Chapter V
Spatial Data Infrastructures

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ABSTRACT

Geographic Information Systems (GIS) are data-centric applications that rely on the input and constant maintenance of large quantities of basic and thematic spatial data in order to be useful tools for decision-making. This chapter presents the institutional collaboration framework and the major technology components to facilitate discovery and sharing of spatial data: Spatial Data Infrastructures (SDI). We review the essential software components –metadata editors and associated catalogue services, spatial data content repositories, client applications, and middleware or intermediate geospatial services– that define SDIs as heterogeneous distributed information systems. Finally we highlight future research needs in the areas of semantic interoperability of SDI services and in improved institutional collaboration.

INTRODUCTION

Geographic Information Systems (GIS) and related spatial applications are data-centric in the sense that they rely on the input and constant maintenance of large quantities of reference spatial data, on top of which integrators and end-users produce value-added thematic geographic information for the purpose of decision-making. A typical GIS workflow can be simplified as consisting of three components: 1) data entry and reformatting, 2) data processing (geoprocessing), and 3) presentation of results to the user. In practice, this apparently simple workflow is constrained by two key factors. The first is limited interoperability among GIS components, because most are tightly coupled to specific data formats or to other software, complicating the task of integrating components from multiple vendors. The second is that the basic spatial data (reference data) necessary to begin geoprocessing are in many cases not readily available, because they are poorly documented, outdated, are too expensive, or are available under restrictive licensing conditions. This second factor has been seriously limiting the ability of government employees, researchers and businesses to exploit geographic information, unnecessarily incrementing project costs and, thus, negatively affecting the economy.

Many government administrations have recognized this critical problem and have initiated coordinated actions to facilitate the discovery and sharing of spatial data, creating the institutional basis for Spatial Data Infrastructures (SDI) (van Loenen and Kok 2004). The Global Spatial Data Infrastructure (GSDI) association (www.gsdi.org) defines SDI as a *coordinated series of agreements on technology standards, institutional arrangements, and policies that enable the discovery and facilitate the availability of and access to spatial data*. The SDI, once agreed upon and implemented, serves to connect GIS and other spatial data users to a myriad of spatial data sources, the majority of which are held by public sector agencies.

In 1990 the U.S. Federal Geographic Data Committee (FGDC) was created and in 1994, then president, William Clinton, asked it (Executive Order 12906) to establish a national SDI in conjunction with organizations from state, local, and tribal governments, the academic community, and the private sector. Three years later the European Umbrella Organization for Geographic Information (EUROGI) was created with the mission to develop a unified European approach to the use of geographic technologies (a mission far from complete). More recently, the European Commission launched the Infrastructure for Spatial Information in Europe (INSPIRE) initiative for the creation of a European Spatial Data Infrastructure (ESDI), based on a Framework Directive (European legislation) defining how European member states should go about facilitating discovery and access to integrated and interoperable spatial information services and their respective data sources. As the number of national SDIs increased, to include in 2004 about half the nations worldwide (Masser 2005; Crompvoets et al. 2004), the Global Spatial Data Infrastructure (GSDI) Association was created to promote international cooperation and collaboration in support of local, national, and international SDI developments.

The basic creation and management principles of SDI apply to any and all spatial jurisdictions in a spatial hierarchy, from municipalities to regions, states, nations, and international areas. Béjar et al. (2004) show how each SDI at each level in the hierarchy can be created in accordance with its thematic (e.g., soils, transportation) and geographical (e.g., municipality, nation) coverage, following international standards-based processes and interfaces, to help ensure that the SDIs fit like puzzle pieces, both geographically and vertically (thematically). This harmonization exercise is necessary to allow for seamless spatial data discovery and exploitation crossing jurisdictional boundaries, in the case of response to flooding or forest fires, just to name two im-

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