INTEROPERABILITIES: THE "SERVICE GENERATION" SDI OF SARDINIA

R.Vinelli[1], G.Pittau[1], M.Salvemini[2], P.Cipriano[3], S.Pezzi[3], L.Zanella[3]
[1] Regione Autonoma Sardegna, Cagliari, Italy
[2] Università La Sapienza, Roma, Italy
[3] CORE Soluzioni Informatiche, Bologna, Italy

ABSTRACT

Are OGCs, ISOs, CENs and W3Cs enough to built up a fitness-for-use SDI, at regional level, in Italy?

This question, coming at the beginning phase of INSPIRE Implementing Rules, is the core of this paper concerning the Spatial Data Infrastructure of Regione Autonoma Sardegna.

The main issues of the paper are:

- "real" user needs collection and formalisation
- GI-service chains realisation

KEYWORDS: Standard, SDI, regional, user, service

INTRODUCTION: WHY A REGIONAL SDI?

"A good building is only as good as its foundation. When the building outlasts its foundation, repair or replacement can be extremely expensive and complicated. Furthermore, the rest of the structure can be severely damaged by foundation failures" [1].

The germinal SDI of Sardinia comes up from the need of Public Administration to re-organise internal procedures for planning and monitoring the natural and the built environment.

In 2002, the Regional Council of Regione Autonoma Sardegna (RAS) approved the implementation project (2005-2007) of the SDI: one of the main goals is to manage the workflow of Geographic Information (providers-to-users), within a distributed and federated architecture of services, according to INSPIRE principles.

Some useful numbers about Sardinia region (Salvemini, 2004):

- area: 24,000 sq.Km
- number of Provinces: 8 (until 2001: 4)
- number of Municipalities: 377
- inhabitants: 1,648,044 (Census 2001)
- residential population density: ~ 0.7 inhabitant / hectare
- optic fibre: 10 Km / sq.Km (national average: 15)
- optic fibre in urban areas: 50 Km / sq.Km (national average: 98)

[1] http://www.ncat.org/greentree/foundation_1.html

The regional SDI points toward a multi-level organisational infrastructure (RAS, Provinces, Municipalities, and other Public Administrations of Sardinia), to distribute expandible sets of GI-services (GI-service chains) on the base of "real" users needs.

DEFINITIONS AND FEATURES

The Sardinian project incorporates two different definitions of SDI:

- infrastructure " … *that delivers to the users integrated spatial information services. These services should allow the users to identify and access spatial or geographical information from a wide range of sources, from the local level to the global level, in an inter-operable way for a variety of uses.* […] " (Smits, 2002)
- infrastructure " … *as a multi-levelled, scalable, and adaptable collection of technical and human services, which are interconnected across system, organisational, and administrative boundaries via standardized interfaces. Those services enable users from different application domains to participate in value chains by gaining a seamless access to spatial information and geo-processing resources.*" (Sliwinsky A. and Wytzisk A., 2004)

The SDI has been designing adopting SOA (Service Oriented Architecture) approach, as form of distributed system architecture having typical properties such as message, description and network orientation, granularity, logical view and platform independecy (W3C, 2004).

In SOA approach, services and busines processes are completely deployed within formal procedures undertaken by Public Administration (PA) departments; funcionalities are delivered either "in the form of services to end-use applications or other services, through a standard-based distributed system architecture" (W3C, 2004).

The architecture has enterely been figured to support the creation of, the maintainence and the application of "composed (sophisticated) distributed services, to meet the demand of inter-organisational computing requirements", on the base of the Open Grid Service Architecture (OGSA) paradigm (Foster et al., 2002).

The most important challenge of the work is the (semi)automatic composition of "simple" GI-services, to solve the lack of semantic homogeneity between systems (Visser U. et al., 2000).

"Simple" services represent the "wall foundation level" of the SDI: they are strictly implemented on the base of OGC technical specification and models (CAT, WMS, WFS, WCS, GML) and (EN)ISO19100 series[2], to share and distribute GI; OGC and ISO "blocks" represent tha basic "bricks" of the Infrastrucure.

