

# From the GIS to the SDI: a design path

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## SUMMARY

*The present time represents the transition from the ancient perspective of considering the GIS for public administrations as a complete system similar to a monad towards an open environment characterized by collaboration and interoperability.*

*The way of designing systems has to profit of the specific developments and insure that they are present in the new projects satisfying the demand of users. Thus some new paradigms have to be taken into account in the design process: they will influence all the phases starting from the conceiving phase, through the realization until the contractual and monitoring phase.*

**KEYWORDS:** *Spatial Data Infrastructure, GIS, Design, Management, Public Administration*

## THE STATE OF THE ART AND MAIN INFLUENCING FACTORS

Researchers make use of doubt and curiosity in their activities, and verify some certainties by means of demonstrations and case studies.

If technological solutions derived from the research are used and validated by organizations to support their daily activities and to provide services to citizens, then scientist can retain that a good job has been carried out .

Applying this principle to the GIS domain, we have to admit that GIS have been accepted and adopted only partially within the Public Administrations, and we also have to admit that maybe research efforts have not been well exploited.

Unfortunately there are still some examples where GIS continue to be confused with the digital cartography, nowadays more and more available but very often lacking in semantic, topology, and data model, thus completely unsuited to be efficiently used in a GIS.

In the last few years some external forces have influenced the scenario and GIS are evolving in terms of technology, but also in terms of their perception and use within the central and local public administration; the main influencing forces may be summarized as follows:

- The successfully development of Internet on one hand has enabled organizations to easily communicate, share data and activities, on the other hand is bridging the gap between people and IT;
- The policies at the European and Member States level in relation to the Information Society in general, and particularly to the e-government activities are easing our daily life. This, applied to complex activities which contain GI suggests unforeseen scenarios;
- Data accessibility and the considerations related to data costs and property rights: the PSI EU directive and similar measures are expected to have a not negligible impact on these issues;

- The IT is now emphasizing the concept of distributed computing and distributed services: this is hardly impacting the organizational aspects of the public administration;
- The new technologies together with the diffusion and acceptance of standards, some on them GI specific (e.g. OGC Specs., ISO TC/211, etc.), some others P.A. specific (e.g. Dublin Core, etc.) are enabling organizations to cooperate and share data and procedures.
- Interoperability can no more be considered as an optional.

On the other hand, the same P.A. is triggering the GIS development; the reasons for this interest are mainly the following:

- Public administrations are seeking for sustainable tools that could ease their everyday work. Traditionally only few basic GIS functionalities have been used by the public administrations in monolithic GIS projects, often not well tailored to address specific user needs, such as the automation of administrative procedures requiring in some way GI processing. Nowadays, public administrations are requiring systems tuned in to their real needs;
- Public administration activity develops in contact with the territory and public administrations are aware of the importance of GI for good governance and for a better decision making process. As a consequence of this fact, GI is requested for more and more administrative procedures;
- The public administrations begin to think at geospatial data, either reference or thematic data, as a service to use more than as a good to store, thus they are more interested in having access to services that provides geographic information and related services opening up a wide domain in which the private sector providing integration and development may play its role.

## **MAIN DESIGN ASPECTS**

In these last years there has been a trend within the Public Administration to delegate more and more functions and responsibilities from the central level to the lower ones. The financial resources flow has not always followed the same path and the local authorities have to deal with endemic problems of shortage of finances.

Awareness is arising of the strategic role of Local Authorities in their functions as strategic planners and providers of public services for their local area, as well as to dialogue with citizens, local community and the private sector.

For these reasons, Local Authorities play a key role in the bottom-up process of Spatial Data Infrastructures implementation. In this sense, high level SDI initiatives (e.g. INSPIRE) should be aware of and monitor how Local Authorities deal with GI&GIS to avoid having Local SDIs in place that are not tuned in: incentives for compatibility, such as funding models and guidelines, are clearly needed.

On their own, Local Authorities are among the largest users and producers of public sector information, and thus of GI too: the themes of GI and GIS have been arisen since some years to the attention of Local Authorities specially in terms of cartography, digital geographic data, cadastral data, utilities networks, facilities management and some other sectors generally related to the information systems and back office activities.

Unfortunately Local Authorities have often experienced in the past unsuccessful GIS implementation, where this has meant basically the acquisition of hardware and software, plus some base data, that finally have been banished to a room and nobody has used them.

Nowadays it becomes more and more important for GI implementations to be integrated with non-GI applications in an overall corporate IT environment; Local Authorities are indeed seeking for operational tools that could enable the automation of their administrative procedures.

Adapting IT standards helps to combine solutions and lets the GI components benefit from the functionalities provided by IT platforms (e.g. application servers, access and security transactions, etc.).

On the other hand, Local Authorities suffer some problems, mainly concerning the lack of skilled personnel, of an overall vision of the state of the art, and of the ongoing activities in the GI&GIS related fields.

As a consequence of this fact, Local Authorities very often decide to outsource to the private sector through open public tenders, thus the success of GIS projects relies on the capabilities of realizing it by the general contractor and , generally speaking , by the software vendors acting as providers and developers.

