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Spatial Data Infrastructures for environmental e-government services: The case of water abstractions authorisations

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ABSTRACT

Environment-related authorisations are a relevant issue for environmental management. They require a considerable effort by the authorities, and this might result in substantial delays for the citizens. Implementing those authorisation processes by means of e-government services would improve efficiency and, consequently, citizen satisfaction. Environment-related authorisations usually require a variety of geospatial information, and have to deal with administrative areas which do not match physical and ecological ones. They also have to integrate heterogeneous information in different formats, data models and languages, and provided by distinct organisations, even from different countries. This paper discusses how Spatial Data Infrastructures (SDIs) can deal with these problems in the environmental domain, while improving the level of service provision in terms of e-government applications. This is even more relevant within the European Union where there is a legal mandate to establish an SDI to support environmental policies and activities with an impact on the environment. As a proof-of-concept, an application to request and manage water abstraction authorisations, based on an SDI, is demonstrated. This application is part of SDIGER, a cross-border inter-administration SDI to support the water framework directive information access for the Adour–Garonne and Ebro River basins, that was a pilot project for the EU INSPIRE Directive. The introduction of this transactional e-government service modifies the administrative process of granting authorisations: it allows to re-use the effort in data capture made by the applicants in their requests, facilitates the submission of more feasible applications and reduces the workload of the office staff.
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1. Introduction and motivation

In recent years, the number and quality of e-government services provided by public authorities have experienced a huge increase. This is mainly due to the fact that many countries are implementing e-government policies, strategies and programs (Ancarani, 2005; Department of Economic and Social Affairs Division for Public Administration and Development Management, 2008; Capgemini et al., 2009).

However, environment-related permits are among the least developed e-government services in Europe (Capgemini et al., 2010, 2009). In the case of these permits, and in contrast with many other e-government services, geospatial data play an important role. Geospatial information is generally difficult to create, maintain, and exploit; it is expensive, and presents scale, resolution, thematic and jurisdictional problems when used (Molenaar, 2006a,b). Besides this, environmental information usually has the additional problem that "environmental boundaries" (e.g. ecosystems, hydrographical watersheds and hydrogeological bodies) do not match administrative areas. Public authorities, which are the main creators and users of geospatial information (Brown and Brudney, 1998; Nogueras-Iso et al., 2004), require the use of geospatial information from controlled sources and trusted quality for the implementation of e-government services (Molenaar, 2006a,b). Environmental geospatial information in particular affects many issues related to human health and safety, so it is crucial that it has good quality and comes from controlled sources.

Currently, the framework for the optimisation of the creation, maintenance and distribution of public geographic information is being provided by *Spatial Data Infrastructures* (SDIs) (Nogueras-Iso et al., 2005; Nebert, 2004). SDIs can be considered part of e-government frameworks dealing with the geographic aspects of e-government services (de Vries, 2007; Georgiadou et al., 2006). They are enabling government agencies to meet the challenges to reduce

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costs, deliver services faster, provide better customer services, and increase productivity. However, in spite of the existence of SDI initiatives in many countries, the level of maturity or sophistication of e-government services is not improving in those areas that require geospatial information, such as environmental management (Andersen and Henriksen, 2006). In this paper, we define *level of maturity or sophistication of e-government services* as the level of service provision to citizens, business or other governments in terms of complexity and completion of the electronic services and procedures offered; definition based on the works by Layne and Lee (2001), Moon (2002) and Andersen and Henriksen (2006).

In this paper, the authors analyse how SDIs can provide elements and mechanisms at different levels of e-government maturity and how, in the case of the European Union, the obligations of environment and water related directives such as INSPIRE (Infrastructure for Spatial Information in the European Community) and the Directive on Public Access to Environmental Information (European Parliament and Council, 2003a) offer opportunities to provide better e-government services. The analysis is illustrated with a proof-of-concept: an e-government service to support the administrative process to apply for and grant water abstraction authorisations within a European water authority and built on top of SDIs. This service, whose technical aspects were presented by Latre et al. (2010), was envisioned as part of SDIGER (Zarazaga-Soria et al., 2007), a pilot project on the implementation of INSPIRE funded by the Statistical Office of The European Communities.

