F.1 Organize a technical project team, define roles and responsibilities of the team members and develop a detailed workplan and schedule for the project phase.

F.2 Determine the training requirements of the project team in relation to the selected GIS/LIS technology platform and the technical tasks require to complete the project work. Obtain the necessary training from hardware/software suppliers or other reliable sources.

F.3 The principle objective of this task is to evaluate whether or not there are any application software packages available from private vendors or other sources (e.g. another local government) that will meet the functional requirements for some or all of the core applications. If appropriate packages exist for certain applications, it may be advantageous to procure those packages versus the alternative strategy which is to custom develop the applications software using internal resources. The costs for purchasing an existing package could be cheaper than the custom development alternative, and it would significantly expedite the implementation schedule.

A survey of potential sources will be conducted to determine whether any software packages exist that may meet the GIS/LIS applications requirements. If existing software packages are available for an application, a fit analysis will be conducted where the application design specifications developed in Phase E are compared against the

functional specifications and capabilities of the software package. Depending upon the results of the fit analyses and other considerations (e.g. cost/benefit), final decisions for the implementation approach will be made for each application.

F.4 If a software package is selected, it will be installed and custom modifications developed as required. The application package will be tested and debugged where necessary. In those cases where an application is to be custom developed, the software will be coded and tested in accordance with the detailed application design specifications developed in Phase E and using structured systems development methodology.

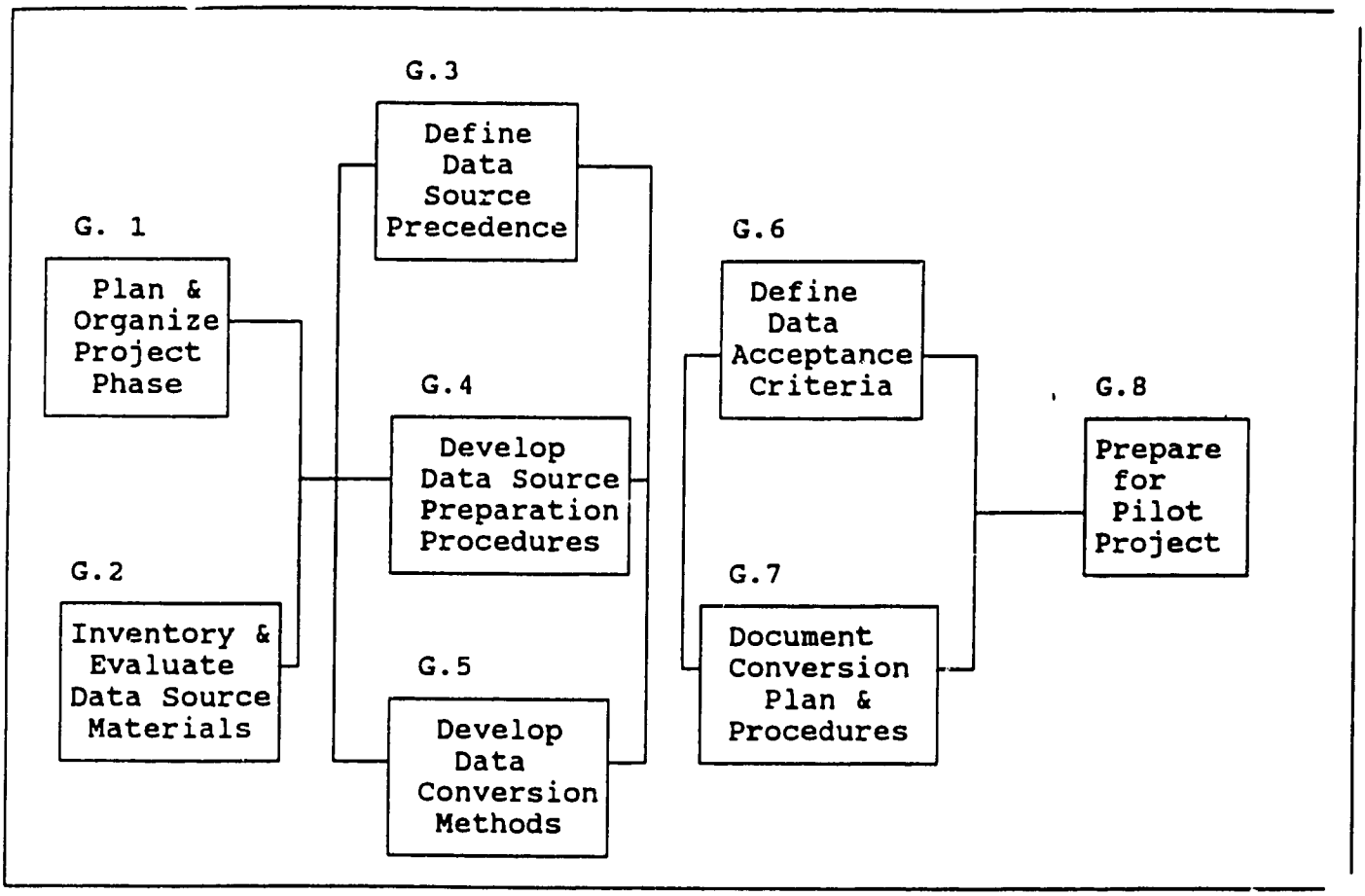
F.5 Procedures will be developed for both users and systems operations staff and fully documented in reference manuals.

F.6 All core applications software will be ported to a staging environment where it will be integration tested and prepared for user acceptance testing as part of the GIS/LIS pilot project.

Project Phase Deliverables

- Data maintenance application software
- Data quality control application software
- Standard mapping application software
- Data query/display applications software
- Data base management applications software
- Application documentation/user reference manuals
- Business procedures documentation

G - Develop Data Conversion Specifications



Key Activities

G.1 Organize a technical project team, define roles and responsibilities of the team members and develop a detailed workplan and schedule for the project phase.

G.2 Inventory potential map materials and records that may be used as a source for the conversion of all required data elements into the GIS/LIS database.

G.3 Evaluate the quality of all potential data sources and establish a data conversion source precedence for each data element to be contained in the GIS/LIS database. The objectives of this task are to determine those sources of data that best meet the requirements for data accuracy and quality. The preferred sources for each data element will be used whenever possible as the data is converted into the GIS/LIS database.

G.4 Define source material preparation and data "scrubbing" procedures. Depending on the accuracy, currency and general quality of existing source map materials and other records, a certain amount of work must be performed to prepare the documents for

conversion into the GIS/LIS database. As with any computer system, it is only as good as the information contained in the database. If you put "garbage" into the system at the front end, you cannot expect your system output to be anything more than "garbage". To avoid this "garbage in - garbage out" syndrome, care should be taken to establish procedures for cleaning up problems or deficiencies with the data sources before any resources are spent automating the data.

G.5 Define detailed data conversion procedures and specifications for creating the GIS/LIS database from the data source materials.

G.6 Establish data error tolerances and acceptance criteria. Develop data conversion quality control procedures.

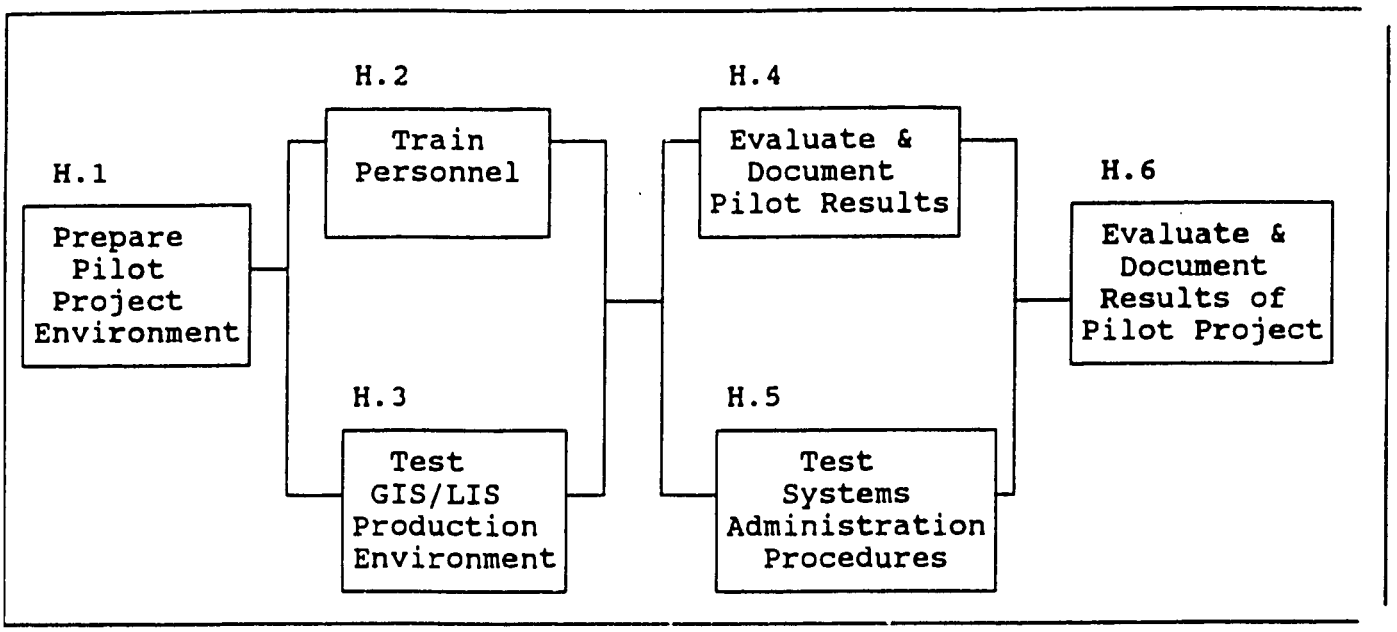
G.7 Prepare a data conversion schedule and document all Data conversion procedures in a detailed data conversion plan.

G.8 Select a geographic area of the City where all data coverages can be converted as part of a GIS/LIS pilot project for testing and validating the data conversion plan and procedures.

Project Phase Deliverables

- Data conversion specifications
- Data conversion procedures manual
- Data conversion workplan and schedule

H - Implement Pilot Project



Key Activities

H.1 Transfer all core applications software code to the systems staging area and perform final systems integration testing. The staging area should simulate the final production environment and will be used for user acceptance testing. Install, configure and test all hardware/software/communications equipment required to support the pilot project activities.

H.2 Develop user training materials and prepare a training schedule that includes representatives from all appropriate GIS/LIS user groups. Train the pilot project participants in the use and operation of the core GIS/LIS applications and related business procedures, the data conversion procedures and quality control operations.

H.3 Perform user acceptance testing for the core GIS/LIS applications and evaluate all facets of application functionality from the end users' perspectives.

H.4 Convert all GIS/LIS data coverages for the designated pilot project area and evaluate the efficiency and effectiveness of the data conversion and quality control procedures. Evaluate and verify that each data coverage is properly converted in accordance with the database design specifications.

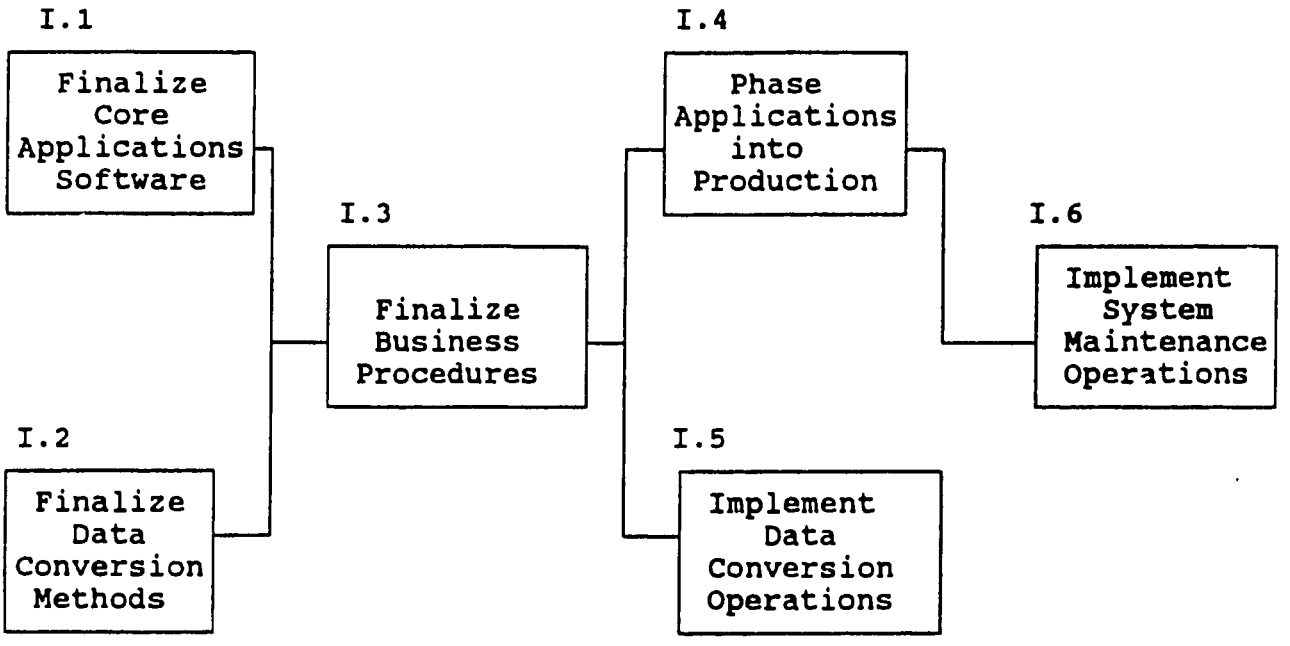
H.5 Evaluate the workflow efficiency and effectiveness of the business procedures established for processing all land records and facilities management transactions.

H.6 Evaluate and document the results of the pilot project in a final report and present findings to both the technical and executive steering committees.

Project Phase Deliverables

- Pilot Project Report

I - Implement GIS/LIS Production



Key Activities

I.1 Review the results of the pilot project and revise, modify or enhance all core applications software as required.

I.2 Review the results of the pilot project and revise, modify or enhance the data conversion specifications and quality control procedures as required.

I.3 Review the results of the pilot project and revise, modify or enhance the business procedures as required.

I.4 Update the conversion workplan/schedule, prepare final procedures manuals, train all personnel on the data conversion team and initiate full data conversion operations.

I.5 Transfer all core applications software to the final production environment. Update the user manuals and procedural documentation. Conduct final training sessions and phase the core GIS/LIS applications into production.

I.6 Implement all required systems administration procedures, user support functions and application maintenance operations.

Project Phase Deliverables

- Data conversion in full production
- Production operations established for all core GIS applications

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APPENDIX A

Evaluation of Existing Data Resources

Members of the mission team extensively investigated the current state of the land records for both the local and regional levels of government. In Poland there are two levels of government, the self-governing units called Gminas which function like municipal governments in the United States, and the federal or state government authority administered through Voivodships that function like counties in the United States. Both levels of government collect, store and maintain critical components of the land records. However, they are neither organized nor integrated into a comprehensive land information system where the maps and related records can be readily accessed, combined and analyzed to support the multiple government activities that are related to land privatization. In general, land and infrastructure information within this region is managed using manual map and record keeping systems, and for the most part, there are no effective data backup procedures in place to recover the records in the event of loss due to disaster or negligent acts.

The existing maps and records that are critical for GIS/LIS implementation and will serve as the basis for GIS/LIS database development are summarized as follows:

City of Gdansk

- Register of Municipal Buildings
- Administrative Decisions Records
- Building Permit Records
- General Plan Map
- Detailed Planning Maps

Voivodship for the City of Gdansk

- Survey Control Base Maps
- Cadastral Records
- Cadastral Maps
- Technical (Physical) Infrastructure Maps

Regional Court of Justice

- Land Title/Deed Records

A more detailed evaluation of these maps and records as potential sources for GIS/LIS database development is provided in the following sections.

Register of Municipal Buildings

The Register of Municipal Buildings is a manual record keeping system for recording facilities and structural information about all of the buildings owned by the City of Gdansk. The records are managed by the Regional Service Centers for Residents (ROMS) of which there are 34 located within the City of Gdansk. The information for each building located within a given ROM is recorded in a separate booklet and stored in filing cabinets at the ROM offices. The Records are organized and accessed by property address, building number and flat number (dwelling unit). There are approximately twelve thousand (12,000) city owned buildings, and in most cases, numerous dwelling units per building. It is estimated that the number of dwelling units within the City rose from 136,250 in 1988 to 146,000 in 1992. Since 1992, however, the growth rate in municipal buildings has become static due to the lack of funds for development.

