A GIS-Based Campus Planning and Information System

E. Dimopoulou, Dr. Surveyor Engineer, Research Associate
X. Christodoulou, Msc. Forest Management, Research Associate
N. Polydorides, Prof. of City and Regional Planning, Director

Laboratory for Architectural Technology and Spatial Planning,
University of Patras

Abstract. This paper presents the development of an integrated geographical information system for the University of Patras. The purpose of this project is to provide detailed and accurate information for the campus master plan revision, which is currently developed by the research team of the Laboratory for Architectural Technology and Spatial Planning. An analysis of the changing needs and priorities related to academic program planning, student demands and faculty and administrative requirements is also provided. Included in the analysis are: identification of sites for future development, suggestions for improved pedestrian and vehicular circulation and parking systems, as well as landscape plans, designed to improve the overall look and functionality of the entire campus. In a further stage of the process, the system will be made available to the University Technical Administration staff, providing guidelines and procedures for the orderly and systematic development of the campus. The outcome of this research-planning project is an example of an information-technology-based planning system, which can be applied to a variety of spatial problems combining relevant geographic, statistical and other data and by using analytical methods and criteria. Based on reliable data and analytical procedures, planners or administrative officers can effectively prepare strategies and recommendations.

1. Introduction

The campus of the University of Patras is located in the town of Rio, 7 km from the center of Patras, in Western Greece, covering an area of 2.5 km2. The first campus master plan was elaborated between 1972 and 1973 [3], a few years after the University of Patras was established and the selected land parcels were expropriated for it. Since then, significant expansion of academic, research and social activity has led to a complex structure which, together with current demand for new academic buildings, has created a pressing need for a major revision of the master plan.

The research team of the Laboratory for Architectural Technology and Spatial Planning undertook this master plan revision [4] and applied a series of GIS tools to support the planning process and decision making [1]. At the current time, master plan revision procedure included meeting with deans and technical administrators of the University, to determine the appropriateness of planning assumptions made in the revision plan.

As first step of the process, a comprehensive review and evaluation of the existing campus master plan was conducted. Included in the plan were suggested areas of development, sites for future constructions as well as traffic regulations and landscape design proposals. Analyzing the strengths and weaknesses of the plan, in relation to the advancements and changes that have been made during the last years in the development of the campus, the following problems were identified:

- New models of infrastructure, training, maintenance and delivery of technical and professional services are required for supporting the instructional and information technologies, transforming both academic and administrative policies and practices.
- New academic departments not predicted, result in student population changes and needs, such as new apartments, student facilities and additional parking places.
- Traffic circulation and transportation routes need to be reorganized in accordance with the new buildings, the parking system and the pedestrian circulation.
- Better-organized green spaces are required, enrolled in an aesthetically enhanced surrounding.

The first section of the paper analyzes the campus as it appears today, through a series of layers of information for the different categories: topographic details, landscape, road network, transportation routes, buildings and statistical data. Needs and priorities are also described related to academic program planning, student demand and administrative requirements. The final section of the paper gives the project's initiatives for a short and a long term planning, by presenting alternative solutions and proposals.

2. Developing the information system

To facilitate the planning process, a series of data gathering and analysis were held. Through this process, composite maps were created and alternative proposals were made to accommodate the objectives imposed by current and future needs in an orderly and functional manner.

2.1 Data conversion

Topographic data in AutoCAD .dxf format were taken from a detailed 1994 survey of the area and exported to ArcView-ARC/INFO format. Additional data concerning new buildings or buildings under construction were digitized from diagrams provided by the Technical Administration Office. Sites of proposed buildings were also added to the system in accordance with the master plan (see figure 1).

