# Participatory Geographic Information Systems



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## INTRODUCTION

Geographic information systems are largely used in different levels of administration and planning where geo-referenced information is a crucial factor behind analysis and determination of different decision-making scenarios. The potential of these systems is increasingly being perceived as a support to facilitate public participation in planning processes.

Understanding that the incentive to public involvement may come in a variety of forms (e.g., to inform, educate, or share administrative decision-making), geographic information systems are a tool that can be improved with interactivity functionalities intended to facilitate information delivery, online discussion, and involvement in decision-making.

These interactivity functionalities facilitate public participation, transforming traditional applications of geographic information systems in public participation tools important for e-government support.

Public participatory geographic information systems (ppGIS) are set up with tools that facilitate citizens' involvement in decision-making related to administration and planning processes. These systems allow information to be disseminated, public reactions to be tested, alternative solutions to be reached, and decision-making responsibilities to be shared.

In this article, we present an overview of the main characteristics of geographic information systems and ppGIS, and discuss future trends of ppGIS related to the acquisition and sharing of knowledge. We also identify aspects of learning that result from ppGIS use and enlighten that ppGIS not only facilitate public involvement, but also comprise tools to support education for citizenship and are means to extend citizens' knowledge constructs in various fields of knowledge.

## GIS AND PUBLIC PARTICIPATORY GIS

Information systems use technology to capture, transmit, store, retrieve, manipulate, or show information used in different decision-making processes. They can be classified according to the characteristics of the information they use, as for instance geographic information systems (GIS) with their particularity of using georeferenced information (Sá & Aguilar, 2004).

GIS are information systems that enable capture, modelling, manipulation, retrieval, analysis, and display of georeferenced data and information (Worboys, 1995). A GIS basically consists of four elements related to the functions of capture, storage, analysis, and display of georeferenced data and information.

GIS are critical and important tools to analyze and visualize spatial-temporal information. Originally developed for the creation of thematic maps, GIS support data capture (e.g., digitizing), data storage (database management systems, spatial database management systems), and data analysis (e.g., combination of spatial and non-spatial data) (Visser, Stuckenschmidt, Schuster, & Vogele, 2002).

A GIS requires resources related to capture, processing, and management of georeferenced information such as:

- Input of data and information from maps, aerial photography, satellite images and other sources of georeferenced information
- Data storage, search, and retrieval
- Transformation of data, analysis, and modelling, including geostatistics
- Communication of data through maps reports and plans

Similarly to computer-based information systems, Web-based systems and consequently Web-based GIS

offer significant advantages to organizations and users alike as a way of managing and acquiring knowledge as well as filtering information.

These advantages or benefits include creation of value-added goods and services, greater safety, improved service, competitive advantage, error reduction, improved product quality, enhanced communication, efficiency and productivity, greater administrative efficiency, more opportunities, cost reduction, work requirement reduction, greater support to decision-making, greater control over operations, and better decision choices (Stair, 1996).

As a function of their geographic scope and ability to support decision-making, GIS come as important tools for e-government applications (Baptista, Silva, & Paiva, 2004). Regarded as a support to e-government applications, GIS and particularly Web-based GIS facilitate public involvement, hence them being designated as public participatory geographic information systems (ppGIS).

A related work is a research study by Gudes, Stern, and Svoray (2004) about the application of a Web-based public participatory geographic information system for Israel planning, whose major purpose is to examine the quantitative contribution of georeferenced information systems in Web environment as opposed to traditional public participation process methods.

ppGIS emerge from two distinct trends, namely technology-based spatial analysis and participatory democracy and are an alternative centred on people, of the use of GIS, which are traditionally centred on technology (Schlossberg & Shuford, 2005). The purpose of ppGIS is to raise the level of citizens' involvement in planning processes as well as to increase the access to tools, data, and information that support decision-making.

Steinemann, Krek, and Blaschet (2005) consider four stages of interactivity in ppGIS: information delivery, online discussion, map-based discussion, and involvement in decision-making. They also consider that the differences between GIS and ppGIS are grounded in seven elements: focus, goal, organizational structure, details, applications, functions, and approach. Table 1 summarizes the topology of those differences.

## PUBLIC INVOLVEMENT, CITIZENSHIP, AND EDUCATION

Incentive to public involvement may aim to inform, educate, test reactions, seek ideas or alternative solutions, and share decision-making (Jackson, 2001). Public involvement allows rulers to adopt forms that are more consensual and in tune with the interest of the public, particularly in planning processes and in reaching solutions for specific matters.

Information technologies are increasingly being perceived as tools to facilitate interaction among individuals, groups, or organizations, thus regarded as means to foment public participation due to their spatial and temporal scope. Communication mediated by computers tends to reduce the usual barriers of communication among individuals in different hierarchic levels within organizations (Sproull & Kiesler, 1991). Web expansion has come to lift the barriers of communication for ordinary citizens, providing them with

*Table 1. A comparison of GIS and ppGIS characteristics (Adapted from Steinemann et al., 2005)*

| Characteristics | GIS | ppGIS |
|---|---|---|
| *Focus* | Technology | People and technology |
| *Goal* | Facilitate official policy-making | Empower communities |
| *Organisational structure* | Rigid, hierarchical and bureaucratic | Open and flexible |
| *Details* | Specified by technologists and GIS experts | Specified by users and focus groups |
| *Applications* | Led by independent specialists | Led by facilitators, group leaders |
| *Functions* | General, multipurpose applications | Project-specific |
| *Approach* | Top-down | Bottom-up |