These records are currently being automated and converted into a central database system by personnel in the System for Land Information which is an independent unit of the City that reports directly to the Mayor. The system consists of a semi-relational database that was custom developed by private contractors working for Gdansk's System for Land Information. The Register of Building data is being linked to parcel maps which are also being automated by this same group. Although there are no backup/recovery systems to protect the manual records, when they are converted into the central database system, they will be backed up onto magnetic tapes and stored at separate locations from the on-line database.

The system under which these records are currently being automated is a definite improvement over the existing manual system in terms of records management and data access capabilities, however, the technology platform being used does not provide full GIS/LIS functionality. Therefore, at present the system does not provide many of the database management tools required for integrating large, complex databases, nor the data analysis capabilities needed to support land planning and development applications. In addition, the system is not commercially supported by an established and stable relational database management systems (RDBMS) vendor that is a leader in the industry who can provide long term technical support and maintenance services which will protect the City's investment in the technology. The use of a commercially available RDBMS will insure that the City's GIS/LIS will continue to evolve and improve as enhancements or new developments in GIS/LIS database management software are made available through commercially supported products.

The work currently being done to convert these records can be considered an interim step in the direction of GIS/LIS implementation, and the manner in which the data are being converted is conducive to migrating the information to a GIS/LIS technology platform.

Administration Decisions Records

These records are stored in a manual system managed by the City's Department of Land Management. The information is used to verify the legal status of all municipal properties and buildings, i.e. all of the legal documents associated with administrative decisions authorizing the uses of municipal properties and buildings are contained in these records. The documents are stored in file folders set up for each municipal property and the files are organized alphabetically by street name followed by street number. The legal documents within each file folder are organized by the date an administrative decision was executed. Approximately 1,200 decisions are processed each year by the City and the number will significantly increase as the central government continues to transfer lands to the Gminas.

Shortly before the previous communist administration lost power, the last ten years of records were destroyed in an attempt to cover up corruption involving the use and management of government properties. At that time there were no procedures or systems in place for backing up or restoring these records and that condition persists today. Although these records are vital to land privatization and should be incorporated into a citywide GIS/LIS, substantial work will be required to clean up the records and bring them current with other related data sets. Conversion of these records into the GIS/LIS should be accomplished in conjunction with the GIS/LIS implementation plan summarized in this report.

Building Permit Records

The Building Permit Records are stored and maintained in a manual system and contain a history of the permitted building activity for all properties located within the City of Gdansk. The records are stored in the Archive of City Hall and maintained by the Department of Architecture. There is no project in progress or planned in the near future to automate these records. There also are no backup/recovery systems in place at the present time. The accuracy and currency of the information is questionable and a significant data "scrubbing" effort will be required before conversion into the GIS/LIS database.

There are approximately 50,000 properties within the City of Gdansk and a given property may have more than one building developed on it. After the change in government, the average number of development permits issued per year was around 5,000. But this has intentionally been slowed down to about 100 permits per year until City officials can develop comprehensive policies and administrative procedures for land privatization and development.

GIS/LIS technology can certainly be used to support development planning and permitting activities, nonetheless, co[illegible]n of these records into a GIS/LIS database should not precede the establishment of [illegible] policies and business processes. These activities will

drive the data maintenance operations and retention practices. Conversion of development permitting data should be planned and implemented in conjunction with the development of specialized GIS/LIS applications specifically designed to support development planning and permitting processes.

General Plan Map

This is a single map with citywide coverage that illustrates the general land use zones planned for the City of Gdansk. The maps are produced at a scale of 1:25,000 and are produced and maintained by private contractors under the direction of the Department of Development. At the present time there are only three official copies of this map available for use by City personnel. Obviously, once automated into a GIS, this map (and others) can be readily updated, duplicated, and distributed to users as needed. This will greatly expand the access and intrinsic value of such map resources.

Detailed Planning Maps

This is a standard map series that is currently being developed by the City. The map series will consist of at least one map for each of thirty five (35) specific districts for which the City has been subdivided for detailed planning purposes. A map is produced as detailed plans for each district are completed and approved by the Board. The City has currently completed detailed plans for fifteen (15) of the thirty five (35) planning districts.

The maps are produced by contractors under the direction of the Development Department at two different scales—1:1,000 and 1:2,000. The larger scale maps are prepared for those areas within a planning district where historical sites are located. The land use zones depicted in the detailed planning maps may not correspond directly to the land use zones of the General Plan map as the planning districts may be further subdivided into finer land use classifications.

The maps should be included for input as a critical data coverage in the GIS/LIS database because of their strategic value for supporting the review and approval of land development plans and permits, property tax assessment and zoning enforcement.

Cadastral Records

The cadastral records are managed by the Division of Geodetic Services of the Voivodship for the City of Gdansk (WODGiK). They consist of information relating to property ownership and property boundaries. There are approximately 50,000 records and 24,000 transactions were processed this past year as follows:

- 11,000 ownership changes
- 7,000 property boundary changes
- 6,000 miscellaneous changes

The cadastral records are organized by urban subdivisions or Obreb and can be accessed by Obreb number, deed number, parcel number, owner name and site address. Sources for these records come from land surveyors, the Regional Court of Justice and administrative decisions rendered by the City of Gdansk for municipal properties. All sources for the cadastral records must be notarized, legal documents and official copies are stored in files established for each property.

Although the cadastral records have been historically managed in a manual record keeping system, they are currently being converted by the System for Land Information (GIS) Unit with the same proprietary DBMS used to convert the Register of Municipal Buildings. As the data is automated it is linked to parcel boundary data which is also being converted to AutoCad format by the System for Land Information Unit. The cadastral records are linked to the parcel graphics via Obreb number and parcel number. The data conversion project is 90 percent completed, however, because the records have not been converted into a GIS/LIS database management system, there will be limited functionality associated with these data sets to support GIS/LIS applications at this time.

Cadastral Maps

This map series is produced and maintained by WODGiK. There are approximately 1000 of these maps and they provide complete coverage for the entire voivodship. The primary features contained on each map include third order survey control points, parcel boundaries, easements, land use and hydrography. They are produced at three different scales of 1:1000, 1:2000 and 1:5000. The scale chosen for a given map depends upon the level of urbanization and density of development. The geographic areas that are highly developed are mapped at the larger scales.

The cadastral maps are currently being converted by the City of Gdansk's System for Land Information Unit into digital format using a software product called AutoCad. AutoCad is distributed by the U.S. company AutoDesk, Inc. As part of the data conversion process, the City is linking the parcel graphics to the cadastral records. Maps for a 50 hectare pilot project area were automated to test the data conversion procedures and evaluate the quality of the map information by comparing it to what was actually on the ground. The results of the pilot reflect that there are considerable problems with the currency and accuracy of the information contained on the maps. On the average, 30 percent of the features for a given map had problems or errors associated with them. As the City moves forward with the automation of these maps, a significant amount of work will be required to rectify the errors and bring the map information up-to-date.

Because AutoCad is not GIS software and cannot support a topological data structure, the digital data will not lend itself to spatial analysis, and therefore, will not support GIS applications. Consideration should be given to migrating the map information that has been automated with AutoCad to a topological data model using GIS software tools. This migra-

tion although feasible, is not transparent and will require post processing of data after completion of the conversion routine.

Base Maps

The Base Map series is also produced and maintained by the Voivod's Division of Geodetic Services. As with the Cadastral maps, the infrastructure maps are produced at two different scales (1:500 and 1:1000) depending upon the level of urbanization and development. There are approximately 1800 of these maps and the primary map features include first order survey control points, building footprints, sidewalks, streets, embankments, manholes, storm drain grates, street lights, power poles, elevation contours, fire hydrants, trees, lawns and transformers. Elevation contours are mapped at 0.5 meter intervals on the 1:500 maps and at 1.0 meter intervals on the 1:1000 maps.

The survey control point data and building footprints are also being converted from these maps by the City of Gdansk as part of the cadastral map conversion project and are subject to the same set of problems. For example, the street data on these maps was determined to be only 85 percent accurate at the conclusion of the City's pilot project.

In addition, the data is not being automated with GIS software, and as a result, will not support GIS/LIS applications.

Physical Infrastructure Maps

This map series is produced and maintained by the Voivod's Division of Geodetic Services and each map within the series includes facilities information for water, sewer, central heating, electricity, natural gas, telecommunications and cable television. It is estimated that there are over 2500 maps for the area under the jurisdiction of the Voivod. The maps are also produced at three different scales (1:250, 1:500, 1:1000) depending upon the level of urbanization and development.

The Division of Geodetic Services has converted thirty two (32) of these maps to digital format using the AutoCad software. They have recently acquired Intergraph's Microstation software product, however, and plan to automate the remaining maps using the Intergraph software. Intergraph's Microstation software is another commercially available alternative to the AutoCad software product and has essentially the same level of functionality. Digital map files can be easily exported from the AutoCad software platform to Intergraph's Microstation software using the standard DXF exchange file format. Both the AutoCad and Microstation software were designed for computer-aided drawing and design (CADD) and do not provide any GIS functionality. Furthermore, due to the present CADD environment, the WODGiK are using digitizing procedures which are not compatible with creating a topological data model in the future e.g. breaking of lines during digitizing to accommodate map symbology. These erroneous practices will severely limit the utility of the automated data and should be

avoided at all cost. Clearly, the WODGiK need to understand the importance of topology in the GIS context and modify their data automation procedures accordingly.

Land Title/Deed Records

This database is currently managed by the Regional Court of Justice and contains all of the land title information for the entire voivodship. Examples of the records stored in the database include: number of deed request, deed number and date, parcel number, parcel address and legal description, lot size, building size, land use and lease date. The land title records are sorted by deed number and there are approximately 50,000 records for the City of Gdansk. The City receives 2,000 requests for land title changes per month but is only able to process 400 of them per month. This diminished capability to process land title transactions can be directly attributed to the poor state of the land records and the lack of automation tools that could significantly facilitate the City's transaction processing capacity. It is projected that the number of requests for deed transactions will double every two years as the land within the region moves from public to private ownership.

In conjunction with the City of Gdansk's LIS pilot project, the Court of Justice deed records for the pilot project area were converted into a relational database by a private contractor. The Polish company, CSK, automated the records using a relational database management system (RDBMS) distributed by Oracle Corporation. The Oracle software is one of several leading RDBMSs that are distributed worldwide. As with other competitor products, the Oracle RDBMS provides robust automation tools for developing, integrating and managing large, complex databases; and when used in combination with GIS software, will provide the GIS/LIS functionality needed to support the geoprocessing applications typically required by local and regional governments for urban planning and development, property tax assessment, land privatization and infrastructure management.

It has been estimated that it would require $500,000 and two years of effort to complete the conversion of the remaining Court of Justice records into the Oracle-based system developed by CSK. However, in order for CSK to complete the data conversion project for the entire voivodship, it will require sponsorship and a stable source of funds from both public and private entities within the region. This funding is currently being sought.

APPENDIX B

LIS Basic Functions

The following functions/applications were developed (using ARC/INFO GIS software) as part of the Lodz pilot LIS project. Many of these tools offer "standard operations" which could be directly transferred and adapted to the developing LIS in Gdansk. Such transfer/ exchange of applications between sites can greatly reduce development costs for LIS in Poland, promoting integration between systems and users.

EG Module WS — LIS version

1. The data base editing:
   - insertion/deletion of the register units,
   - insertion/deletion of a parcel according to with land use,
   - insertion/deletion of owners in register unit,
   - insertion/deletion by land classification,
   - division of parcels by categories of land use,
   - merging of parcels by categories of land use,
   - transfer of parcels between registers units,
   - changes of characteristics of register units.

2. Procedures for data change and storage:
   - storage of changes,
   - suspension of changes,
   - reconstruction of parcel history.

3. Review of the data base (with the possibility of printing and saving on a disc selected elements):
   - review of particular tables and optional sorting,
   - user created data lists in registers made by overlaying consecutive layers in the data base,
   - reconstruction of the data base status on a particular day, search for full information about a particular record object (parcel, register unit) according to minimum input information (name, serial number of document, address),

- creation of a list of identifiers for selected objects transferred for use in other modules of the system,
- transfer of control to other modules in the system.

4. Reports (typical documents of land records shown on the monitor screen with the ability to print or save on a disc file):
   - register of land,
   - reference record or parcels,
   - alphabetical list of owners and possessors,
   - list of land by record unit,
   - list of land by register groups,
   - list of land by precinct,
   - list of land in various land use classes,
   - extracts from register of land,
   - collate list of changes,
   - generate notices about a changes.

5. Duties of EG administrator:
   - completeness and coherence check-up of the data in the data base,
   - approval of introduced changes,
   - generation of report for suspended changes,

6. Duties of EG and EBL administrator:
   - data verification concerning individuals according to (local) PESEL and REGION systems,
   - establishment of the data base user authorizations,
   - archive record for data base protection,
   - reproduction of the data base according to archive records.

EBL Module WS - LIS version

1. The data base editor - insertion of changes according to the change document:
   - insertion/deletion of the building,
   - insertion/deletion of the premises,
   - insertion/deletion of owners,
   - changes of characteristic of register items.

2. Procedures of data change storage:
   - storage of changes,
   - suspension of changes,
   - reconstruction of the parcel history.

3. Review of the data base (with the possibility of printing and saving to disc selected elements):
   - review of particular tables or text with optional sorting,
   - user created data lists in registers made by overlaying consecutive layers in the data base,
   - reconstruction of the data base status on a particular day,
   - search for full information about a particular record (building, premises) according to minimum input information (name, serial number of document, address),
   - creation of the list of identifiers for selected objects transferred for use in other modules of the system,
   - transfer of control to other modules of the system.

4. Reports (documents related to buildings and premise records shown on the monitor with the possibility of printing or saving to a disc file):
   - extracts from records of buildings and premises,
   - alphabetical listing of owners.

5. Duties of EBL administrator:
   - completeness and integrity check-up of the data in the data base,
   - approval of introduced changes,
   - generation of report of suspended changes,
   - data transfer to/from PC-LIS data base and the other WS-LIS data bases,

6. Duties of EG and EBL administrator:
   - data verification concerning individuals elements according to PESEL and REGION systems,
   - establishment of the data base user privileges for access to archive record in the data base
   - reproduction of the data base according to various options from the archive record.

X Module WS - LIS version

1. Definition of an operations area (viewing area):
   - definition of a window with two points,
   - definition of an operation area on the basis of list of objects (lists of identifiers or sequence of various (selection) indices),
   - focus by means of address (name of the street and serial number)
   - current definition of an operation area saved under a name specified by the user,
   - use of an operation area according to determined parameters,
   - screen handling functions (zooming and roaming, moving, presentation in a given scale, adaption to a range of chosen elements).

2. Choice of information layers and methods for their presentation:

- indication of layers for presentation,
- definition of the presentation method for each layer (colors,graphic standards, presented attributes),
- definition of classification and thematic elements according to the value of attributes,
- choice of prepared lists of objects included in one information layer and their use as parameters to define the presentation method,
- saving of a set of layers and their presentation in a catalogue,
- switch to active layer, i.e. making selections of objects from a given layer, presenting their attributes and graphic data,
- presentation of the data according to determined sets of layers and their definitions on the screen, printer or plotter.

3. Creation of new information layers and handling of their attributes:
   - creation of a layer as a fragment of an existing layer,
   - creation of a layer consisting of objects on the specified list,
   - creation of a layer from intersection of two other layers,
   - creation of a layer containing buffers of a given size around graphical objects from a selected layer e.g. select all parcels within 500m of building x.
   - creation of a file by a choice of elements,
   - joining of an attribute to the attribute tables from other layers according to given parameters
   - calculation of new values for selected attributes.

4. Presentation of individual (graphic) objects:
   - presentation of attributes for a given object with the possibility of adding its identifier to a list displaying its descriptive attributes.

5. Graphical selection of objects:
   - selection of the objects within user-defined rectangle, circle of a given radius, and polygon with the option of joining selected objects to the list.
   - selection of objects from a given layer, including those within the limits of similar objects from a different layer.