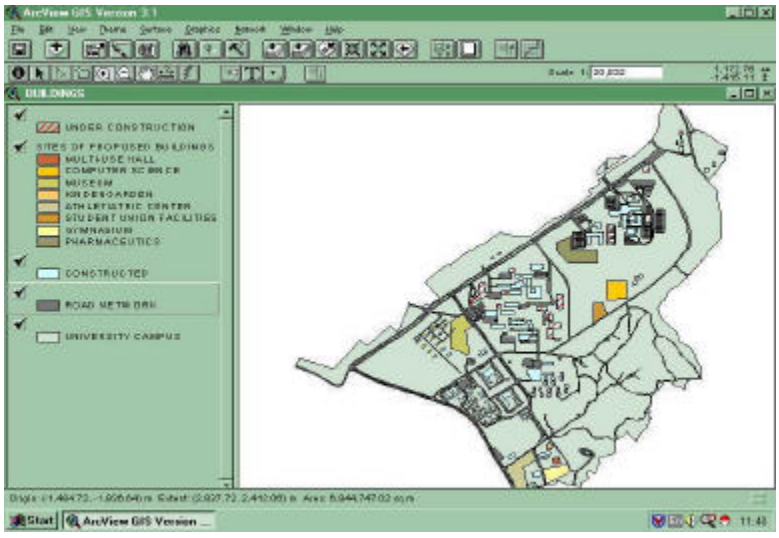
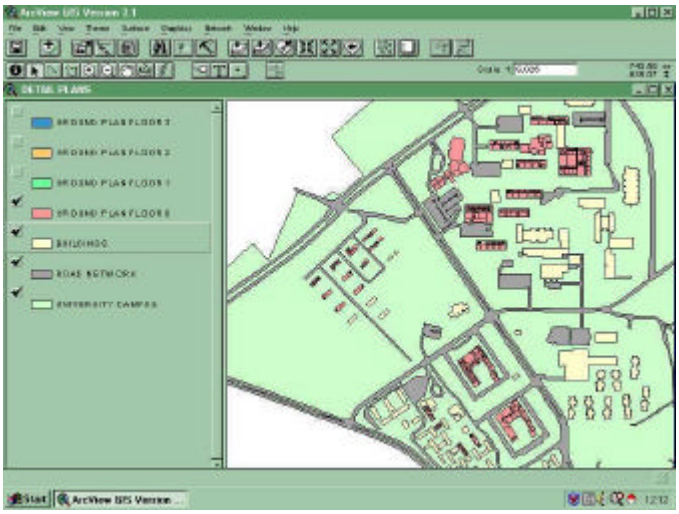


Figure 1: *Buildings:* existing, new, under construction and proposed

After the editing stage in the ArcEditor environment, a series of poly- or line- coverages were created: area boundaries, building footprints and detailed ground plans for the different levels (see figures 2a, 2b, 2c & 2d), main and secondary road network along with bus routes and parking facilities (see figure 3). Bus and taxi stops and terminals are also displayed, added as point coverages. Contour line coverage was also created from the elevation points first transformed into TIN in the ArcView 3D environment.



2a: Ground floor

2b: 1st floor

2d: 3d floor

2c: 2nd floor

Figures 2a – 2d: **Buildings** Ground Plans

Statistical data on the contribution of student population and academic and administrative staff were also collected in order to perform, in a further stage, proximity analysis (see figure 4). Finally, coverages concerning the surrounding landscape were also created from the initial topographic .dxf file, including plant species, walking paths, botanic gardens and parks (see figure 5).