"Qualified" (domain) services are compositions of "simple" GI-services: they can be seen as specialisation of the conceptual "complex service chain" model (Bernard, 2003). The term "qualified" means that GI-services are made up on the base of formal and procedural workflow within PA activities.

The following Title (Strategic Componts and Methodologies) focuses on use cases strategies and business and data access: actually, these represent the "lagging" side of a standardisation process where ISO & OGC documents have already been progressed (Canadian General Standards Board, 2005).

[2] The nine EN ISO 19100 standards became national standards (UNI EN ISO 19100) in June 2005.

In this sense OGC, ISO, CEN, W3C, … standards ("bricks") should be fully applied within INSPIRE Implementating Rules to produce "semimanufactured" products products and best practices, such as services source components, UML diagrams, XML Schemas, profile and extension descriptors, cost-benefit analysis and legal issues documents, … to distribute and reuse in the European panorama. This target is extremely important for Public Sector Information (PSI) projects: at regional, national and European levels we need to define Domain Specific Standards for both data and services (technical specifications), within INSPIRE Implementing Rules, to achieve harmonisation and "socialization" of service interfaces.

In this direction, examples of the "semimanufactured products" are represented by the "Qualified" services discussed in this paper, as they are finalised to meet aspects and requirements of low costs, fitness-for-use and productivity.

Within INSPIRE Implementing Rules phase, European SDICs such as the Sardinian SDI could provide a collaborative organisational platform on specific standards development to specific domains such as Environmental Assessment, Building permits, Cadastral procedures, Demographics: national domain-specific operational scenarios and use cases (like the ones developed within the Sardinian SDI) represent a possible solution to lead requirements gathering and standards testing and demonstration (Canadian General Standards Board, 2005).

STRATEGIC COMPONTS AND METHODOLOGIES

Logical and functional layers of the SDI

The implementation of the technological stack has been designed "locally" but with a "globally-thinking" attitude, in accordance either to the INSPIRE Directive and position papers (Smits, 2002), and to the National Implementing Rules for System Cooperation between PAs (Sistema Pubblico di Cooperazione – SPC), defined by the Italian National Authority for Informatics within Public Administration (CNIPA, 2004).

The logical layers of the architectural model are:

- *user layer*: it identifies human and system users; three types of user clients to access GI:
    - "light" applications (i.e. web browser)
    - "enriched" applications (i.e. desktop OSS, desktop licensed, ad hoc)
    - services (i.e. OWS)
- *integration layer* [3]: developed in Enterprise Application Integration (EAI) event-driven approach; it is defined to structure real-time communication between users, services and applications.
- *service layer*: geoprocessing/mapping/catalog services
  Services are managed using MIDDLE ® platform[4]: this solution allows to built up complex service chains, adding SPC requirements (CNIPA, 2004).
  "Simple" services provided are:
    - Catalog Services (data and services)
    - Map Services
    - Feature Services

[3] *Integration layer* and *Service layer* represent the Middleware level of the architecture

[4] Key elements of MIDDLE platform are *BUS* (publish&subscribe), *Adapter* (interconnection elements from/to "simple" services), *Process Manager* (to control complex GI-service chains; the process is designed using UML graphic modelling tools), *Portal Engine* (two elements, BackOffice and FrontOffice, to present web services to application interfaces)

- Coverage Services
- Gazetteer Services
- e-commerce Services
- SIGMATER Services (planned) [5]

- *data layer*: Geographic Information as digital data, but also "maps, charts, and textual documents as well as non-geographic data", will be managed, described and made available