6. Review of the descriptive attributes and selection of objects:
   - review of the descriptive attributes of the object e.g. building in an active layer (spatial attributes as well as the attributes included in the descriptive data base, integrated with the layer) with the possibility of adding chosen objects to the list,
   - selection of objects where descriptive attributes satisfy given conditions, with the possibility of adding of chosen elements identifiers to an output list.

7. Creation of lists:
   - creation of descriptive attribute values placed on the list with the option of output in various formats.

8. Creation of standard output documents for land and buildings records:
   - drawn from records of land,
   - digital maps of land and buildings records.

9. Creation map compositions:
   - compositions with standard content of the basic map layout,
   - compositions using optional, user-defined content and symbol representations, with the possibility of adding optional graphical elements.

10. Operations on a list of items:
    - deletion of the list
    - merge of two lists,
    - deletions of objects from the lists.

11. Control of data bases integrity:
    - control of internal coherence of graphic data base,
    - control of the integrity of graphical data bases (DZ and BD layers) with descriptive data bases EG and EBL,
    - display/search for incompatible reports/error checking.

12. Update of the data base:
    - update of ARC/INFO layers/coverages.

13. Transfer of data between data bases:
    - transfer to/from PC-LIS base to the other PC-LIS and WS-LIS data bases,
    - transfer of data (graphic/attribute) from main systems to local/regional subsystems.

Overview-The Lodz LIS Core Applications

The Lodz LIS applications consist of a number of modules developed using the ARC/INFO system macro language (AML) and PC based (SML). Once activated, each module presents the user with a menu driven interface offering a number of tools and operators. This allows the user(s) to perform a numbers of tasks without the need for complex "command line" operations and intimate knowledge of the base software. Furthermore, such GUIs (Graphical User Interfaces) which are increasingly standard to GIS, can guide the user through a number of complex functions and procedures required to complete a particular process.

This is extremely important since as illustrated earlier, many processes related to land management are complex, necessitating a number of inter-dependent tasks to be completed, often sequentially.

The Lodz LIS Application Modules can be divided into three categories:

1. Parcel and land record management (EG Module).
2. Building record management (EBL Module).
3. Database management including both spatial and non-spatial query, analysis, output and maintenance functions (X Module).

These three application areas could support the core functions of the Gdansk GIS/LIS almost immediately, offering a variety of tools and capabilities.

In addition, they offer the ability to further customize specific applications where necessary, to meet the need of users and/or the integrated database environment. The following pages itemize the extensive functionality offered by the Lodz LIS application modules. Special attention should be given to the databases maintenance tools and procedures. (See the following "LIS Basic Functions" descriptions from Lodz.)

It is important to note that the modules have been designed to function under both a PC and Workstation (UNIX) environment. This reflects the need to integrate PC users with higher levels of technology in a distributed network environment. This will definitely be the prevailing GIS/LIS user environment in Gdansk, and the Lodz model presents some viable options. The Gdansk GIS project team should pay close attention to the Lodz Pilot Study LIS Implementation Report. Although every site is unique in terms of local requirements, the GIS/LIS implementation process does present some common issues to all potential users.

Gdansk, and indeed other sites in Poland, should pro-actively learn from the Lodz experience so far, and avoid some common mistakes or "reinventing the wheel" which can severely impede system implementation.

APPENDIX C

Implementation of GIS/LIS in Poland—A National Strategy?

The Lodz case study is also very significant in that it presents a first attempt to integrate the needs of a local LIS program with the goals of a nationwide LIS modernization program, as promoted by the Surveyor General of Poland (See appendix: "LIS-Modernization Programme). Although every GIS/LIS site will be rather unique and must be autonomous in terms of operations, these systems cannot develop in isolation from or ignore the larger goals of the national LIS program. GIS/LIS implementation should facilitate "cross cutting" activities across sectors and likewise, should support various functions at a hierarchical level. For example, the system development in Gdansk will be managed and operated at the local or gmina level. However, cooperation with the voivoda is essential, and some linkage to central government (LIS) policy should also be accommodated.

In Poland at present, there appears to be some difficulty in compromising local LIS initiatives with regional, and certainly national government policies. If common issues are not defined to allow this hierarchical integration to occur, then Poland runs the risk of developing a nation-wide disaggregated framework of GIS/LIS sites lacking any coordination of activities, technology transfer and data sharing;-the key elements of successful GIS application. This must not happen since the loss in potential collective benefits and productivity would be prohibitive to all parties.

Therefore, local, regional and national agencies should work towards finding a common approach or context for GIS/LIS implementation. This approach should advocate unity (integration), while accommodating the need for a diversity of GIS/LIS activities at different scales. These activities will need to address and impact the myriad of problems faced by local governments, and help support the decentralization of administration in Poland.

A Potential Model for GIS/LIS Implementation in Poland

While a compromise approach to LIS is being sought between the local, regional and national government levels, the following simple model may provide a feasible framework for future development:

1. The Surveyor General and central government using their collective influence, could negotiate the procurement of a large number of GIS software packages. These should

conform to international standards, be supported in Poland with an established install base, have a non proprietary structure supported by a host of hardware platforms, offer diverse capabilities, readily interface with existing systems and facilitate customization to meet local application needs.

2. The Surveyor General supplies these standard set of software tools to strategic regional (Voivoda) and/or local (Gmina) sites together with a set of guidelines which outline the requirements of the national LIS modernization program.

This should not preclude individual agencies using or procuring additional complimentary tools where necessary, but will enforce some degree of procedural and technology compatibility.

3. These "how to" instructions are complimented by a suite of generic core applications which will assist sites in meeting the guidelines, while also supporting local requirements in certain LIS application areas e.g. land records/parcel management, building records maintenance.

4. The Surveyor General provides "seed" grants and/or supports and highlights successful implementations at key reference sites e.g. Lodz and Gdansk; these act as case study models for other locations which can learn from these established sites, reducing costs, time and redundancy in the implementation process.

5. The Regional Surveying Offices (Voivoda) provide necessary guidance and some technical assistance to local GIS/LIS sites, while acting as conduits for information between the local and central government and vice versa. This will fulfill the aim of decentralizing some local government functions, while also facilitating the flow of essential information (about land resources) from the local to national level to support strategic policy making by central government.

While it is uncertain whether the required legal/regulatory framework exists to support this model, such an approach would contribute to the integration of LIS both from geographical and institutional perspective.

APPENDIX D

Summary of Current Hardware and Software Environment

The current technology environment summary is divided into three major sections: 1) application software, 2) hardware and 3) data communications network. It is not meant to be a comprehensive list of all of the hardware/software resources available at the City of Gdansk but to provide a general overview of those existing technology resources that may support spatial data processing operations.

Application Software

Software for Handling Spatial Data - Spatial data systems provide automation tools for converting, maintaining and displaying information normally found on maps, images or detailed drawings. Spatial data software systems can be categorized into the following major categories:

- **Computer-Aided Drawing and Design (CADD)** - "allows a user to interact with a visual image on a computer screen to create, modify or manipulate maps or engineering drawings and designs. CADD systems store spatial data as graphic information and handle maps simply as drawings with little or no data continuity across map sheets. Many CADD capabilities are important for map production. For example, flexible and high-quality cartographic displays and output may be created with CADD software tools. However, this technology does not incorporate spatial analysis or geographic data management functions. CADD software was developed to support drafting and design/modeling and is primarily used in the industry for data capture and map publishing." (Exler, 1988)
- **Automated Mapping/Facilities Management (AM/FM)** - "combines a subset of CADD capabilities for interactive graphics entry and storage techniques with a database capability. The systems focus is converting manual maps and records into a digital database for query, work-order processing and facilities model depiction and management. AM/FM software systems usually lack spatial data analysis capabilities." (Exler, 1988)
- **Geographic Information System (GIS)** - Consists of software tools for "organizing spatial data into a continuous geographic database which can be analyzed to provide answers to queries of a geographic nature....the generic GIS can be viewed as a variety

of spatial data analysis tools laid over a topological spatial data model that is integrated with a standard relational database management system. (Goodchild, 1985)

The City of Gdansk's System for Land Information Unit has several application software products currently available that can be used for handling spatial data and include the following:

Product	Quantity
AutoCad Release 11	8 licenses
CAD Raster	2 licenses
Arc/Info Revision 6.1	1 license
Intergraph's MGE/MGA	1 license
Intergraph Microstation	8 licenses

AutoCad is the only software product listed above that is being used to any appreciable degree by the System for Land Information. It is currently being used for purposes of automating the cadastral maps and survey control base maps that are produced by the Division of Geodetic Services of the Voivod for the City of Gdansk.

Intergraph's Microstation software is a competitive product to AutoCad which also provides CADD functionality. At the present time, it is not being used by the System for Land Information to support any spatial data processing applications, but may be used in the future if it can be demonstrated that it provides better price/performance than AutoCad.

The Arc/Info and Intergraph MGE/MGA software products provide full GIS functionality. Each software system has its strengths and weaknesses relative to the other in various functional areas. Both of these products are not being used at the present time because personnel in the System for Land Information will require technical training to develop the necessary expertise that will enable them to work productively with the software tools.

Database Management System Software (DBMS) - Database management software systems provide tools for managing attribute data or textual information about the geographic features that can be located on a map. "A DBMS helps to integrate data collected by the many different departments of local government about features on the ground, in buildings and under the ground." (Huxhold, 1991) For example, "a property tax assessor must know what permits have been issued for alterations to buildings, or utility companies need to know what public facilities are under the ground where they are about to dig. These are information needs that cross functional areas (Property Taxation and Building Inspection, Utility and Public Works). They are also needs that relate to the same location (an address, block or street segment). They are horizontal data-integration needs of a local government that can be satisfied only by effective database management systems." (Huxhold, 1991)

The Gdansk System for Land Information is currently using a non-commercial software product developed by the Gdansk-Barcelona Association for capturing attribute data from the

following sources: register of buildings records, cadastral records and administration decisions records. The Gdansk-Barcelona Association is a private company that is providing technical assistance to the City of Gdansk for its LIS project. The software provides automation tools for capturing and storing the data and supports data access and query functions, however, it does not support a fully relational data model and, without careful examination of the software documentation, it is not clear whether the software provides all of the critical functions required to qualify it as an effective database management system.

The City also has a relational database management system embedded with the Intergraph MGE/MGA software. The DBMS is one of several leading commercial database management systems in the industry and is distributed by the U.S. company Oracle. It is currently not being used due to lack of training and expertise.

Computer Hardware Resources

The System for Land Information has a Novell 311 PC-based Local Area Network (LAN) that consists of the following hardware components:

- **File Servers** (1) 80486 processor with 16MG RAM and 2GB disk storage
- **Workstations** (8) 80486 PCs with 16MG RAM, 120MG disk drive and equipped with high resolution graphics monitors
- **Plotters** (1) HP draftmaster
- **Printers** (1) HP IIIP laser printer
  (1) HP IIID laser printer
- **Scanners** (1) LDS 40000+ with 400dpi resolution
- **Digitizers** (1) _____?
  (1) _____?

The PC LAN is being used to support the automation of the survey control base maps, cadastral maps and related land records as part of the City's LIS Project. There are also two risc-based workstations available on loan to the City but they are not being used to support the LIS data conversion effort that is currently in progress and are not connected to the PC LAN.

Data Communications Network

The existing PC LAN used by the System for Land Information is not bridged together or connected to any other LANs, minicomputer or mainframe systems located within other departments of the City or the Voivod. At the present time there is no integrated citywide communications network available to adequately handle GIS/LIS data traffic between City departments and external entities.

Network services are available in the Gdansk region from one Public Packet Switching Network (PSN), POLPAK, and two private PSN: 1) TELBANK, owned by a Polish con-

sortium and 2) NASK, the Polish Academic and Research Network. The Polish Academic and Research Network provides both X.25 switching and TCP/IP routing, whereas the other two PSNs use only X.25 protocol.

Fiber Distributed Data Interface (FDDI) is currently under development as the metropolitan standard and two universities have installed over six kilometers of 62.5/125 multi-mode fiber cables on their campuses which could be configured for FDDI purposes. In addition, twenty two kilometers of dark fiber was laid by the Polish Cable Television throughout the metropolitan area and could be configured as a FDDI ring and serve as a communications backbone for a citywide network.

APPENDIX E

Review of the General Project Document for the Gdansk Land Information System "Systemu Informacji o Terenie (SIT) Dla Gminy Gdansk"

During the period of this technical assistance mission to Gdansk, a document was released which forms the basis of a general plan for LIS development in the city. Although not specifically within this scope of work, the contents of the document are extremely important to any future work plans.

Therefore, the following sections will include a review of the aforementioned document prepared by the Gdansk-Barcelona Association under contract to the city of Gdansk. Comments will be both general (referring to overall issues affecting implementation planning) and specific, (concerning individual elements of the plan which could impact the implementation process).

1. The document should include a complete bibliography of individuals, agencies and sources consulted in the creation of this plan. This will support the notion that the work was a truly holistic exercise and not the opinion of a few individuals. A holistic planning process is essential in the development of any GIS/LIS implementation plan.

2. In the presentation of such documents, the authors should indicate to the client the level of their past experience, and references in the relevant fields that are addressed. This guarantees some credibility. This is essential in Poland where numerous GIS/LIS projects plans have been developed and "sold" to clients by wholly inexperienced parties causing serious problems and even financial losses. As the GIS/LIS sector grows in Poland, there is an urgent need for both transparency and objectivity in the delivery of technical consulting services to various clients.

3. The General Plan for Gdansk in its present form is too technology oriented with little or no consideration given to major institutional, procedural and organizational issues which are essential components in any GIS/LIS implementation.

4. Budgets/costs are indicated for various tasks with little indication about how exactly these numbers were derived and/or assessed. Sustaining operations through continued core

funding is an issue which should also be addressed. The balance between technology versus operational cost assessment appears to be extremely disproportionate (The 80:20 rule of thumb indicates that operational costs are approximately 80 percent of a total budget for GIS/LIS implementation, the remaining 20 percent designated for hardware and software).

5. The division of labor between various partners in the implementation of a GIS/LIS is an effective mechanism to share costs. However, multiple agency projects absolutely require close coordination and cooperation if any savings are to be realized. This in itself incurs additional administrative costs which should be factored into budget projections.

6. Cost recovery projections showing the level of revenues that will be generated by the use of GIS/LIS in the privatization of property, should be expressed with greater caution.

What will be the actual impact of GIS/LIS on the privatization process is complex to assess and even harder to predict. Optimistic projections can run the risk of raising expectations with respect to financial returns to grossly unrealistic levels. The promise of cost recovery should not be a major justification for the implementation of such a system in Gdansk. Other benefits such as the integration of various government activities through information sharing should be emphasized.

7. Related to 6., the plan could benefit from some cost benefit analyses where such measures are practical to implement e.g. with respect to hardware, software, various data automation techniques etc.

8. Description of the status of buildings, land records and the cadastral system in Gdansk is quite comprehensive although should include a more qualitative assessment of the data resources, their relative accuracy and value for a GIS/LIS. For example, the process to correct land records and where necessary re-survey parcel boundaries is vital to data integrity. The relationship of these "quality assurance" procedures to the implementation process should be emphasized.

9. A model is proposed linking the GIS/LIS to various departments in the city which will be primary clients of the system. No mention is made of their functions, which databases they will access and what processes the system will be required to support in each agency. These aspects should be assessed as a first stage in the formal design process.

10. The choice of hardware proposed in the plan appears to be based on a number of subjective criteria i.e. this is "state of the art" therefore the most appropriate. This denies the importance of systematically examining alternatives with adequate functionality and yet cheaper overall costs. In addition, hardware maintenance and support issues which are critical, are not addressed.

11. Similar to 10., the proposed GIS software has been based on a number of technology based assumptions rather than actual system requirements. Also, there is far too much

diversity in the software choice which will demand additional training, maintenance and will inevitably cause compatibility problems in data formats, transfers etc. The choice of one line of software products with adequate functionality, regular upgrade history and local support is vital. Again, this choice should be driven by actual needs of end users and proposed applications which should be assessed in advance in order to make informed choice in technology.

12. In terms of accepting hardware and software donations (which are too common in the plan) a strict policy should be adopted. A GIS facility can only sustain an extremely limited and carefully chosen range of products. Although "loaners" and donations from highly aggressive vendors are attractive, they detract resources from many other important tasks. Therefore, it is important to avoid using a potential GIS site as a promotional vehicle or testing facility. Any donations should only be accepted after careful review and should ALWAYS include the necessary training to sustain the technology.