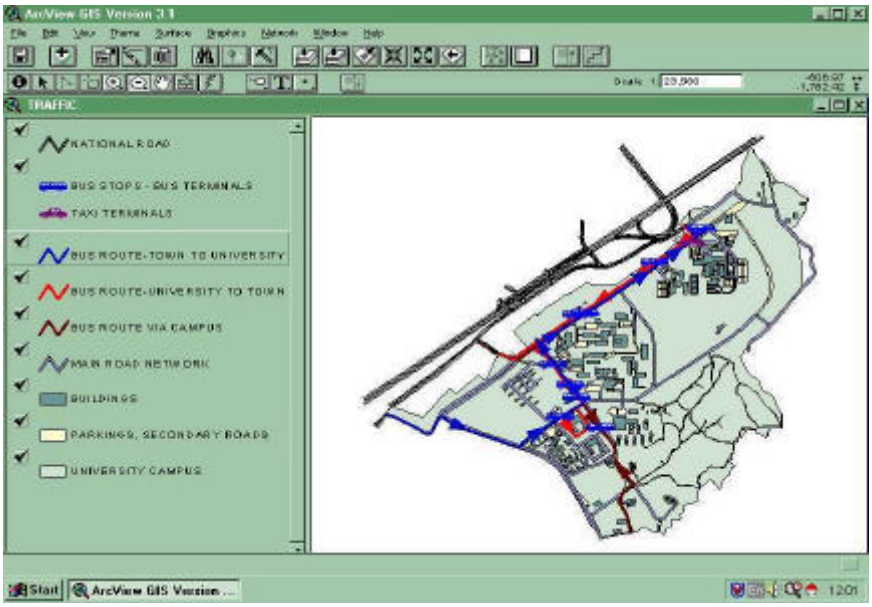


Figure 3: Traffic circulation – Transportation

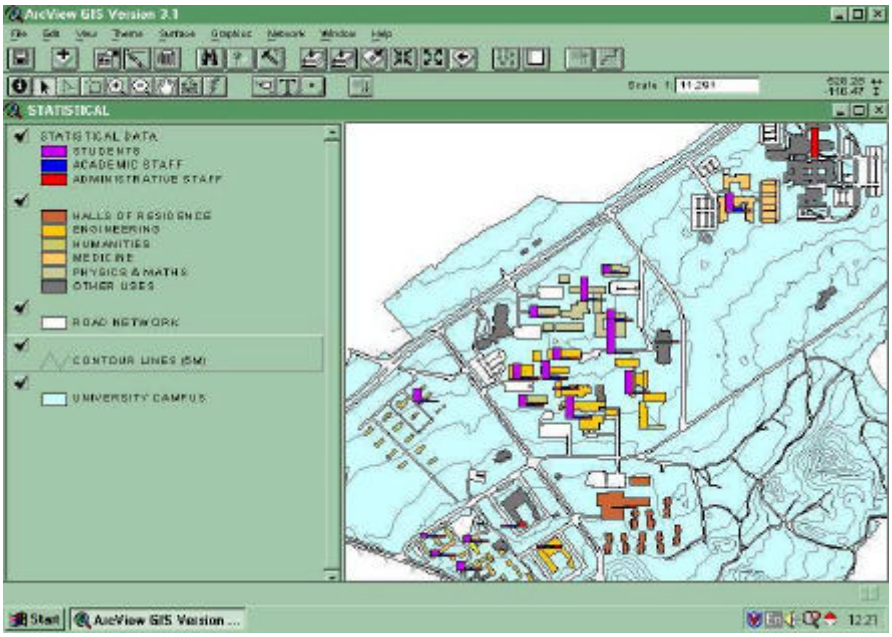


Figure 4: Academic buildings and statistical data

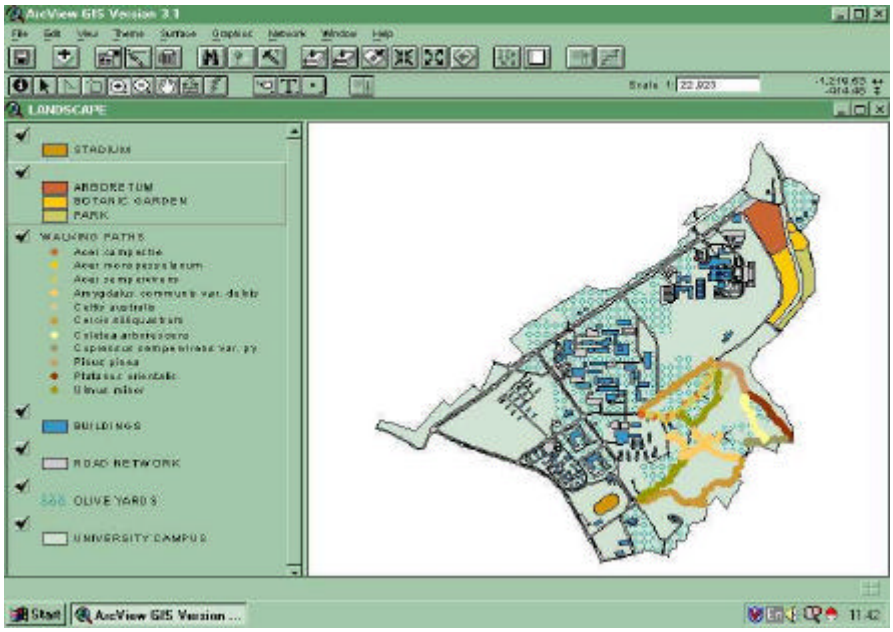


Figure 5: Landscape – Surrounding Environment

2.2 Analyzing the current situation

All the above coverages were overlaid to produce a base map synthesis, showing the current situation of the campus and providing the information system the necessary input data for further analysis. The analysis stage was based on the current needs and priorities of the university regarding building requirements; improve circulation and access to the campus area; improve social and academic services and facilities; remodel open space utilization preserving the character of the Patras University campus.