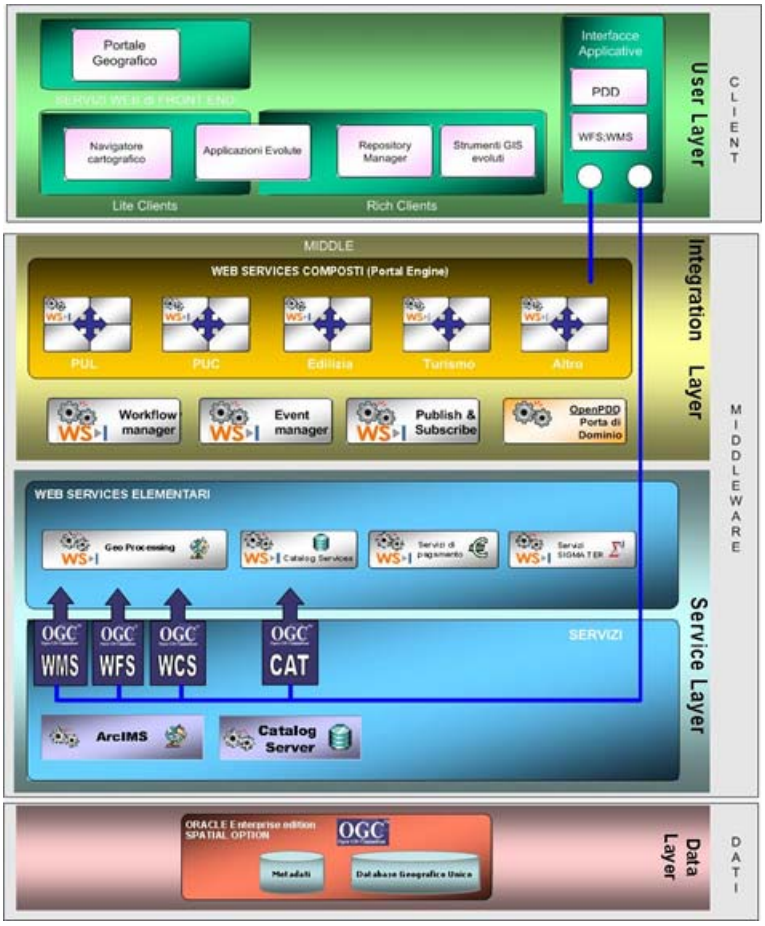

Figure 1: Integration layer architecture

[5] SIGMATER (*Servizi Integrati catastali e Geografici per il Monitoraggio Amministrativo del Territorio*) is one of the best-practice e-Gov project (partly funded by Ministro per l'Innovazione e le Tecnologie). The target of SigmaTer is the development of services to access and distribute cadastral and topographic information and metadata, to allow Public Administrations to perform analysis and produce formal documents related to building permissions and urban planning development.
Many services developed in SIGMATER project are already available and will be reused by other PAs in Italy.
More details (in Italian language) at http://www.sigmater.it

Results expected move parallel to INSPIRE milestones: metadata management and publishing, geo-search portal, data visualiasation and transfer, geoprocessing analysis, e-business support and multilingual support.

Great emphasis is put on Catalog services: the following figure shows the implementation model for managing distributed metadata catalogs (data and services)[6] in the proposed architecture:

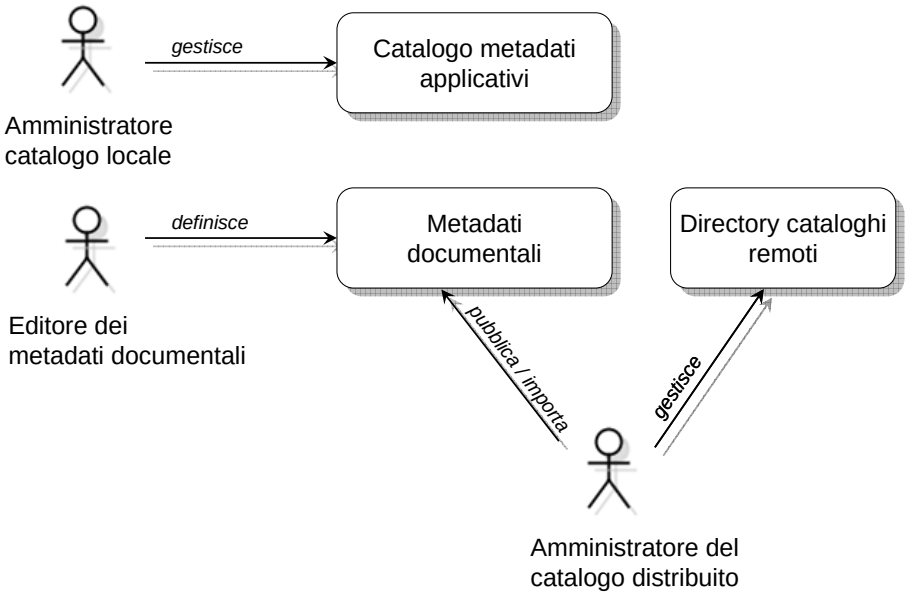

Figure 2: Distributed catalog management: actors (local administrator, editor, central administrator) and actions (managing, publishing, harvesting)