13. The overall work plan presented in the document is far too complex, ambitious and attempts to support too many parallel activities. The proposed GIS unit does not have the capacity of fulfill these task in the designated time. Any work plan should first attempt to prioritize and rationalize which activities are the most important to GIS/LIS development. Furthermore, there should be more focus on completing database(s) and tasks which support ONE priority application which can be readily implemented and will begin to produce tangible benefits quickly. There is a very real danger of over-diversification during the implementation process-this can prove fatal to the project. Focus and planned incremental growth are vital. The city should revise the proposed work plan using the outline work plan attached to this report as a logical framework for scheduling various activities.

14. Although the report contains a comprehensive review of data resources and various attributes intended for the system, some attempt should be made to define "obligatory" contents of the proposed databases. That is, elements which are essential to various operations and applications. Once again, database(s) should be designed to support needs and not simply as unlimited repositories for all available information sources with which vary greatly in value and integrity. This requires an understanding of some of the processes that will be supported and inventory/review of current data resources. In addition, rationalized database contents will simplify and reduce costs for maintenance, update and management procedures, which will be continuous demands of the system.

15. The plan should at least begin to define some of the overall procedures and protocols that will be required to maintain, update and control the database(s). The system proposed in Gdansk will support multiple and distributed users, therefore these issues should be addressed in general now, and more detail during the database design phase.

16. The general plan should propose a more "phased" approach to LIS implementation in Gdansk. This should include pilot testing, review and re-design stages and gradual migration towards final GIS/LIS implementation. The present plan is too complex and does not detail

intermediate stages and processes required to reach a fully implemented and functional system.

17. As an example of an organizing framework for a "General Plan" document the City of Gdansk should refer to "The General Project-Pilot Implementation of a Land Information System in Lodz." Although this document does not cover all the details that are relevant to the Gdansk situation, the structure and themes addressed by this general project plan are useful. In general, the Gdansk report should greatly reduce its narrative contents and concentrate on defining some of the relevant elements i.e. data, hardware, software, procedures, personnel, organizational and institutional issues which should all be at least partly addressed in a "general" implementation plan.

APPENDIX F

A conceptual paper (44 pages) describing the Land Information System (LIS) Modernization Program for Poland as outlined by the Surveyor General. Brief extract of the document attached. Some mechanism should be found to ensure this national program benefits local GIS/LIS initiatives. Individual sites should address local problems but also become integrated into a nation wide LIS network.

MINISTRY OF PHYSICAL PLANNING AND CONSTRUCTION

LAND INFORMATION SYSTEM

MODERNIZATION PROGRAMME

Elaborated by:
Remigiusz Piotrowski Ph.D.(Eng.)
Surveyor General of Poland

WARSAW 1991

Resolution

"The State Geodetic and Cartographic Council issued a positive decision, following a comprehensive discussion at its meeting of the 14th November 1991, concerning an action programme presented by the Surveyor General of Poland as regards the modernization of the Land Information System, and moved that it be urgently implemented.

It also been accepted that the definition of the Land Information System (LIS) submitted by the Surveyor General of Poland corresponds to the purposes and the long-term goals which the system is to serve".

This programme was approved by the Minister of Physical Planning and Construction on 18th February, 1992.

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1. INTRODUCTION

1 To possess a modernly organized land information system is imperative for any contemporary state; to ignore this could, with time, become a substantial development barrier. On the other hand, its becoming increasingly difficult to remove all arrears which have developed here since, next to the imperative large financial outlay, the decisive factor is that of time which is required to construct appropriate data resources above all by field measurements and reconnaissance. The economic plight in which Poland finds herself at present does not augur well for such expensive undertakings as that described herein, at least in the immediate future. Having said that, time is running out and, ultimately, could weigh heavily on the planned intentions. That is why a series of absolutely imperative steps have been planned, with full attention being directed to their practical aspects of implementation and not to personal ambition.

2 The LIS - Land Information System is part of the national organizational infrastructure, which is geared to interlink, in a joint effort of all those bodies whose purpose is to collect the most widely understood land information. It ensures that such information reaches those bodies which are best able to use it for the benefit of the economy and for national defence purposes. Obviously, the essence of the matter is to use the available finance frugally, by the most rational division of tasks when collecting the richest possible data resources. The principle here is that, once gained an item of information serves all but against payment or in exchange for other information.

3 The existence of LIS is the imperative condition for the economic development of the region where it is used. It is not, however, an adequate condition. The thing is that the system is only a data-supply system and much depends on the kind of environment in which it is to function. A whole series of queries appears at this point. Will the emergence of this system be accompanied by a market demand for the type of information it can deliver? Will such organizations appear which will be able to make profitable use of the offered information?

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4 Replies to these and similar queries are of truly fundamental impact, particularly for local decision-makers, who are usually bombarded by propaganda claiming that the recommended hardware and software boast an enormous spectrum of applications, mainly as "ready-made" land information (*spatial*) systems. In that case little is said of the problems related to the data base of such a "system" and the prospects of expanding it further. One must always bear in mind that a basic difference exists between the continually searched for use of information technology as an instrument to make the effort of human teams more efficient, and its risk-prone applications in systemic solutions which encompassed large areas of the country and many organizational units.

5 The assumption is that a contemporary, properly organized land information system could play a substantial part in at least the following areas:

- tax and fees assessment;
- maintaining legal order in land management;
- economic management and physical planning;
- designing of civil engineering projects;
- financial real -estate surety (*mortgage*);
- ensuring that existing technological and communication infrastructure networks on urban land are kept efficient;
- marketing in real-estate business.

6 The government administration and its specialized agencies are the regular recipients of data concerning land management. These considerations in conjunction with the need to maintain a degree of a certain minimum stability of the system has resulted in part of its activities being paid from state budget funds. The accepted concept of the system decides just what proportion this will be. In capitalist conditions land information in its widely comprehended definition should be an easily marketable commodity. Hence one could envisage that the LIS could begin function on purely commercial principles when the proper time comes.

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7 The general concept of the system also defines its degree of concentration. Even at the present level of digital and information technology no limitations exist in practice in constructing systems of highly developed data bases and centralized management. Such systems display lower operating costs, the possibility of recruiting highly-qualified personnel is simpler as is equipment service. They can be developed without any real problems[1]. However, the further away the recipients are from the data base, the more important it is to ensure that the available means of communication must be infalliole. A large degree of concentration also increases the scope of the effects of any breakdown in the system's central control office. One of the major headaches which faces the Polish LIS is to balance the options mentioned here one against the other and, in the outcome, to select the most pertinent degree of system concentration.

8 An elementary property of any land information system is the spatial localization of the data; that is practice, to be able unambiguously to define the situation of every registered object in the field from the information offered by the system, and, in turn, to give spatial position for the selected group of information describing that object in a certain manner.

9 It is the unquestioned, traditional area of geodesy and cartography to maintain spatial reference systems, to define the size, shape and location of topographic objects *(anthropogenic and natural)* which constitute parts of the system's interest and the keeping of real estate registers. This points to the leading part played by the national geodetic and cartographic service in management of the LIS also the general direction of its strategy of development and expansion[2]: from geometric data files to files geared to descriptive data biassed towards individual branch problems.

10 Bearing in mind what has been stated above it is obvious that the state and organization of the state geodetic and cartographic resources and the register of land and buildings *(real estate cadaster)* is an essential condition for the efficiency of a land information system. What is fundamental significance here is also the legal regulations of the principles under which the system is fed by information. What we have in mind here is the duties imposed on the contractors of geodetic and cartographic jobs and also on the various and numerous agencies and

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specialist government administration services, public notary offices and the regional - court sections of land and mortgage registers. The quality standards for the collected data and the forms of the system's final documents, approved by state institutions and on the real - estate market constitutes a separate problem.

11 From the above remarks alone it is clear that no kind of mechanical transfer of the foreign solutions of the land information system is feasible in Polish conditions. The technologies used in various information processes can be adapted but the system has to be developed in specific application to Polish conditions.

12 There can be talk of LIS construction from scratch, that is from the bottom up solely in the countries on a very low stage of development of state structures. The development of information processes technologies and the changing needs of the economy stimulate such systems to continual expansion and development. That is quite natural.

13 The Polish Land Information System is presently based on:

- land registers[3)],
- the institution of land and mortgage registers[4)],
- rudimentary information of buildings[5)],
- large - scale economic map[6)],
- geodetic register of networks of technical underground utilities[7)],
- sectoral (branch) registers of networks of technical underground utilities[8)],
- a set of topographic maps,

while in the area of institutional order it is mainly based on geodetic and cartographic documentation centres*.

14 According to the suggested classification** this system is, in effect, in the initial stage of development, whose targets, philosophical concept and information resources do not adapt to the far-reaching economic and political manoeuvres which Poland is presently tackling. In particular it is characterized by:

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* vide supplement, paras 106-108

** vide supplement, para. 129

- insufficient credibility of the information compounded by the rapid devastation of their carriers (*maps, registers etc.*);
- unsatisfactory adaptation of the system's information service to the current social and economic national development conditions (*property, market*);
- the continuing low value of system investments;*
- the poor automation level of the information processes;
- the poor organizational level of integration of base subsystems;
- the dissipation of efforts to introduce digital methods and information technology to the system.

What has been described above surely fully justifies defining the scope of envisaged activities as system modernization.

15 Every information system boasts a related "system manager" (*system supplier*) and "system user" which could, clearly, be linked in specific circumstances. Having said that, to mistake these two functions is the reason for a multitude of irritations based on a misunderstanding of the invested authority involved. This, is turn, often lead to conflicts pregnant in later effects.

16 The system manager is a unit which is resposible for system implementation within its organization framework, at least to the extent of one information process which could, with some general abbreviation, be described as the following sequence of operation:

data acquisition -

- continual updating of the data files -

- giving access to the information.

17 Anyone who intends to manage an information system on a national or local scale, must additionally realize that he is assuming further duties. Some of these are:

- administering the system's finances and organization over for a specific area of the country;
- taking the changing requirements of the system users into account and offering them a range of services especially in processing primary data;

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* vide supplement, para. 119

- constant concern to increase the system's efficiency which requires the introduction of more modern information technologies and methods;
- training and promotion activities.

A relatively large, professionally qualified personnel is required to pursue these tasks. The resulting financial consequences do not necessarily balance with an income from fees which may originate in giving access to information.

18 The status of system manager could be applied for by such units which have used a conventional map to register original land management information in their work so far.

19 A system user employs the system as an instrument to pursue his own goals, by applying to the system for a specific set of primary information* and obtaining it on traditional or magnetic carriers or over direct links. In this latter case, a system user can have, in practice, the same access to the data files as a system manager but without the additional obligations he carries.

20 The system has aroused large but rather superficial interest. A general treatment of information technology as something of a miracle maker can be observed, with a simultaneous underestimation of the importance of a constant influx of primary information as the key to the securing of the system, as well as data reliability. The system is characterized by a strong of changes in its data base. Serious disillusion could result from the uncritical acceptance of suggestions by chance promotors of information technology *(cost effectiveness calculations)* since the modernization costs of the LIS are large and are spread out in time. On the other hand, jobs undertaken but not concluded can only lead to a definite loss of the injected capital.

21 Potential LIS users, especially certain local self-government bodies, continue to treat it as the source of cost-free information donated by the state. Though their programme declarations speak of the need to possess such an instrument, the impression they make is they are poorly equipped to use it effectively.

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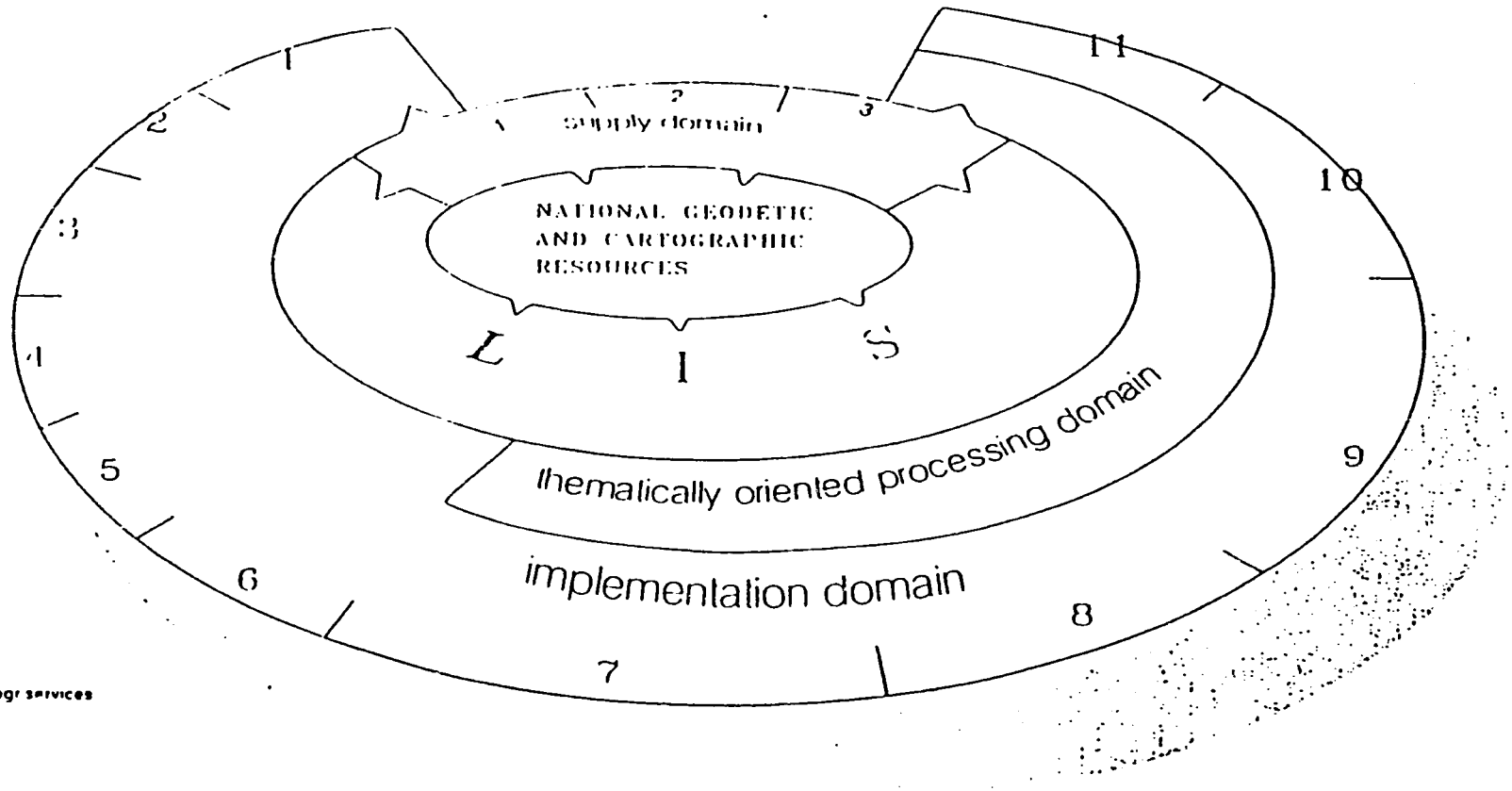
* or suitably processed

LIS-Relations with Environment

Information supply to LIS

1 coordinated
2 enforced
3 co operative



Implementations

1 market of geod and cartogr services
2 service to individuals
3 credit business
4 real estate business
5 general administration
6 technical infrastructure management
7 land management
8 town and country planning
9 environmental protection
10 development planning
11 capital construction planning

APPENDIX G

A formal cooperative agreement in the area of GIS/LIS development between the City of Gdansk and the Regional Office of Cartography and Geodesy (Voivoda). This type of collaboration is essential in Poland, providing a mechanism to link the needs of local->regional->national LIS programs.

Gdańsk 1992.05 [illegible]

U M O W A

o współpracy pomiędzy Urzędem Wojewódzkim a Zarządem Miasta Gdańska w zakresie budowania Systemu Informacji Terenowej wraz ze Zintegrowanym Systemem Informacji Miejskiej

Stronami niniejszej umowy są:

1.Urząd Wojewódzki w Gdańsku reprezentowany przez Wojewodę Gdańskiego i Dyrektora Wydziału Geodezjii Gospodarki Gruntami,
2.Zarząd Miasta Gdańska.