Modern spatial analysis approaches, such as location-allocation modeling, buffering, population profiles and route analysis, can significantly assist in preparing strategies for reconstruction and further development of the project area.

We used the ArcView Network Analyst to generate areas with high activity potential and to create time buffering in order to be used to plan transportation routes. For locating new buildings or campus facilities, querying operations were performed to the system. Furthermore, 3D views of the campus, generated by 3D-Analyst were of great help for deciding new locations, giving an overall view of the surrounding environment from different perspectives.

3. Proposals

As part of the revision master plan process, alternative designs and planning solutions were considered. This process resulted in a number of proposals. These include:

To improve – better organize the built environment of the campus, in accordance with the current and future needs.

1. To improve the campus traffic system (see figure 6):
   - Minimizing access to the campus into two main entries, limiting transversal circulation (see figure 7).
   - Making the circulation easier and safer through narrow, traffic-calmed streets.
   - Strategically increasing parking surface area, only in selected sites.
   - Introducing a university campus shuttle bus.

2. To improve open spaces, places, parks, and landscaping surrounding:
   - Creating a pedestrian and transit-friendly circulation system (see figure 8).
   - Creating a central place in front of the Administration Building (see also figure 8).
   - Designing entries/gates in a symbolic-style format.

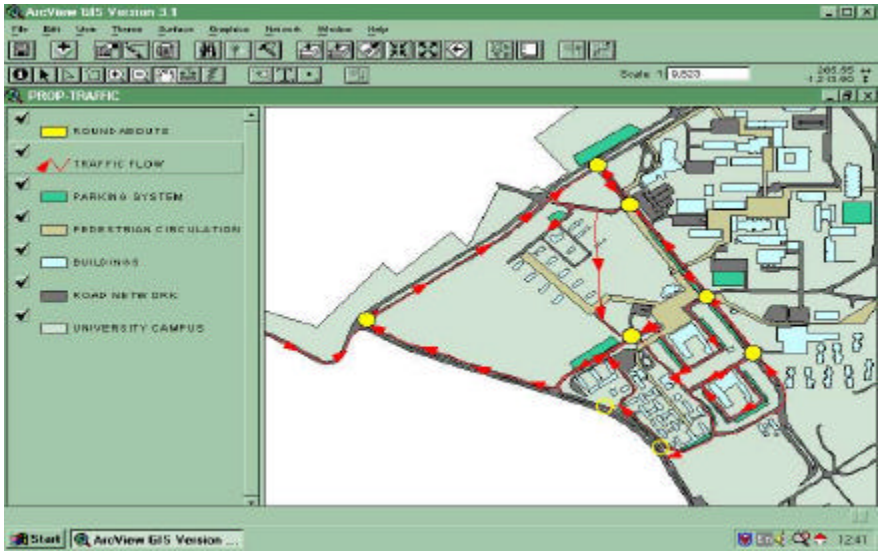


Figure 6: Traffic Flow Proposal

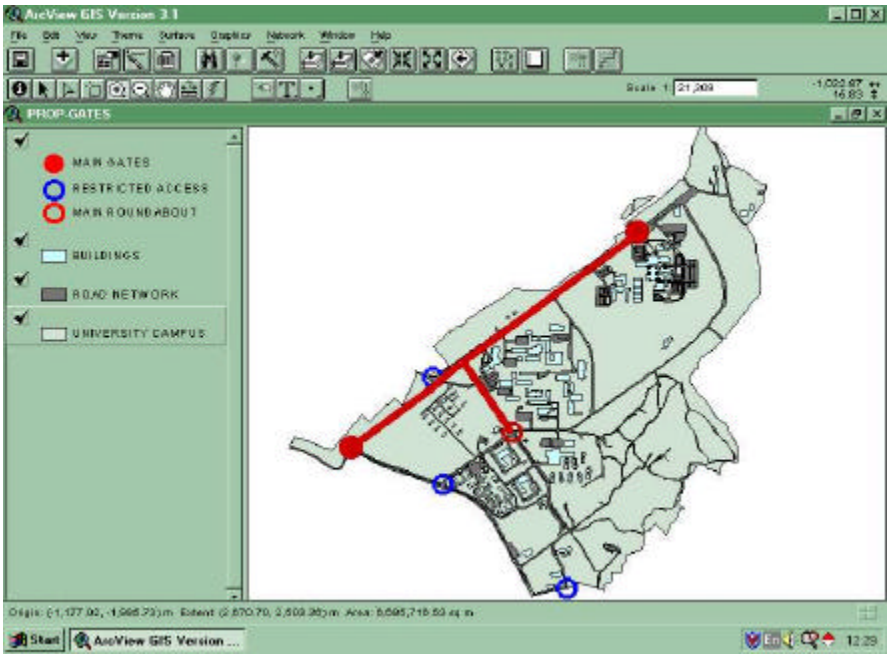


Figure 7: Access to the campus - Gates Proposal

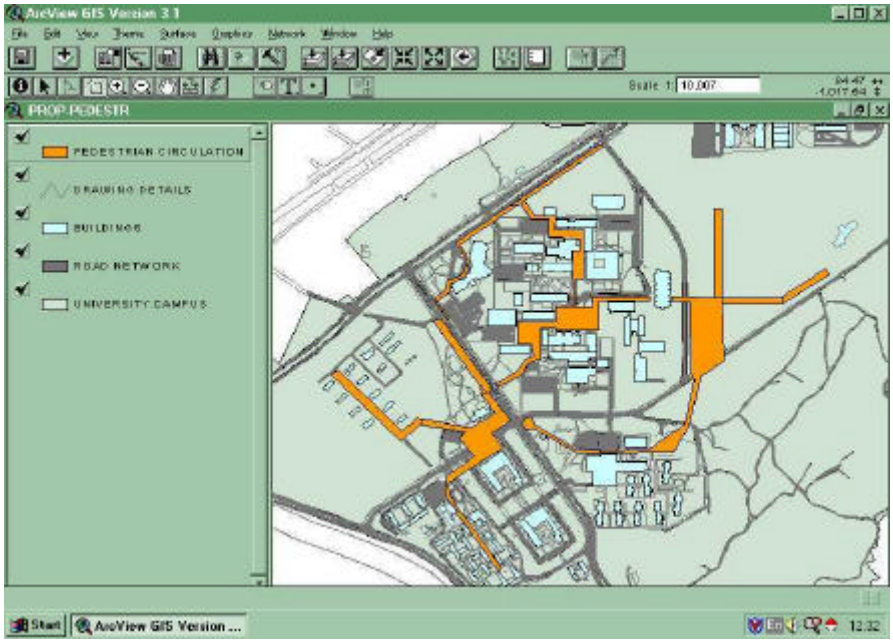


Figure 8: Pedestrian System's Proposal

3. To incorporate a former military base, now owned by the University, into the campus for residential development, including:

- Residents for academic staff
- Residents for post graduate students
- Residents for visitor professors and
- Specific commercial services.

4. Conclusion

When the planning process is completed, the system will be made available to the University Technical Administration staff, giving them access to the data and plans, according to their needs, and greatly improving productivity at the service and management level both for maintenance and planning purposes [2].

Detailed plans, graphs and photographs of the buildings linked to the base synthesis map, as well as user-friendly interfaces added to the system, provide the user with easy access to a multimedia information system regarding campus structure and activities. Furthermore, the Technical staff of the University in collaboration with the Laboratory for Architectural Technology and Spatial Planning of the University of Patras can continue to wide the system's inputs for expanding it in fulfilling future demands. Therefore, the system becomes an efficient tool for the administration, for utilizing its services in an autonomously managed way.

The outcome of this research-planning project is an example of an information-technology-based planning system, which can be applied to a variety of spatial problems combining relevant geographic, statistical and other data and by using analytical methods and criteria. Based on reliable data and analytical procedures, planners or administrative officers can effectively prepare strategies and recommendations.

References

[1] Futterman, M., 1997, "GIS Solutions for Livable Communities", in Proceedings of the ESRI Conference, San Diego, USA

[2] Dickman, A., 1997, "GIS Supports Social Services Planning in South Florida", in Proceedings of the ESRI Conference, San Diego, USA

[3] Doxiades, 1973, "Patras University Campus Master Plan"

[4] Laboratory for Architectural Technology and Spatial Planning, University of Patras, 1998 "Master Plan Revision of Patras University Campus", Scientific Responsible Prof. N. Polydorides