At the moment three types of services have already been studied:

- *discovery services*: EN ISO 19115, using both candidate CEN Metadata Core profile[7] and Dublin Core Schemas[8]
- *harvesting services*: to collect remote available metadata (public)[9]
- *inquiry services*: to access the complete metadata information at dataset and dataset-series

[6] Metadata are managed in a distributed platform environment, adopring EN ISO 19115:2005 and ISO/FDIS19119:2003 standards; actually nine ISO documents already became national standards (see note 2): at this moment CNIPA authority is working on a draft proposal of an Italian Core profile of the standard (according to candidate CEN Core Metadata profile)

[7] Under development (CEN-TC287 Working Group 5)

[8] http://dublincore.org/schemas/xmls/

[9] Actually, two alternatives have already been taken into consideration but not yet implemented: Z39.50 protocol (ISO23950) and OAI-PMH services.

The Geo-Brower: ZOOM +, ZOOM -, PAN, … are all services

J2EE represents the solution to develop Front-End applications to browse geographical data.

Every application interface will access GI via web services, made available by the integration layer: this guarantees to separate the graphical component of the Portal from the content (information).

As a consequence, Graphical User Interfaces (GUI) will be developed with regard to W3C Web Accessibility Initiative (WAI) specifications (W3C, 1999), and to the need for multilingual environments.

Accessibility factor is an important challenge taken into consideration in the development of the Sardinian SDI: WAI specs became mandatory requirements at national level for Public Administration website (Parlamento Italiano, 2004)[10]; unfortunately accessibility requirements are critical aspects in webGIS applications, in particular if we consider all factors related to sensory (seeing), pysical (dexterity, movement) and cognitive disabilities in clauses on user interfaces (CEN/CENELEC, 2002).

Every functionality of Front-End applications for browsing geographic data has been conceived as a service:

- *viewing services* (zoom, pan, scale, all, …)
- *selection services* (point, circle, bbox, polygon)
- *misure services* (areas, perimeter)
- *search services* – Gazetteer (province, municipality, locations, ...)
- *layer services* (on/off)
- *print services* (PDF ® export, …)

Simple services will be assembled to build up composed chains related to specific targets related to procedural activities. Composed GI-services (definede as “opaque chains” in ISO19119), will be made accessible to Front-End applications, and will include OWS services for regular operations such as mapping and direct data access.

GI-service chains are designed on the basis of an analytical model connected to thematic domains and applications (departments within RAS and other Public Administrations in Sardinia): Environmental Impact Assessment, Town Planning appraisal, Land Use monitoring, …).

The complete definition of actors and information “entities” is formally described in a RUP (Rational Unified Process) model approach[11]: Use Case scenarios and System requirements are formally modelled through UML diagrams (use cases, sequence, class, component, deployment), and textually described to collect opinions coming from UML-unskilled people.