Strony postanawiają co następuje:

art.1

Budować System Informacji Terenowej, zwany dalej Systemem z uwzględnieniem wytycznych Krajowego Systemu Informacji Terenowej. System będzie ponadto wykorzystywał najnowsze rozwiązania istniejące w tym zakresie w metropoliach europejskich.

art.2

Urząd Miasta Gdańsk zainstaluje cztery stacje robocze do wprowadzenia bazy danych systemu przez pracowników podmiotów wyłonionych w drodze konkursu ofert przez Zarząd Miasta.Urząd Wojewódzki poniesie opłaty związane z udostępnieniem pomieszczenia przy ulicy 3 Maja Nr 9 w Gdańsku.

art.3

Koszty związane z wykonaniem niezbędnych pomiarów i wprowadzaniem bazy danych dla obszaru całego miasta pokrywane będą przez Zarząd Miasta Gdańska.

art.4

Prace rozpoczną się od uruchomienia numerycznego modułu osnowy geodezyjnej opracowanego na zlecenie Zarządu Miasta Gdańska. Koszty wprowadzenia bazy danych w tym zakresie pokryje Urząd Wojewódzki. Właścicielem i eksploatującym ten moduł będzie Urząd Wojewódzki.Zarząd Miasta Gdańska otrzyma możliwość bezpłatnego dostępu do danych w trakcie budowania systemu i aktualiacji baz danych.

art.5

Zgodnie z istniejącym w dniu podpisania umowy prawem oraz interesem osób trzecich Urząd Wojewódzki poniesie koszty udostępnienia danych z Ośrodka Dokumentacji Geodezyjno – Kartograficznej i operatu ewidencji gruntów.Zapis ten dotyczy okresu tworzenia podstawowej bazy danych.

art.6

Powstające w trakcie prac bazy danych w zakresie osnów,mapy zasadniczej,punktów granicznych,ewidencyjnej bazy danych zgodnej z systemem EG Miast będą sukcesywnie przekazywane do Urzędu Wojewódzkiego w Gdańsku w celu włączenia do Państwowego Zasobu Geodezyjno – Kartograficznego.Pozostała część bazy danych, nie będąca własnością Zasobu jest własnością Miasta Gdańska.

art.7

Wszelkie prace związane z tworzeniem bazy danych nie mogą zakłócić ciągłości pracy Ośrodka Dokumentacji Geodezyjno – Kartograficznej, Zakładu Ewidencji Gruntów oraz Zespołu Uzgadniania Dokumentacji w zakresie obsługi interesantów.

art.8

Zarząd Miasta Gdańska będzie mógł udostępniać odpłatnie tylko zawartość baz danych nie będących własnością Państwowego Zasobu Geodezyjno – Kartograficznego.

art.9

Strony uzgadniają, że w procesie tworzenia projektu generalnego systemu weźmie udział jako konsultant prac dotyczących Zasobu Geodezyjno – Kartograficznego Z-ca Dyrektora Wydziału Geodezji i Gospodarki Gruntami Urzędu Wojewódzkiego – Maciej Sosiński.

art.10

Po zbudowaniu bazy danych zgodnej z wytycznymi Krajowego Systemu Informacji Terenowej strony zobowiązują się do wzajemnego nieodpłatnego przekazywania informacji o zaistniałych zmianach i dopilnowania utrzymywania baz danych w aktualności. Korzystanie z aktualnej bazy danych Zasobu będzie się odbywać odpłatnie.Fundusze uzyskane z tej działalności Urząd Wojewódzki przeznaczy na utrzymanie bazy danych w aktualności i wdrażanie SIT w innych obszarach województwa gdańskiego.

art.11

W przypadku możliwości finansowania prac nad budowaniem systemu w Gdańsku przez Urząd Wojewódzki strony dokonają stosownych uzgodnień w odrębnej umowie.

art.12

Wszelkie sprawy nieuregulowane w niniejszej umowie będą rozstrzygane w oparciu o przepisy Kodeksu Cywilnego.

art.13

Niniejsza umowa została sporządzona w czterech egzemplarzach po dwa dla każdej ze stron.

Umowa zawarta w Gdańsku dnia 12.06. 1992 roku.

Urząd Wojewódzki

WOJEWODA

Maciej Piaszyński

Zarząd Miasta

PREZYDENT MIASTA GDAŃSKA

mgr inż. Franciszek Jamroż

GŁÓWNY GEODETA WOJEWÓDZKI

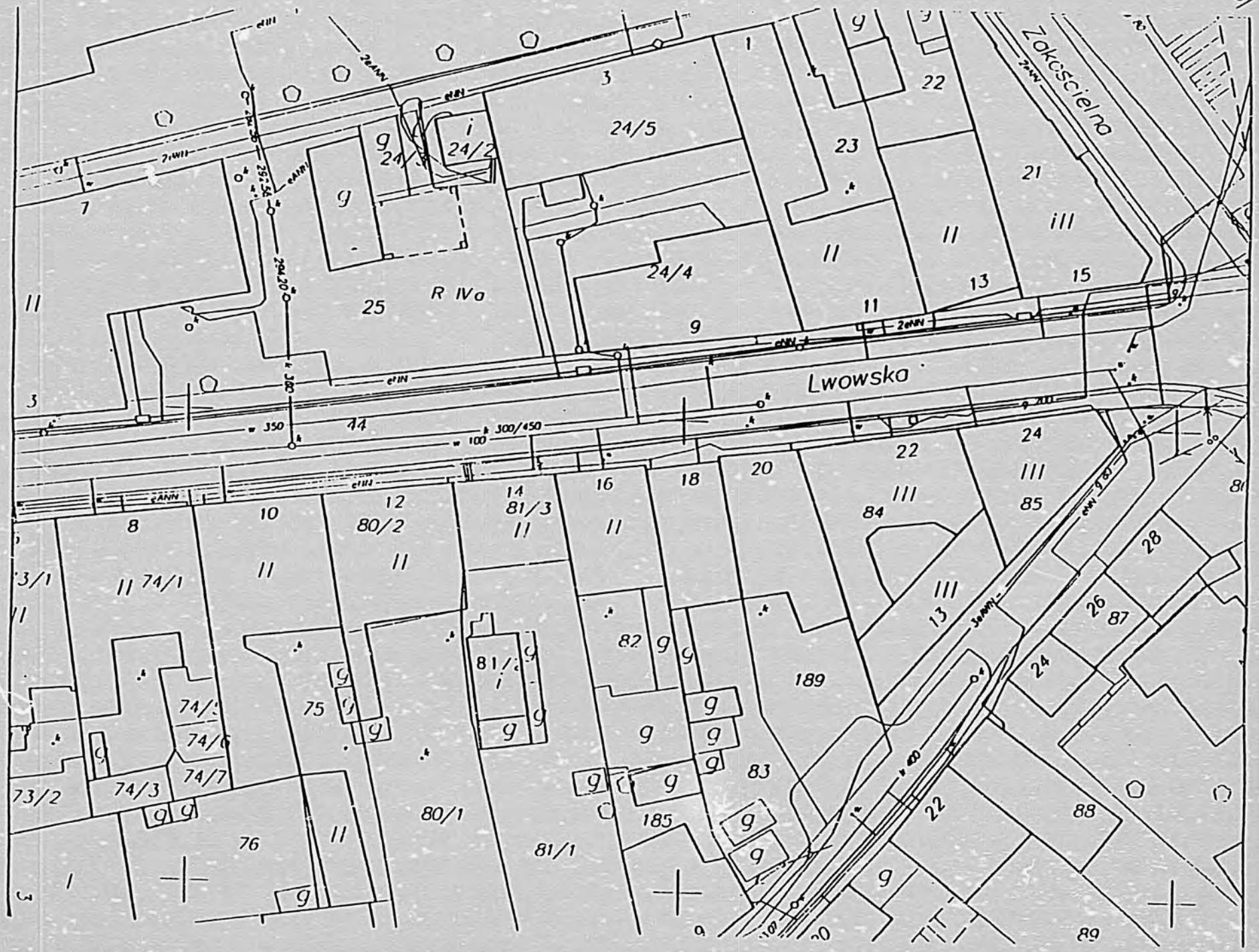
Tadeusz Janikiewicz

DYREKTOR

WICEPREZYDENT MIASTA GDAŃSKA

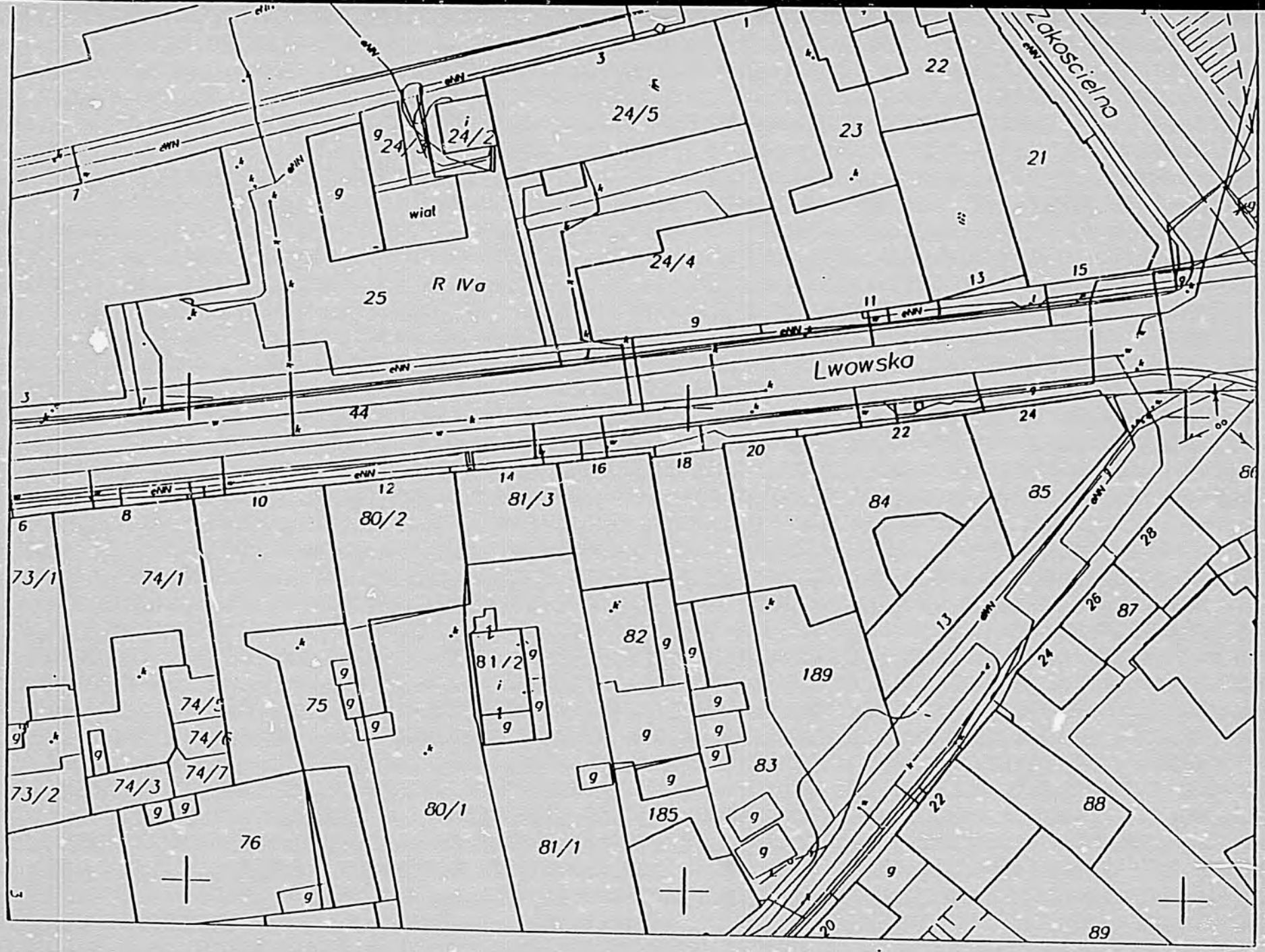
APPENDIX H

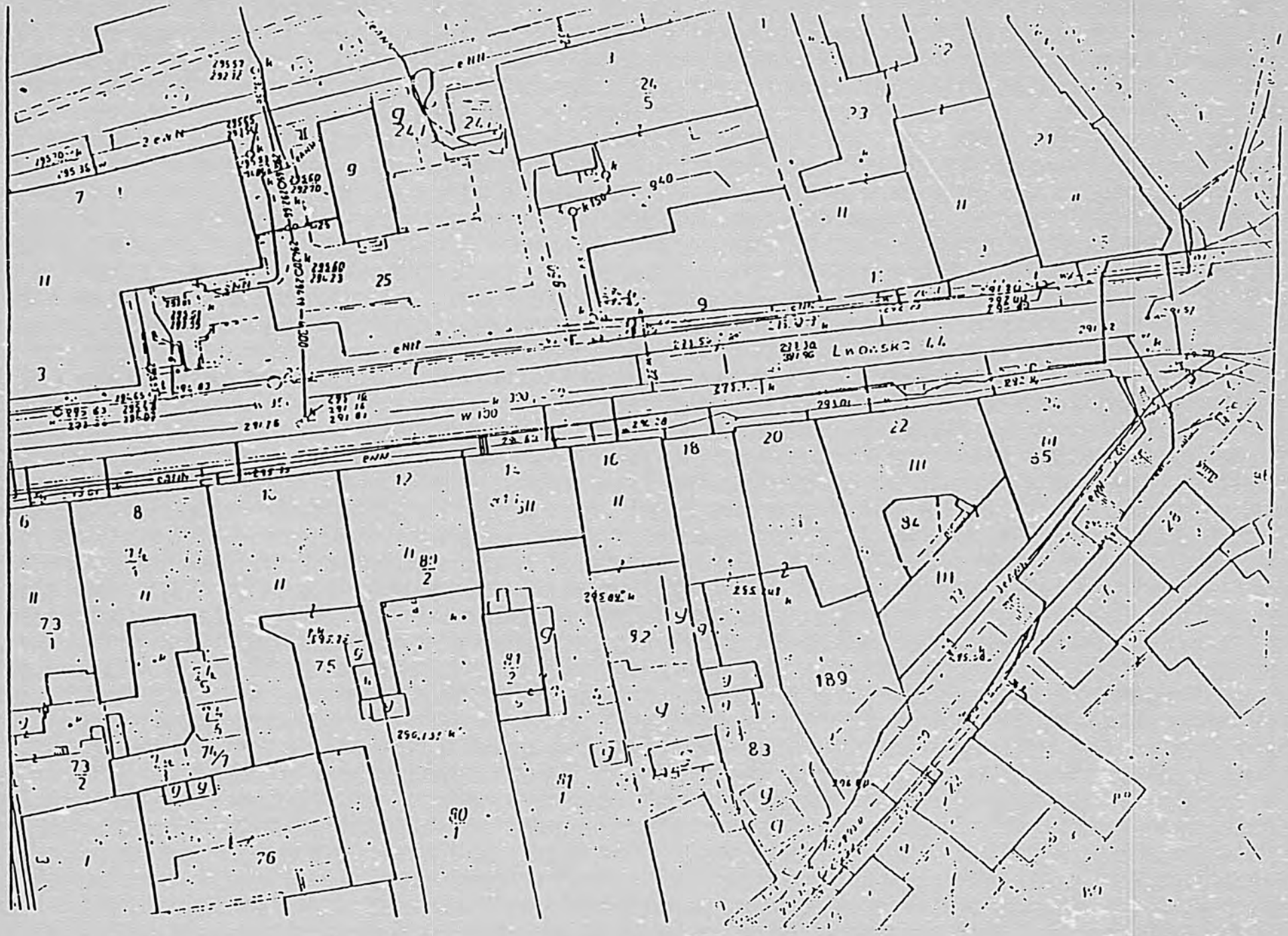
Samples of the evolving LIS database for Gdansk. First page shows the original source material property (cadastral) maps which are being digitized. Second page shows a hard copy output of the automated map where some details from the original have been rationalized. Third page shows a sample of the "Technical Infrastructure" maps for Gdansk which are currently being automated by the Voivoda (WODGiK). Details of the technical infrastructure (water, sewer, gas, heating, electrical, telephone) will form "base layers" for the Gdansk LIS, and will be utilized by numerous clients in both the public and private sectors.