The rest of the paper is structured as follows. The next section deals with the relation among geospatial information, SDIs and spatial data initiatives in the European context. Section 3 analyses and discusses the relation between e-government services in the environmental domain and SDIs. Section 4 shows how e-government services can be developed using components of an SDI, presenting the example of an application that implements a process to request water abstraction authorisations. Finally, in Section 5, the results of this work are discussed and some conclusions are drawn.

2. Background

2.1. Geospatial data and Spatial Data Infrastructures

Geospatial data, that include references to locations on Earth, are a requirement in many environmental management processes. Nowadays, more and more geospatial data are being gathered and made available by different institutions and companies (Goodall et al., 2008; Giuliani et al., 2011). This is due to several factors such as the increasing number of sensors at monitoring sites, technological advances in high-resolution satellite imagery, or the wide availability of GPS data.

Despite this increase in geospatial data availability, their use and management is still more complex (due to diversity and volume) when compared to other kinds of data (Di et al., 2008), so the need for effective data access, sharing, and processing becomes increasingly important. Not surprisingly, the main creators and users of geographic information are public authorities (Brown and Brudney, 1998; Nogueras-Iso et al., 2004). These public authorities need those data to come from well-known sources and to be of good quality (Molenaar, 2006a).

SDIs provide a platform for the distribution of geographic information (e.g. environmental data), at different organisational levels (local, national, regional and global) involving both public and private institutions (Nebert, 2004; Nogueras-Iso et al., 2005). SDIs are composed of spatial datasets, metadata and services; agreements on sharing, access and use; and coordination mechanisms (European Parliament and Council, 2007). Discovery, access and distribution of up-to-date information are achieved by means of standard web services. Ideally, this should be done at any government agency that has the responsibility of creating and maintaining geographic information.

2.2. Related European directives

In the field of SDIs, the European Union approved the INSPIRE Directive (*INfrastructure for SPatial InfoRmation in Europe*) in 2007 (European Parliament and Council, 2007). INSPIRE is an ambitious legislative directive whose aim is the creation of a European SDI in order to support Community environmental policies, and other policies or activities which may have an impact on the environment. The European SDI is developed hierarchically, i.e. it is based on the infrastructures established and operated by the Member States. In the same way, these national SDIs could be built including other infrastructures developed at sub-national levels, also as a hierarchy (Rajabifard et al., 2000, 2003) or as a connected network (Vandenbroucke et al., 2009).

Besides INSPIRE, a number of different initiatives and pieces of legislation in the environmental field are being adopted in the European Union with a strong focus on environmental data. One of them is the directive on public access to environmental information (European Parliament and Council, 2003a), which states that "[i]ncreased public access to environmental information and the dissemination of such information contribute to a greater awareness of environmental matters, a free exchange of views, more effective participation by the public in environmental decision-making and, eventually, to a better environment". Public authorities should make available and disseminate environmental information to the general public to the widest extent possible. The directive on the re-use of public sector information (European Parliament and Council, 2003b) deals with the same idea, extending the scope of it to the whole set of public sector information (with some exceptions) and with a strong emphasis on fair, proportionate and non-discriminatory conditions for the re-use of public sector information for both commercial and non-commercial purposes (Janssen, 2011).

Another piece of European environmental legislation, closely related to the example presented in Section 4, is the Water Framework Directive (WFD) (European Parliament and Council, 2000). The main objective of this directive is the achievement of a *good state* for all the European waters by 2015 using a management based on river basins, not on administrative boundaries. Managing basins is a problematic issue not only at international level, but also within countries where several government agencies share responsibilities on the administration of hydrological areas. It is considered the most important and complete piece of legislation in this respect (Letcher and Giupponi, 2005): a *Common Implementation Strategy* (CIS) was designed for its execution, and additional directives, like the directive on groundwater (European Parliament and Council, 2006a) and the directive on the discharge of dangerous substances (European Parliament and Council, 2006b), have had to be developed to fulfil some of the requirements it poses. Not only in the environmental domain has it been demanding, but also in the field of environmental information systems, that have been heavily influenced by the need to support the processes of the WFD (Usländer, 2005). The requirements on public information and consultation that the 14th article of the WFD establishes are further developed in the *Guidance on Public Participation in Relation to the Water Framework Directive* (European Commission, 2002) and the *Guidance for reporting under the Water Framework Directive* (European Commission, 2009a), that consider information supply as the base to support consultation and active involvement in the management of the river basin by the general public, stakeholders and other authorities. In addition, the *Guidance*

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