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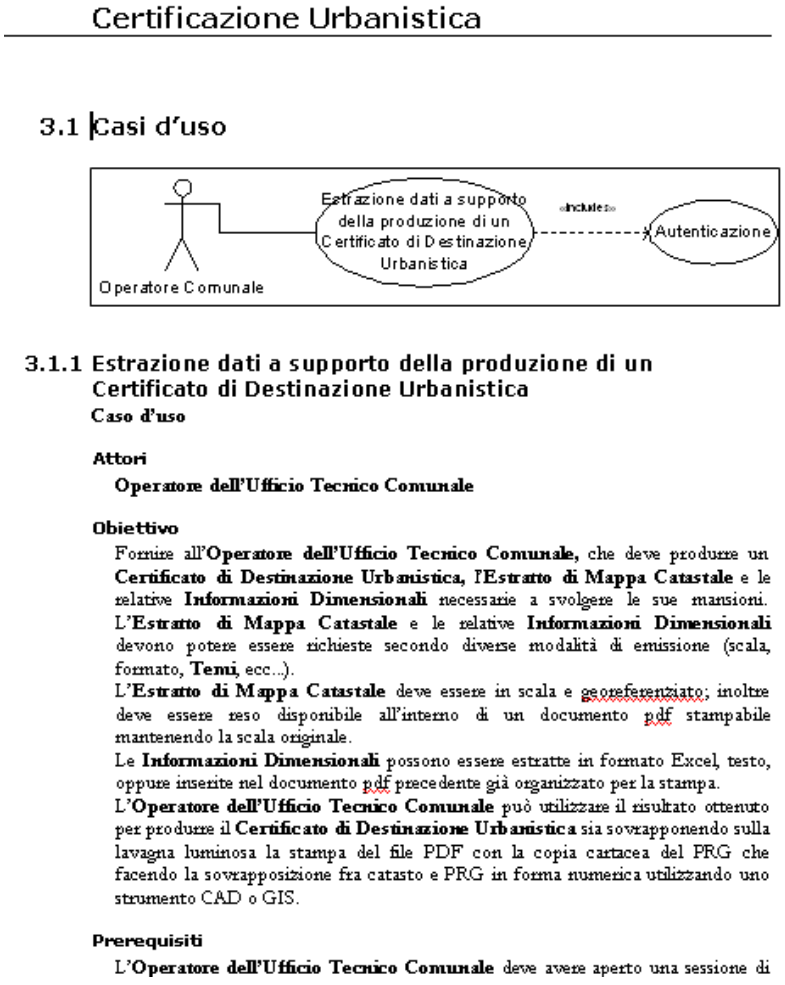
[10] The national legislation Accessibility in PAs (Legge 9 gennaio 2004, num. 4) is based on the same principles as US Section 508 (Rehabilitation Act, 1998): all state and local governenments and agencies that develop and use information technology must ensure that "*members of the public with disabilities have access to and use of information and data, comparable to that of the … members of the public without disabilities.*". *The legislation also extends this requirement to all private contracts for technology products and services for the federal government. The assumption is that state and local governments will eventually adopt, either through statute or informally, the requirements of the federal Section 508 for their own websites and technology* (Chavan A, Steins C., 2001)

[11] RUP approach is used according to ISO-IEC 9126-1:2001 standard on reusability and quality requirements of software developed.



Certificazione Urbanistica

3.1 Casi d'uso

3.1.1 Estrazione dati a supporto della produzione di un Certificato di Destinazione Urbanistica

Caso d'uso

Attori

Operatore dell'Ufficio Tecnico Comunale

Obiettivo

Fornire all'**Operatore dell'Ufficio Tecnico Comunale,** che deve produrre un **Certificato di Destinazione Urbanistica,** l'**Estratto di Mappa Catastale** e le relative **Informazioni Dimensionali** necessarie a svolgere le sue mansioni. L'**Estratto di Mappa Catastale** e le relative **Informazioni Dimensionali** devono potere essere richieste secondo diverse modalità di emissione (scala, formato, **Temi**, ecc...).

L'**Estratto di Mappa Catastale** deve essere in scala e georeferenziato; inoltre deve essere reso disponibile all'interno di un documento pdf stampabile mantenendo la scala originale.

Le **Informazioni Dimensionali** possono essere estratte in formato Excel, testo, oppure inserite nel documento pdf precedente già organizzato per la stampa.

L'**Operatore dell'Ufficio Tecnico Comunale** può utilizzare il risultato ottenuto per produrre il **Certificato di Destinazione Urbanistica** sia sovrapponendo sulla lavagna luminosa la stampa del file PDF con la copia cartacea del PRG che facendo la sovrapposizione fra catasto e PRG in forma numerica utilizzando uno strumento CAD o GIS.