WERSJA ISTNIEJĄCA

WERSJA PROPONOWANA





MAPA ZASADNICZA

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APPENDIX I

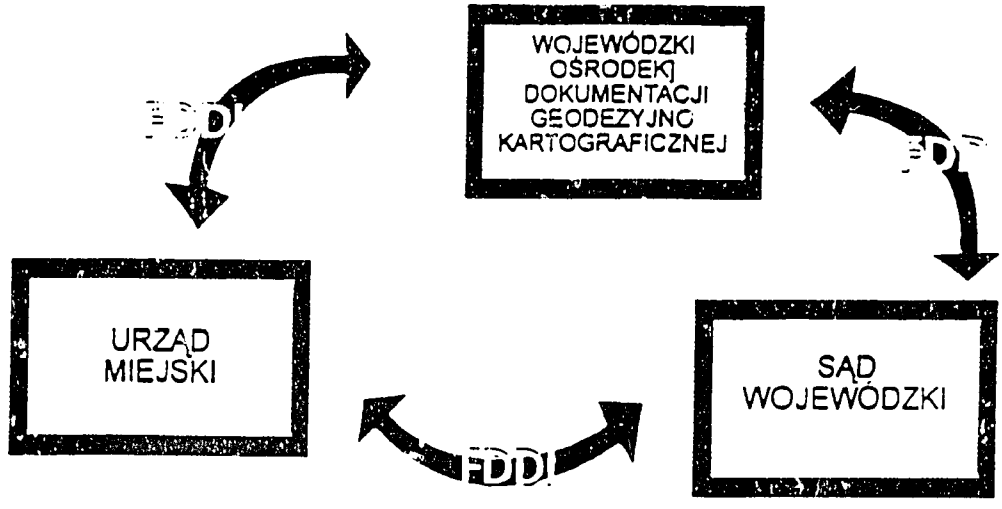
Proposed fiber optic communication between the key participants in the Gdansk LIS namely the city (Urzad Miejski), Voivoda (WODGik) and the Regional Court of Justice (Sad Wojewodzki). This forms the main data "backbone" for the LIS.

On a larger scale, page 2 shows conceptually how this LIS "Backbone" will inter-connect with a major fiber optic highway already installed between the tri-city area of Gdynia-Sopot and Gdansk. This will facilitate access to the GIS/LIS for numerous users (public and private) including utility companies, Banks, Regional Infrastructure Service Centers (ROMS) etc.

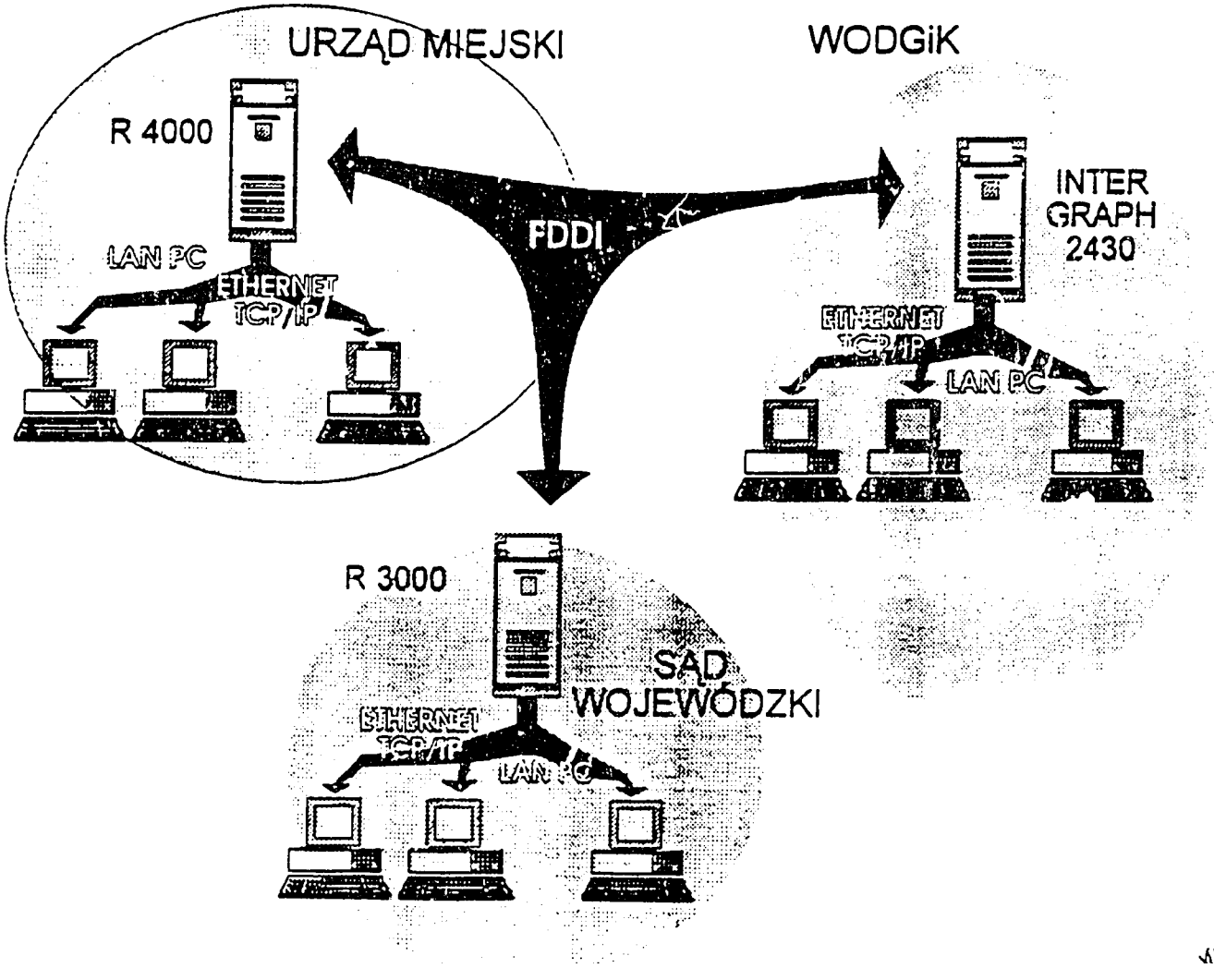
Page 3 shows the current development of an automated deed management system at the Regional Court of Justice (FENIKS-ORACLE). This will be a key component in the Gdansk LIS. This system although created independently, will be fully integrated into the LIS, and has selected technology which is fully compatible with the proposed (topological) GIS data model.

POWIĄZANIA ZEWNĘTRZNE S.I.T.

FAZA PIERWSZA, TERMIN REALIZACJI - 1993
PĘTLA ŚWIATŁOWODOWA, PROTOKÓŁ FDDI
100 Mb/sek

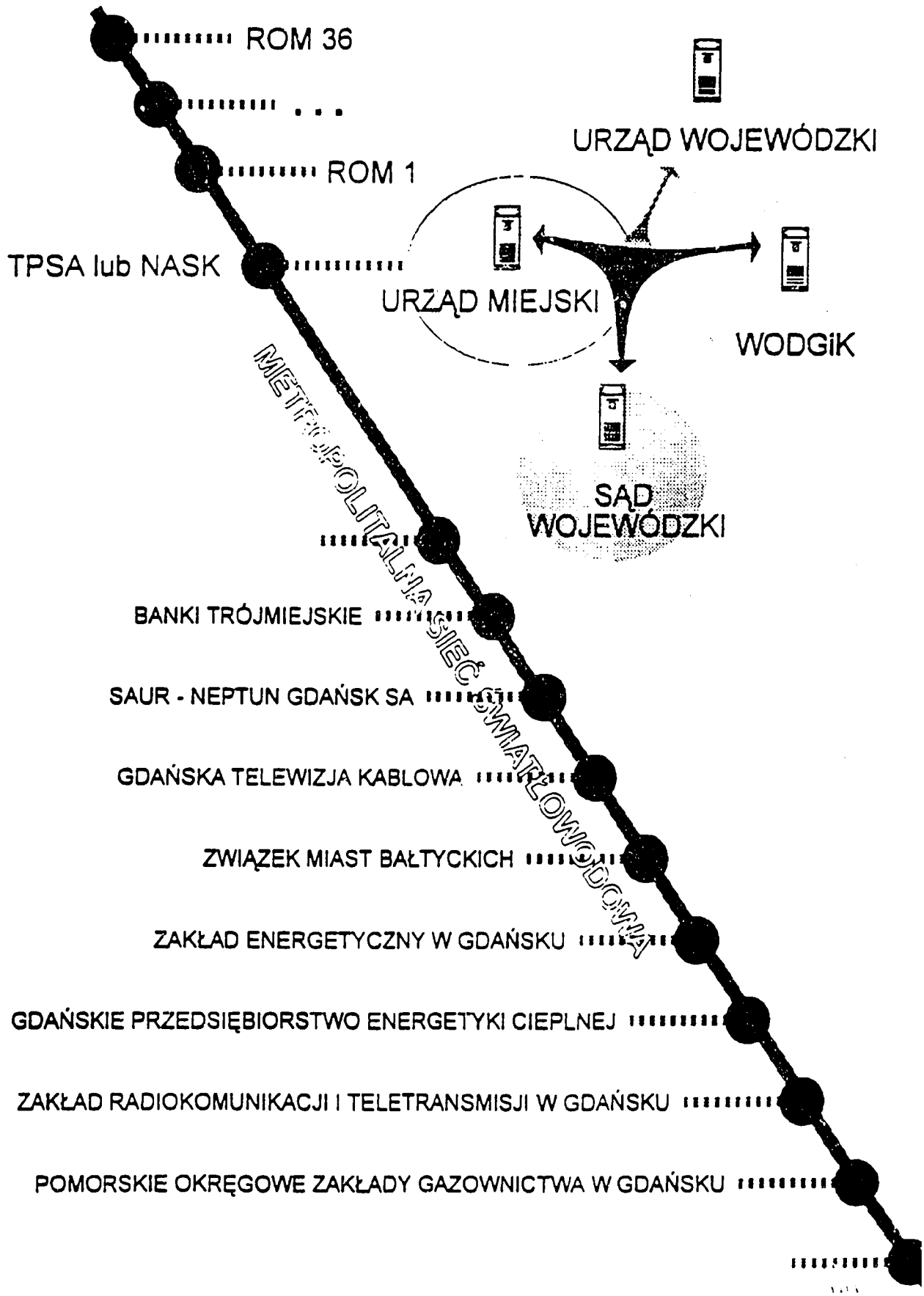


ROZWIĄZANIE TECHNICZNE
PIERWSZEJ PĘTLI ŚWIATŁOWODOWEJ

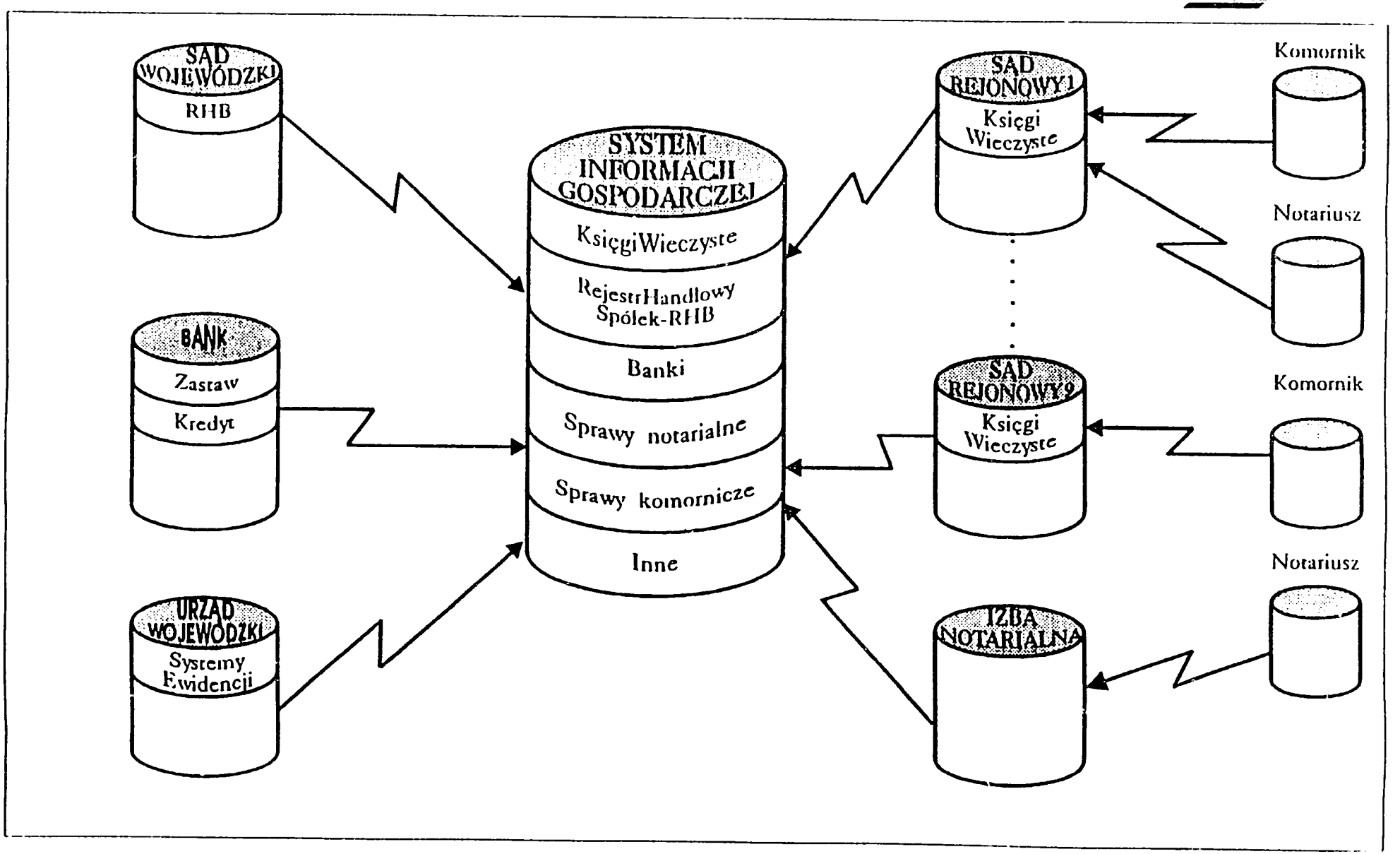


POWIĄZANIA ZEWNĘTRZNE S.I.T.

FAZA DOCELOWA POŁĄCZEŃ ŚWIATŁOWODOWYCH - 1994



SYSTEM BADANIA WIARYGODNOŚCI INFORMACJI GOSPODARCZEJ



OPIS SYSTEMU
BADANIA WIARYGODNOŚCI INFORMACJI GOSPODARCZEJ

Bank Gdański SA i Computer Studio Kajkowski SA planują wspólne powołanie Bankowej Agencji Informacyjnej i zbudowanie Systemu Weryfikacji Wiarygodności Podmiotów Gospodarczych, który mógłby być wykorzystywany przez banki i instytucje finansowe w działalności kredytowej, windykacyjnej, a także przez przedsiębiorstwa w ich działalności inwestycyjnej, handlowej.

Powstanie tego systemu wymusza obecna sytuacja w której banki cierpią na brak obiektywnych sposobów sprawdzania wiarygodności swoich klientów. Dotyczy to również przedsiębiorstw i firm zagranicznych próbujących uzyskać informacje o swych obecnych i przyszłych partnerach gospodarczych. Instytucje te, przy podejmowaniu decyzji kredytowych, kierować się głównie muszą. nie zawsze obiektywnymi danymi, dostarczonymi przez swoich klientów.

System ten dla województwa gdańskiego obejmowałby powstanie (w okresie 2 lat) i współpracę następujących bazy danych:

- baza danych ksiąg wieczystych, zawierająca informacje ze wszystkich ksiąg wieczystych zawartych w lokalnych bazach zlokalizowanych w 9 Sądach Rejonowych województwa
- baza danych rejestru handlowego RHB oraz rejestru przedsiębiorstw państwowych
- baza danych spraw egzekucyjnych prowadzonych przez komorników
- baza danych spraw prowadzonych przez notariuszy
- bazy danych banków, w tym baza zastawu i kredytobiorców

Wszystkie bazy systemu połączone zostaną siecią teleinformatyczną umożliwiającą przyszłym użytkownikom dostęp do wszystkich baz systemu, oraz umożliwiającą odpowiednią wymianę i aktualnianie informacji zawartych w poszczególnych bazach.

Powstanie systemu ułatwi i uaktywni proces tworzenia dalszych branżowych baz danych.

System zapewni w pełni obiektywne i wiarygodne informacje, opracowane w dowolnych przekrojach zgodnie z zapotrzebowaniem klienta systemu. Możliwa również będzie współpraca z bazami danych administracji państwowej, tzn. ewidencjami ludności, gruntów, pojazdów.

Infrastruktura systemu pozwalać będzie zarówno na dostęp do centralnej bazy systemu zawierającej pełne dane o całym województwie jak również do baz rejonowych zawierających informacje dotyczące danego rejonu.

Planowane nakłady finansowe Bankowej Agencji Informacyjnej w latach 1993/94 wyniosą szacunkowo:

- Założenie bazy danych ksiąg wieczystych 4.7 mld zł
- Zakup sprzętu w skali województwa 11.5 mld zł

co w sumie daje kwotę ponad 16 mld złotych.

APPENDIX J

Selected data collection and survey instruments which are essential tools in the GIS/LIS design and implementation planning process. This is especially critical in the Database Design tasks and procedures (see Implementation Plan).

ENTITY DEFINITION FORM

COMPLETED BY: _____

DATE: _____

ENTITY:

SYNONYMS:

ENTITY DEFINITION:

FREQ. OF OCCURRENCE:

GROWTH RATE:

FEATURE ACCESS OR EDIT RESTRICTIONS:

GRAPHIC MAINTENANCE RESPONSIBILITY:

NOTES:

FULL ATTRIBUTE DEFINITION FORM

COMPLETED BY: _____

DATE: _____

ATTRIBUTE: OF ENTITY:

DESCRIPTION/DEFINITION:

FORMAT: MAX LENGTH/VALUE: UNIT OF MEASURE: M/O:

DATA ACCESS RESTRICTIONS:

MAINTENANCE RESPONSIBILITY:

VALIDATION RULES:

DEFAULT VALUE: % OF TOTAL:

VALUE FOR NULL:

NOTES:

EXISTING SYSTEMS ENVIRONMENT SUMMARY

INTERVIEWER: _____

INTERVIEWEES: _____

_____

_____

DATE: _____

1. SYSTEM NAME:

2. USER DEPARTMENTS:

3. APPLICATION DESCRIPTION:

4. FILE STRUCTURE:

5. COMPUTER PROCESSOR/OPERATING SYSTEM:

6. PERIPHERAL HARDWARE:

INDICATE WHETHER YOUR GROUP PROVIDES TO OR RECEIVES GEOGRAPHIC INFORMATION FROM THE OTHER GROUPS.

USER GROUP: _____

TYPE OF DATA	PROVIDES TO	RECEIVES FROM
EXAMPLES: SUBDIVISION PLATS BUILDING PERMITS STREET ADDRESSING LAND OWNERSHIP INFORMATION ZONING INFRASTRUCTURE/UTILITIES		

PROCESS/INFORMATION WORKFLOW QUESTIONNAIRE

INTERVIEWER: _____

INTERVIEWEES: _____

_____

_____

DATE: _____

1. PROCESS NAME:

2. ORIGINATING SOURCE (WHO & HOW IS THE PROCESS INITIATED?):

3. RESPONSIBLE PROCESSING AGENCY:

4. INTERAGENCY COORDINATION:

   - WHAT INFORMATION IS PROVIDED TO WHICH AGENCIES?:

   - WHAT INPUT DOES EACH AGENCY PROVIDE?:

5. WHAT KEY INFORMATION IS INVOLVED IN THE PROCESS?:

6. WHO MAINTAINS THE INFORMATION?:

7. WHAT REPORTS, MAPS OR DOCUMENTS ARE PRODUCED IN THE PROCESS?:

8. MAINTENANCE INTERVAL (DESCRIBE FOR EACH INFORMATION GROUP, REPORT, DOCUMENT OR MAP):

9. FILE/STORAGE DOCUMENT LOCATION(S):

10. LAWS OR ORDINANCES GOVERNING SCHEDULE, TIMING, OR OTHER RELEVANT ITEMS AFFECTING WORKFLOWS:

11. CURRENT WORKFLOW PROBLEMS/ISSUES:

12. RECOMMENDATIONS (SEE ABOVE):

13. PLEASE DIAGRAM WORKFLOWS ASSOCIATED WITH THE ABOVE KEY TASKS INCLUDING TIMING AND INVOLVEMENT OF OTHER AGENCIES/DECISION MAKERS. (FEEL FREE TO USE THE BACK SIDE OF THIS PAGE IF NECESSARY):

EXISTING DATA FILE DESCRIPTION FORM
(MANUAL OR AUTOMATED RECORDS)

INTERVIEWER: _____

INTERVIEWEES: _____

_____

_____

DATE: _____

1. DATA FILE NAME/DESCRIPTION:

2. PHYSICAL LOCATION:

3. FILE RESIDENT MEDIA:

4. ESTIMATED VOLUME:

5. ESTIMATED ANNUAL GROWTH RATE:

6. BACKUP POLICY/PROCEDURES:

7. RETENTION POLICY PROCEDURES:

8. SECURITY/CONTROL REQUIREMENTS:

9. FILE ORGANIZATION:

10. FILE STRUCTURE:

11. DBMS:

12. FILE ACCESS:

13. MAINTENANCE RESPONSIBILITY:

14. MAINTENANCE FREQUENCY:

15. MAINTENANCE SOURCE INFORMATION:

16. QUALITY CONTROL PROCEDURES:

17. ENTITY/ATTRIBUTE DEFINITIONS:
(USE EXISTING FORMS)

APPENDIX K

The first stage in the formation of a Public-Private Enterprise in Gdansk destined to manage GIS/LIS development and operations on behalf of the city. This declaration or agreement was made between the initiating partners namely; the City of Gdansk, the Voivoda (WODGiK) and nine private and/or public utility companies with a proprietary interest in the funding of LIS development. This public-private cooperation in GIS/LIS development designed to share data, resources, level of effort and funding requirements is unique and may form a viable model for sites across Poland and Eastern Europe.

DEKLARACJA INTENCJI
W SPRAWIE WSPÓLNEJ BUDOWY ZINTEGROWANEGO SYSTEMU NUMERYCZNEJ MAPY PODSTAWOWEJ GDAŃSKA

parafowana w dniu .06.1993r. przez **WOJEWÓDĘ GDAŃSKIEGO** reprezentowanego przez:
- Dyrektora Wydziału Geodezji i Gospodarki Gruntami Tadeusza Jankiewicza
- Z-cę Dyrektora Wydziału G.i G.G. Macieja Sosińskiego.

oraz:

1.**ZARZĄD MIASTA GDAŃSKA** reprezentowany przez :
-
-

2."**SAUR-NEPTUN" GDAŃSK S.A.** reprezentowany przez:
-
-

3.**POMORSKI OKRĘGOWY ZAKŁAD GAZOWNICTWA W GDAŃSKU** reprezentowany przez:
-
-

4.**GDAŃSKIE PRZEDSIĘBIORSTWO ENERGETYKI CIEPLNEJ W GDAŃSKU** - spółka z o.o. reprezentowane przez:
-
-

5.**TELEKOMUNIKACJĘ POLSKĄ S.A. ZAKŁAD TELEKOMUNIKACJI W GDAŃSKU** reprezentowany przez:
-
-

6.**ZAKŁAD ENERGETYCZNY GDAŃSK** - reprezentowany przez :
-
-

7.**ZAKŁAD RADIOKOMUNIKACJI I TELETRANSMISJI W GDAŃSKU** reprezentowany przez :
-
-

8.**POLSKĄ TELEWIZJĘ KABLOWĄ S.A.** reprezentowaną przez:
-
-

9.**ZAKŁAD KOMUNIKACJI MIEJSKIEJ W GDAŃSKU** reprezentowany przez
.

§1.

Deklaracja dotyczy budowy i współfinansowania podstawowego ogniwa Systemu Informacji Terenowej , za którą uznaje się numeryczną mapę miasta. W szczególności głównym elementem planowanego zamierzenia jest sporządzenie mapy ewidencji sieci uzbrojenia terenu oraz mapy jako podkładu dla celów projektowych w zapisie numerycznym.Uruchomienie transmisji danych do użytkowników systemu prowadzących system.Podstawowym organizacyjnym elementem planowanego zamierzenia jest wdrożenie nowej struktury organizacyjnej uzyskiwania niezbędnych w procesie geodezyjnego przygotowywania inwestycji.
Wyżej wymienione elementy wymagają stworzenia wspólnego funduszu realizacyjnego.

§2.

Główne cele realizacji przedsięwzięcia są następujące:
1.istotne usprawnienie oraz skrócenie w czasie i potanienie procedury uzyskiwanie niezbędnych w procesie inwestycyjnym uzgodnień;
2.zdyscyplinowanie inwestorów - we wspólnym interesie- w zakresie przestrzegania przepisów o obowiązku inwentaryzacji powykonawczej przewodów podziemnych sieci uzbrojenia technicznego terenu i obiektów z tą siecią związanych;
3.podniesie jakości technicznej oraz wiarygodności danych poprzez uporządkowanie rozproszonego obecnie zasobu informacji geometrycznej o sieciach uzbrojenia technicznego terenu oraz poprzez jego uzupełnienie i aktualizację danymi z instytucji branżowych;

§3.

Budowa nowej mapy realizowana będzie w oparciu o odpowiednie wytyczne Głównego Geodety Kraju zaakceptowane przez Ministra Gospodarki Przestrzennej i Budownictwa.

§4.

W celu przygotowania odpowiedniego POROZUMIENIA pomiędzy Stronami w wymienionej w tytule DEKLARACJI w sprawie wspólnej budowy mapy numerycznej Gdańska.Dyrektor Wydziału Geodezji i Gospodarki Gruntami Urzędu Wojewódzkiego w Gdańsku powoła odpowiedni Zespół.
W skład Zespołu wchodzić będą przedstawiciele każdej ze Stron , którzy parafują niniejszą DEKLARACJĘ oraz przdstawiciel Wykonawcy robót.

§5.

Za podstawowe zadania wymienionego w §4 Zespołu uważa się :

1.określenie kosztów planowanego , wspólnego przedsięwzięcia oraz zasad jego finansowania;
2.rozpoznanie wielkości dostępnych środków finansowych - w funkcji czasu -

na realizację przedmiotowego zadania ;

3. opracowanie harmonogramu rzeczowo-finansowego planowanego Zamierzenia;
4. wykonanie szczegółowej inwentaryzacji obecnego potencjału materialnego Stron w przedmiotowym temacie;
5. wykonanie szczegółowej inwentaryzacji potrzeb Stron w zakresie baz danych;
6. określenie odpowiedniej konfiguracji sprzętu komputerowego dla Stron - współuczestników realizacji Zamierzenia;
7. opracowanie zasad współpracy oraz zasad udostępniania danych nowotworzonego zasobu mapy numerycznej;
8. przygotowanie ostatecznej wersji Porozumienia Stron - uczestników przedsięwzięcia.

§ 6.

Prace Zespołu powinny być zakończone w terminie do dnia 15 października 1993r.

§7.

Koszty wykonania prac Zespołu wymienione w $5 niniejszej Deklaracji pokryte zostaną z utworzonego przez Strony wspólnego funduszu.

§ 8.

Niniejsza Delaracja dostępna jest dla innych jednostek nie wymienionych w preambule a chcących brać udział w przedsięwzięciu.

§ 9.

Niniejsza Deklaracja została sporządzona w 20 egz. po dwa dla każdej ze Stron.

Parafowano w Gdańsku dnia 06.1993r

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APPENDIX L

A recently published article on GIS related to the privatization issue.

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PRIVATIZATION OF LAND AND THE POTENTIAL IMPACT OF GIS IN THE NEWLY INDEPENDENT STATES (NIS) OF THE FORMER SOVIET UNION

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INTRODUCTION

Russia is a country of immense proportions and remarkable diversity. Stretching from the Baltic to the Pacific rim, Russia remains at the center of a fragmented Soviet Union. Today, this newly independent nation, like so many other republics in the region, faces the many challenges which come with independence. Russia must find unity in diversity, reform a stagnating industrial complex, restructure an inefficient agricultural sector, reform political and social policies, and move the entire economy into a global marketplace. Russia has come to embody the consequences of the changes that are occurring across the region. Such radical changes invariably create an atmosphere of uncertainty, and the history of the region has shown that this can lead to social and political instability, which is often a prelude to conflict.

However, there is hope that the processes underway will, over time, have a positive impact and lead to the necessary economic restructuring. If these reforms are to prevail, they will rely heavily upon the resilience and ingenuity of the people, augmented by appropriate technical and financial assistance from the West.

This paper documents change, ingenuity, and progress in one vital sector of the emerging Russian economy. Land in Russia and the other republics, constitutes a massive potential resource which must be effectively mobilized if the economies of the Newly Independent States (NIS) are to prosper in the future. However, the issues relating to land are complex and contentious. After all, it was mass poverty and resentment towards the "landed elite" that swept the Bolsheviks to power in the revolution of 1917. Since that time, the land resources of Russia have remained a latent asset, socialized and mismanaged for years, and a new revolution is beginning to realize the true potential of the land.

But why is land so critical to the economy of Russia and the NIS, and how can its full potential be realized? In the West, privatization and private ownership of land is frequently a requirement for investment, which in turn forms the basis for growth in many economies. So, in Russia and the other independent republics, privatization of land must occur in order to create

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sound opportunities for investment from within, and particularly from the West. Some land privatization initiatives have been started in the region and shown signs of progress, depending upon many factors and prevailing local conditions. Frequently, these initiatives have been supported by donors whose programs inevitably confront the legacy of the Soviet land system, which presents immense obstacles to privatization and other reforms.

MAGNITUDE OF PROBLEM

To better understand the magnitude of the land issue and related problems in Russia, it is useful to look at a case study. Nowhere are these changes and upheavals more evident than in the heart of the old Soviet Union, namely, Moscow.

A sprawling megalopolis of 9 million people occupying over 1,000 square km, subdivided into 400,000 parcels, Moscow embodies many of the grave mistakes of past policies, and yet is showing signs of hope for the future. Like many large cities in the West, Moscow is coming to terms with many problems related to its urban land: planning, effective land utilization and management, pollution, dereliction and environmental problems, finding space for new housing, reconstruction and development, infrastructure and service provision, and of course, the development of an efficient land market for revenue generation and economic growth.

All these traditional urban issues and problems are compounded by the fact that all land in Moscow has been held captive by an atrophied system of state ownership and mismanagement. How can the city reinvigorate the land and realize the economic potential of this resource through privatization and investment? Many other urban areas across the former Soviet Union are confronting this same crucial question. Part of the answer may lie within one city agency known as the Geo-Trust.

The Geo-Trust is a city government agency which is the trustee of a massive information resource which describes the many complex components forming the metropolitan area of Moscow. Geographic information is meticulously stored in the form of large scale maps which are regularly updated to reflect changes, and are routinely used by a number of agencies mandated with various functions within the city. Among these users are utility companies and numerous City Prefectures. Currently, 60,000 maps at a scale of 1:500 show in detail the many features of the urban fabric in Moscow: These components include the transportation infrastructure, roads and highways, railroads and waterways, utilities such as the heating and water systems, electricity and gas networks, basic geography such as soils and slope, hydrology and aquifers, open spaces and recreational areas. Possibly, the most important information shown and maintained by these maps are the property parcels which subdivide the urban land, frequently occupied by various building types. These land parcels and their physical assets constitute the basis for a future Land Information System (LIS) designed to manage the city, empower decision makers with relevant information, and assist in the development of an efficient land market within Moscow's urban economy.

Although the Geo-Trust stores and maintains a vast information archive on the City of Moscow, only a fraction of these detailed and diverse data resources are being used regularly. Hard-copy maps are often limited in detail and difficult to use, in addition, they are costly to update, maintain and reproduce. Furthermore, even regular updating of hard-copy maps provides snap shot inventories of the real world, not truly reflecting the dynamic changes occurring in a city such as Moscow.