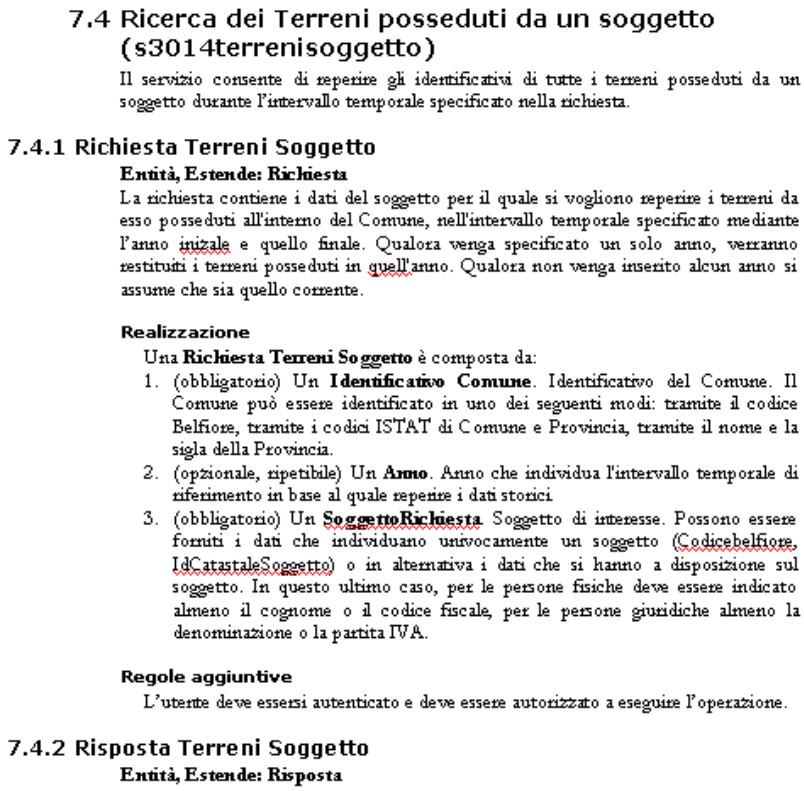
Prerequisiti

L'**Operatore dell'Ufficio Tecnico Comunale** deve avere aperto una sessione di

Figure 3: Use Case scenario and textual description in CDU service (Certificato di Destinazione Urbanistica – Land Use Destination Certificate) taken from SIGMATER project

This work is intended for producing a "repository" of entity models and XML Schemas (XSD), extremely important to derive those elementary services crossing over different thematic domains[12], and composed GI-service chains.

[12] The same model has been used in SIGMATER project (footnote 5) as well as PEOPLE e-Gov project.



7.4 Ricerca dei Terreni posseduti da un soggetto (s3014terrenisoggetto)

Il servizio consente di reperire gli identificativi di tutte i terreni posseduti da un soggetto durante l'intervallo temporale specificato nella richiesta.

7.4.1 Richiesta Terreni Soggetto

Entità, Estende: Richiesta

La richiesta contiene i dati del soggetto per il quale si vogliono reperire i terreni da esso posseduti all'interno del Comune, nell'intervallo temporale specificato mediante l'anno iniziale e quello finale. Qualora venga specificato un solo anno, verranno restituiti i terreni posseduti in quell'anno. Qualora non venga inserito alcun anno si assume che sia quello corrente.

Realizzazione

Una **Richiesta Terreni Soggetto** è composta da:

1. (obbligatorio) Un **Identificativo Comune**. Identificativo del Comune. Il Comune può essere identificato in uno dei seguenti modi: tramite il codice Belfiore, tramite i codici ISTAT di Comune e Provincia, tramite il nome e la sigla della Provincia.
2. (opzionale, ripetibile) Un **Anno**. Anno che individua l'intervallo temporale di riferimento in base al quale reperire i dati storici.
3. (obbligatorio) Un **SoggettoRichiesta**. Soggetto di interesse. Possono essere forniti i dati che individuano univocamente un soggetto (Codicebelfiore, IdCatastaleSoggetto) o in alternativa i dati che si hanno a disposizione sul soggetto. In questo ultimo caso, per le persone fisiche deve essere indicato almeno il cognome o il codice fiscale, per le persone giuridiche almeno la denominazione o la partita IVA.