To realize the full potential of their information resources, the Geo-Trust has embarked upon an ambitious program to computerize the 60,000 maps and the information they contain, for the entire Moscow metropolitan region. Like cities and municipalities worldwide, the Geo-Trust is using Geographic Information System (GIS) technology to create a detailed digital

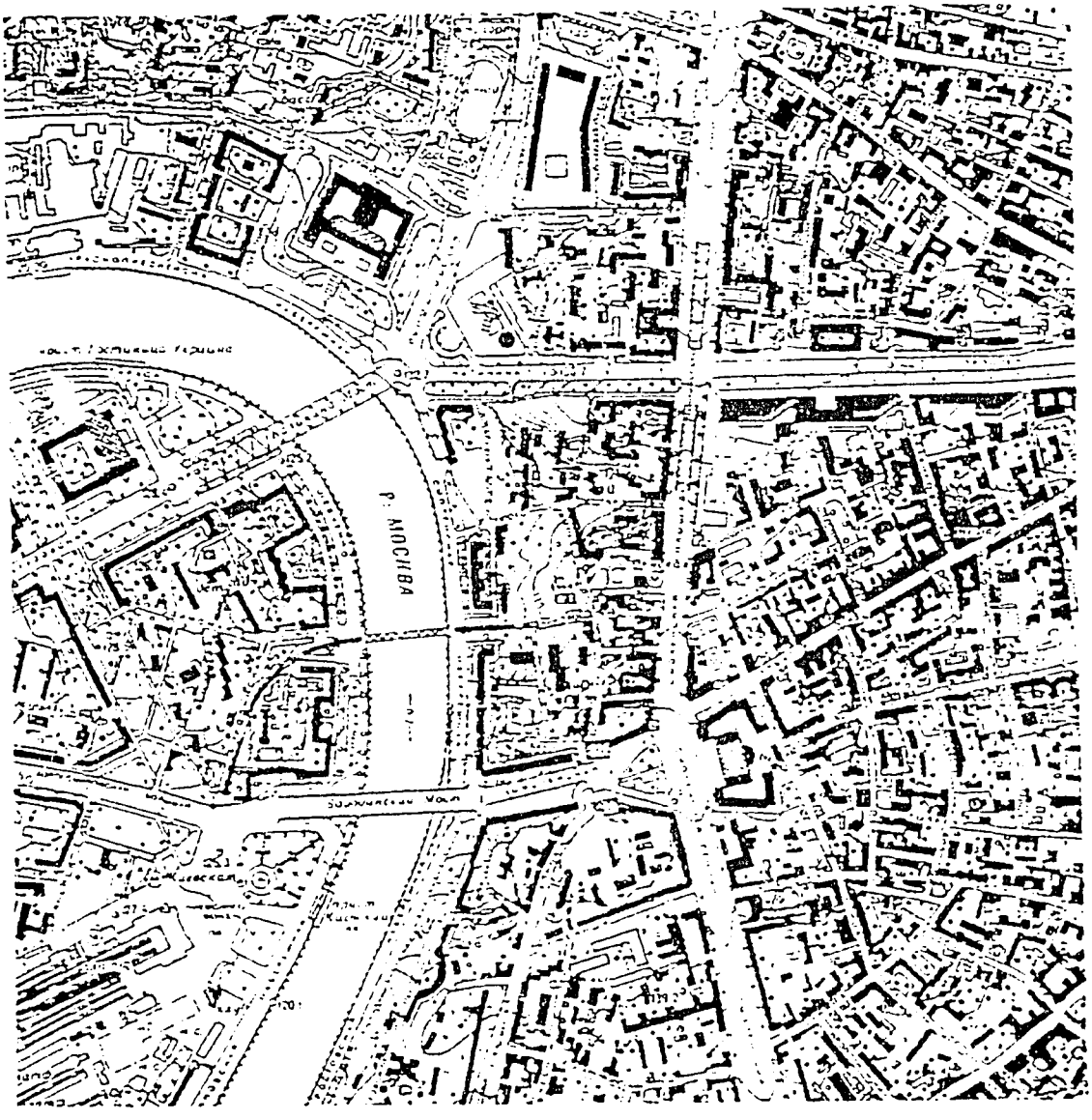

FIGURE 1. Extensive Detail of the Developing Moscow Spatial Databse — Automation of Data by Kiberso Using Infoso Software. (Courtesy of Moscow City Geo-Trust.)

cadastre for Moscow (Figure 1). This is developed by digitally capturing the numerous geographic features detailed on the maps or "planchettes," and building a related database in which associated information can be stored.

TECHNICAL SOLUTIONS TO RUSSIAN PROBLEMS

To undertake this automation process, the Geo-Trust has contracted a local enterprise called Kiberso which is currently engaged in the creation of the Moscow LIS.

Kiberso was formed in 1990 by a group of cartographers, mathematicians, and computer programmers who had left the military establishment as the Soviet Union disintegrated. For 20 years, they had applied geographical analysis techniques and technologies for military purposes, such as designing cruise missile navigation systems. Today, they use their skills and experience for civilian purposes by applying GIS technology to resolve various problems, especially in the urban and environmental sectors. In late 1991, PADCO (Planning And Development

COllaborative) Inc., an international planning and development group based in Washington, DC, recognized the unique capabilities of Kiberso and formed a joint venture. This alliance was designed to share skills and knowledge, as well as to promote various activities involving the application of GIS technology to development problems in Russia, the NIS and beyond.

Using a small rented computer, Kiberso first developed a prototype GIS and, in 1991, succeeded in winning the contract for GIS implementation at the Moscow City Geo-Trust. Today, their GIS product, Infoso, is being applied by not only Geo-Trust, but many major organizations in Moscow, including the city gas company, Mosgaz, the heating company, Mosenergo and the Land Committee which administers the city's cadastre and monitors the privatization of land.

Kiberso's work is key to developing a detailed land information database for the entire city of Moscow at a scale of 1:500. The process begins with the scanning of each of the 60,000 hard-copy maps or "planchettes" archived by the Geo-Trust. This captures the map into a digital form which is then manipulated by the Infoso GIS software. First, the image is corrected for any distortions which may result from the scanning process. A threshold of brightness is established to enhance the geographic features which appear as points, lines, polygons, and annotation. Subsequently, reference or tie points are determined for each digital map, which link the scanned image to the real-world coordinate system of the city. In this way, each of the 60,000 maps will ultimately edge-match into a vast, seamless urban database. Finally, annotation as letters and numbers is automatically recognized by the system as operators digitize features such as buildings, utilities, and property lines.

Concurrently, attribute information is also added to the related database. For example, for a building "footprint" digitized into the system, attribute data may include ownership details, number of floors or units, current use and function, building value, and connections to services such as sewer, water, and electricity. Data such as these are invaluable for basic management needs and essential for effective privatization initiatives. Once incorporated into an integrated GIS database, the options and capabilities for information management, updating, analysis, and visualization are enormous.

However, reaching this goal requires a substantial investment in hardware, software, procedures, data, and personnel — the basic components of a GIS. Furthermore, the institutional framework of government within Moscow must be reformed to accommodate and accept the potential benefits of GIS, (such as information sharing). At the Geo-Trust, investments in the GIS development process have been modest, limited by serious financial constraints. Nevertheless, slow and determined progress is being made using the few computers available to the Geo-Trust for automation and interpretation. Plans have been developed for 70 workstations which would provide the capacity to not only complete the LIS for Moscow, but also create a network linking users across agencies, ministries and organizations — all sharing a common interest and need for the information and capabilities offered by GIS. Through their ingenuity, the staff of Kiberso have resolved the major technical barriers to system development. Now, additional funding is desperately being sought by the city government to expedite this formidable and urgent program.

IMPACTS

Local and city governments have historically addressed demands for greater services and management needs, partly by applying new technologies and approaches such as GIS. Countless urban areas worldwide have implemented or are planning the introduction of GIS to improve information management practices which consequently impact the efficiency of government services. From Los Angeles to Lisbon, Paris, and Bangkok, GIS technology is having a significant impact on efficiency, productivity, service delivery, and investment in urban areas of varying size and complexity.

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Under the auspices of the Geo-Trust, the same process is now occurring in Moscow. The indigenous GIS technology and skills developed by Kiberso are being applied to the massive task of creating an LIS for Moscow. Similar systems applied to other cities around the world show a variety of impacts. But what will be the benefits for Moscow and other urban areas in the former Soviet Union, who face not only huge management problems and financial constraints, but also political barriers to reforms, including the introduction of information technologies such as GIS?

In the West, many cities applying GIS have experienced a range of organizational impacts. The creation of an integrated spatial database for a city invariably makes information more accessible for a wider range of users. Sharing of a common geographic database by multiple parties may lead to a greater consensus on various issues, reduction in duplication, and holistic management practices. Specific and typical urban applications of GIS include:

1. An automated cadastre can be developed in which property lot dimensions, positions and legal descriptions are stored in the system and are interactively used for property research, land value modeling, mass appraisals, and parcel management.
2. Integration of natural resource data into the system yields countless environmental applications including impact assessment, air- and water-quality monitoring, hazardous-area mapping and inventory of wetlands, agricultural, and other public lands.
3. Building "footprints" captured in a GIS can be linked to data such as zoning information, parcel size, address, owner of record, assessments, legal division, and other related information. These constitute essential data for building management through inspections, permit tracking and fee or taxation systems (Figure 2).
4. Urban planning is a frequent beneficiary of accurate and accessible information derived from a municipal GIS. Only extensive and reliable geographic information can assist in issues such as capital improvement planning, industrial/commercial site studies, housing sector analyses, parcel history tracking, demographic studies, and land suitability planning.

These real benefits from GIS experienced in numerous cities worldwide are all immediate and urgent needs in Moscow today.

Specifically, the privatization of land and especially, the establishment of housing markets are both information-intensive processes. Understanding of location and spatial relationships is often critical, e.g., the characteristics of housing units versus their relative location in the city, their proximity to the central business district (CBD), retail outlets, transportation nodes, water, sanitation, and other urban services. All these variables will impact land investment potential and property values. Identifying such relationships is transparent in a GIS, thus creating real estate opportunities for investors to buy, sell, and lease land in a market based on accurate and timely information derived from an integrated system.

As the creation of an LIS continues in Moscow, the Geo-Trust is slowly providing information to a variety of users. Utilities such as the Moscow Gas and Heating Companies are using the database to plan maintenance routines of grossly inefficient networks, in an attempt to optimize utility services throughout the city.

Since good information is the basis for sound investment, the evolving LIS for Moscow offers a unique opportunity for financial and technical assistance. The benefits of such a system are clear and the needs are most urgent. The work of the Geo-Trust and Kiberso, with the support of PADCO Inc., constitutes a unique enterprise based on indigenous technological tools, holistic expertise and innovation. The task of implementing GIS technology in the West often calls for substantial financial investment in systems destined to improve cost-recovery through greater efficiency and improved city management. In Moscow, much progress has been made in this effort with only modest local financial investment.

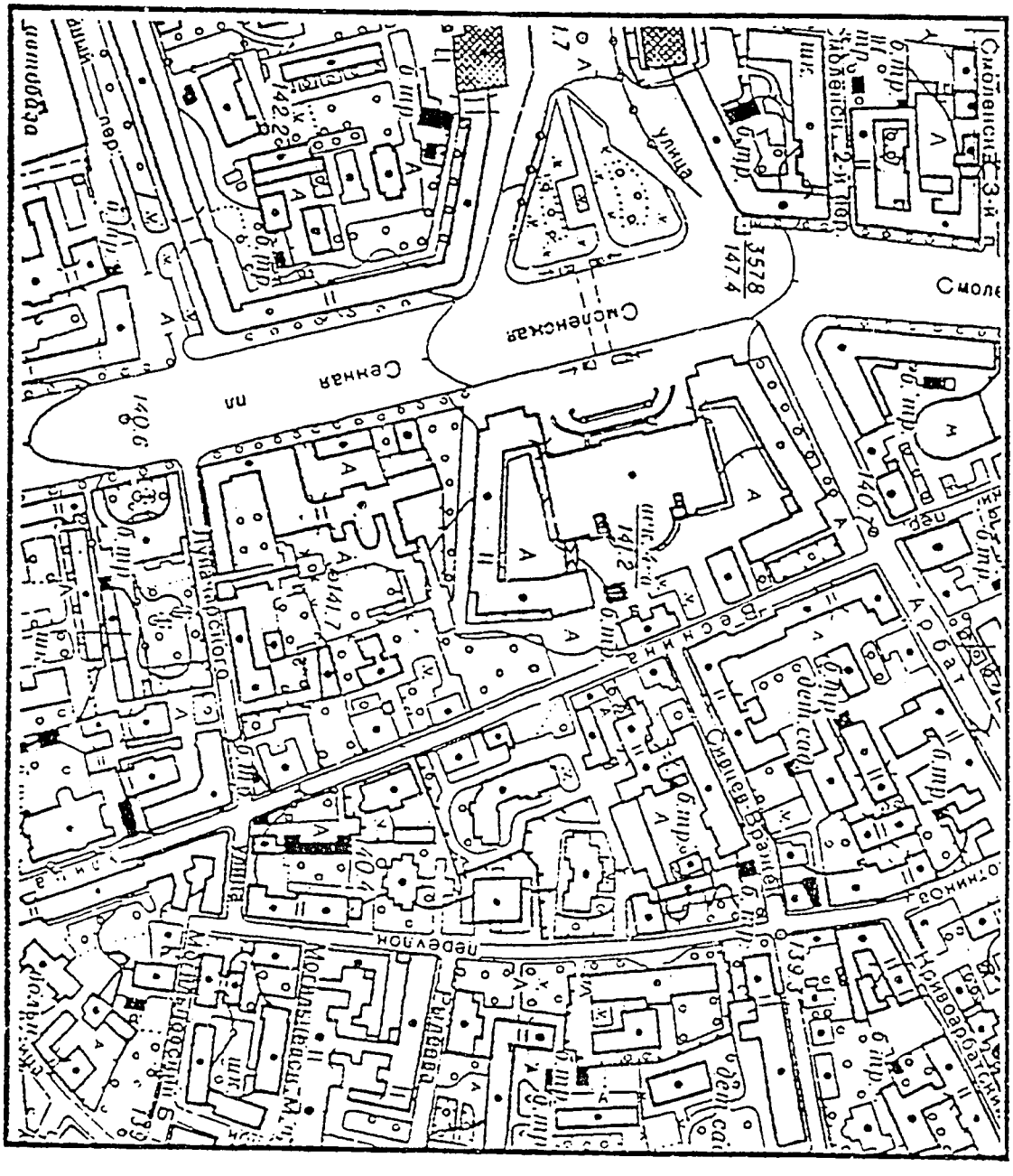

FIGURE 2. Sample of Moscow GIS Database Showing Building Footprints. (Courtesy of Moscow City Geo-Trust.)

However, despite this modest progress, the great opportunities offered by GIS are overshadowed only by a lack of funding, and the increasing demand for information from public agencies and private organizations alike, who both share a future interest in Moscow's land resources. Given the appropriate investment and support, the Geo-Trust, together with Kiberso, have the potential to rapidly create a seamless comprehensive geographic database for the City of Moscow.

CONCLUSION

Once created, the LIS for Moscow will, for the first time, offer managers, planners, decision-makers, and investors the opportunity to visualize and understand the complexity of this ever-

growing, pivotal city in the region. Information resources stored, managed, analyzed, updated, and viewed through GIS technology, will empower individuals and agencies with the ability to make more informed decisions and reforms. Facilitated by technology and new approaches towards information, the city may experience a fundamental shift in policies from secrecy to information sharing, from gross inefficiency to informed management, from obstruction to accessibility. Russia and the other NIS are entering an era in which information can have a profound impact in shaping economic and social policies, especially during the transition to a market-based economy. During this transition, the inventory and effective management of land resources using information systems such as Kiberso's Infoso will be a key factor. We cannot deny these emerging economies the same opportunities and technical tools that are proving so beneficial in cities across the world.

In Russia, political stability has been dictated, historically, by the destiny of the people, who, in turn, have a close cultural connection to their land. The intimacy of this relationship is, perhaps, difficult to appreciate from a Western perspective, but is best expressed in the following Russian proverb: "When a handful of Russian soil is gently pressed in the hand...it will yield a drop of blood."

Acknowledgements: I would like to thank a number of people for their insight and advice in writing this overview paper. My colleagues at PADCO who wrestle daily with profound issues, in not only the NIS, but worldwide. Finally, my new colleagues and friends at Kiberso in Moscow, especially Mr. Eduard Patrik and Mr. Valeri Zolotorev. They are a constant source of inspiration and a credit to the overwhelming generosity of the Russian people. For these and many other reasons, they richly deserve our help and support.

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