Regole aggiuntive

L'utente deve essersi autenticato e deve essere autorizzato a eseguire l'operazione.

7.4.2 Risposta Terreni Soggetto

Entità, Estende: Risposta

Figure 4: Requeste & Response in CDU service: textual description derived from XML Schema (from SIGMATER project)

XML Schemas are currently developed either (semi)automatically or manually by using industry standard UML modelling tools and XML development environment tools.

Composed GI-service chains represent the core of the Infrastructure, aiming to automate, rationalize and optimize procedural processes within local PAs in Sardinia (Sliwinsky A. and Wytzisk A., 2004).

The CDU example presented in the following Figure is one of the geo-processing analysis services related to Urban Planning domain currently under definition; other examples are:

- *calculation services*: variables related to Master Plans normative areas, regarding people estimated in development areas, sq.meters of green areas and public services, percentage of building parcels available, apartments estimated, …
- *report services*: overlay analysis produced by RAS users will produce results as thematic maps and reports, to be described in the catalog (metadata) and made available via such services

- *consultation services*: Master Plans can be visualised via on-line or desktop applications, according to the original version or to the "mosaic" version[13]

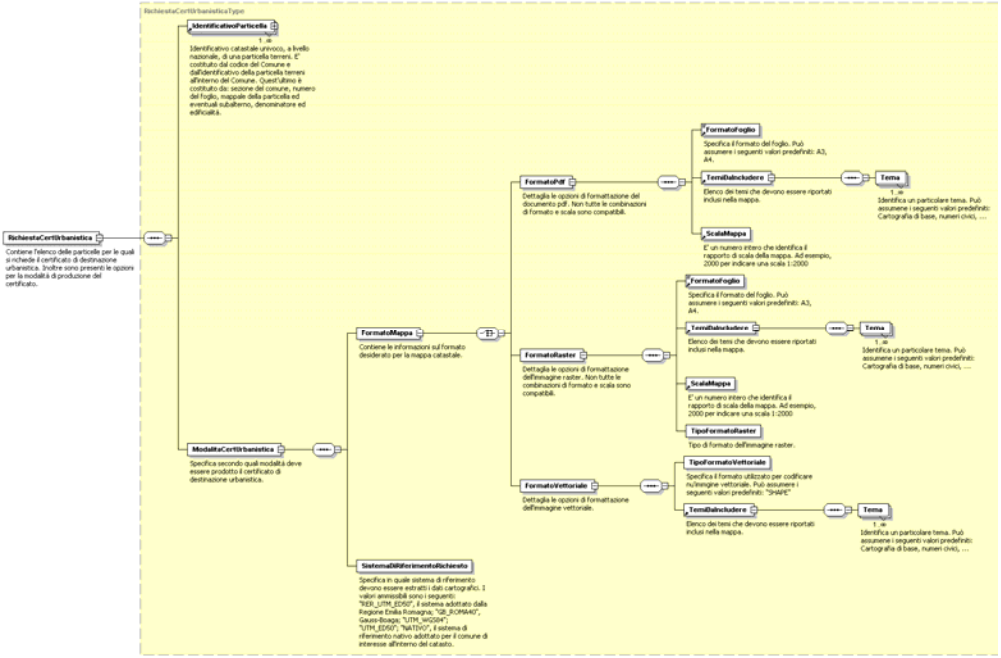


Figure 5: CDU : XML Schema example (from SIGMATER project)

A "<GETSUPPORT>" REQUEST ??

The need for a support towards harmonisation and "socialisation" of service interfaces

Some critical factors already emerged in the development of the Sardinian SDI, some already met a technological solution, but other are not related to "technology" but to organisation-and-methodology and to semantics.

Within the INSPIRE Implementing Rules many documents will be collected and used by Drafting Teams to derive "how-to" documents and cookbooks on SDIs development.

From our point of view there is a need to extend at European and national level the experience in the knowledge, development and implementation of GI standards and technical specifications (EN ISO, OGC, W3C, …): the main issue is related to what we could describe as "semifactured products".

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13 Master Plans (Piani Urbanistici Comunali and Piani Regolatori Generali) are designed and managed at municipal level. One of the most interesting information layer is typically the planned land-use classification (residential, retail, public areas, …): since there isn't any rule or normalised glossary to identify and code the land-use classification, at regional level there is the need for a "mosaic" version of municipal Master Plans.

Semimanufactured products are represented by documentation, models, schemas, application samples and references, related to GI-service chains within Public Administrations; these "semimanufactured" should guarantee low costs, fitness-for-use and productivity requirements.

National domain-specific operational scenarios and use cases (like the ones developed within the Sardinian SDI) represent a possible solution to lead requirements gathering and standards testing & demonstration.

One of the first topic under discussion is the candidate European Metadata Core profile: the assumption here is to provide also the encoding Schemas for implementing metadata services, but some issues on UML modelling tools, model approach, national & thematic profiles and multilingual requirementes have to be solved.

In this sense, semimanufactured products should include reference material (i.e. UML diagrams possibly generated using FOSS tools[14]).

At European level, within INSPIRE Implementing Rules, Model Driven Architecture (MDA)[15] approach should be seriously supported by standardisation bodies (CEN, NSBs) and organisation (i.e. Eurogi) to guarantee platform-independent architectures and implementation code transformation.

Another important topic having direct implications on service implementation is the semantic issue: here semantic is seen at human level, as ability of people "*to find and use spatial data produced at different times by different people for different purposes, in which geographic features may be represented using different naming schemas and geometries*" (Orchestra Executive Board, 2005).

"Human" semantic interoperability needs "human" readable rules to organise geographic information to be used in thematic domains and applications (i.e. environment impact assessment, disaster risk management, …).

Community Demonstration Projects and Discussion Groupware

Sardinian SDI is one of the "natural" INSPIRE test-project, since it will have been building up on interoperable services, within Public Administration departments at different levels.

Some critical factors during the analysis and implementation phases (also coming from other national experiences) already confirm the need to exchange skills and practices to anticipate and solve problems, thus reducing risk factors during projects development.

"HOW-TO" worshops are tremendously needed, at European and national levels: one possible reference model is the FGDC Community Demonstration Project (CPDs), to demonstrate practically how to implement and extend standards (according to EU directive on access public sector information). CDPs could be managed on the basis of INSPIRE Implementing Rules, coordinated at European level and managed at national level, and possibly structured as a sort of

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[14] On metadata example: ISO19139 package (FDTS version 1.0) was developed using Rational ® Rose as UML graphic tool; this solution is not helpful for those implementing Schemas on other platform, since XMI format is not always correctly imported/exported in different licensed solutions. At European level, Freeware and Open Source Softare (FOSS) tools for UML modelling should be encouraged (i.e. UMT-QTV, developed under 5th FP co-funded ACE-GIS project).

[15] "*The goal of the MDA is to provide the basic concepts for doing platform-independent architecture modelling and provide the means for transforming these models to platform specific models or implementation code. The MDA will have impact on how we think about different model abstraction levels. It will also influence the tool support for the model-driven way of thinking*".
(Beusen P. and Hall M., 2004)

"mixed" e-learning programme, based on the combination of "live" events (workshops, meetings, …) and groupware solutions.

Live workshops should focus on best practice experiences and projects, mainly at national and regional levels, presenting technical issues ("how-to" implement experiences) merged to organisational and legal aspects.

Groupware, on the other hand, should look at the importance of extending public participation in standardisation process (new work items, revision, amendment), linking standardisation working groups (ISO, CEN, OGC, …) and national delagations to users[16], and bringing "real" users needs into the discussion[17].

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16 One example is the "embrional" ISO/TC211 Focus Group on Data Providers (http://www.isotc211fgdp.info/index.php)

17 "*It is a principle of standards activity that all interests affected by the work are taken into account. This principle is applied by the Member bodies of CEN and CENELEC in forming their national opinion and representing it through their national delegations at the European level*".
[…]*Standards work is by nature technical and complex. Where possible and necessary, Member body staff should provide consumer representatives with briefing on technical issues and guidance on standards procedures*.
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