In this scenario, Local Authorities have the need to hold the key role in specifying requirements for services to be realized and data quality standards, and monitor the entire implementation process of the entire system to make sure that the final product will satisfy their real needs: how to do that?

Regulations and decrees are often existing that regulate generic Information Systems Implementation in the Public Administration: models can be derived from them, but more GI-specific issues should be taken into account in order to increase the effectiveness of the systems devoted to the geospatial information and to SDI ( Spatial Data Infrastructure) realization.

The most relevant starting point for the life cycle of such a project should be to follow the Deming PDCA (Plan\_Do\_Check\_Act) model, where the P.A. defines the Strategic Plan and the Feasibility Study, from which it derives in order to start the realization phase the tender documentation that professionals in charge of the control and monitoring use as reference during the all operational phase of developing the components until the final approval.

It has to be assumed according with some INSPIRE estimations that the realization of a modern SDI may not be lasted less then three years if starting from scratch and or a very low level of integration.

Now, assuming that IT is highly dynamic, Public administration needs may change therefore: which can be a suitable model able to adapt to changes?

In this scenario, the Strategic Plan, the Feasibility Study, and the tender documentation play a really crucial role, while the monitoring activities can be a powerful tool to manage the entire implementation process.

All the mentioned elements have to be considered as components of the design process.

## **KEY ISSUES FOR THE DESIGN PATH**

Having all this in mind, the following issues need to be addressed since the beginning when designing GIS or SDI implementation projects for Local Authorities:

- GIS implementation to be successfully should be integrated with non-GI applications in an overall corporate IT environment based on web services: this will enable easy geo-data access to both non-GI skilled personnel and the GI specialists ;
- Simple OGC WMS and WFS are not enough, and more complex geo-webservices should be tailored to address and satisfy everyday administrative procedures already in place ;
- Efforts should be made for collecting from high level governments (EU, Member States) all information and knowledge on the GIS and SDI building process, in order to diffuse them at all levels of the Public Administration for creating awareness and insure adequate results ;
- A clear and efficient mechanism should be individuated and put in place in order to provide continuous independent and qualified technical advice to Local Authorities (e.g. guidelines, funding models and possibilities, etc.) ;

- Official templates and guidelines for contract/tender documentation preparation and in itinere control should be drafted and provided to support Local Authorities during the entire GIS and SDI implementation process;
- Directing and monitoring are key tools, quantitative and qualitative procedures have to be individuated to check the good unrolling on the implementation process and the user satisfaction.

## PRINCIPLES OF DESIGN

In order to define the new rules for the design of an SDI and a GI system it is useful to briefly analyze the main types of systems which have been developed since last few years regarding the specific sector.

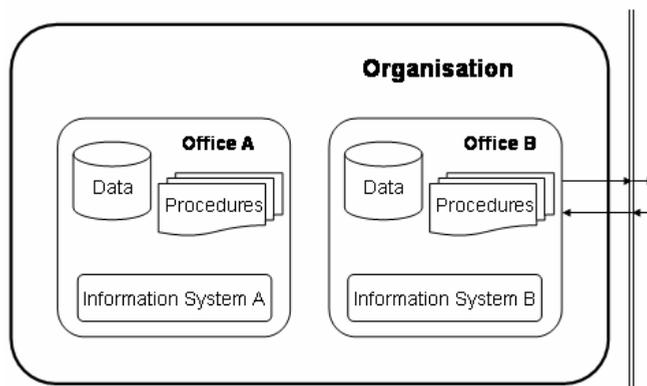
The figure 1 depicts a situation easily detectable in many local public authorities where information systems satisfy specific user needs at department level and only some of them are connected to some external infrastructure such as the RUPA (Rete della Pubblica Amministrazione) which is serving at the present time a consistent number of Italian central and local administrations.

The represented situation is far away to be an SDI, each system may be considered as self contained and in relation with the external world through the data output which are eventually provided on demand to some other subjects.

Those type of systems generally represent the traditional way of realizing a GIS based on a dichotomy system (data and GIS procedures). It is very often easy to find out the two components follow a separate and different path to be put in place.

GIS are generally provided by vendors out of the shelf and the data are often input by the users and or provided to them through a separate system of procurement.

The client server architecture is generally not present in the architecture aiming to the external world nevertheless in the internal part of the system may be found a robust architecture providing real functionalities to departments and offices.



**Figure 1:** architecture detectable in Local P.A.

Figure 2 represents a much modern type of approach where the GIS is placed on the side of a web server farm in order to provide some specific capabilities to the whole system.

The specific architecture is referring to the GIMMI project (<http://services.txt.it/gimmi>) which has been discussed in previous papers (see bibliography).

It is possible to note that the client side is well individuated and that it is staying on the side communicating through the adequate protocols. The situation depicted has some peculiarities regarding the fact that the GIS is completely external and is providing functionalities to the entire system through the previously mentioned protocols.

In some sense this kind of situation is representing the case in which only some functionalities of a GIS are provided on demand similarly to what is performed by the data base providers which reside outside the the core of the system.

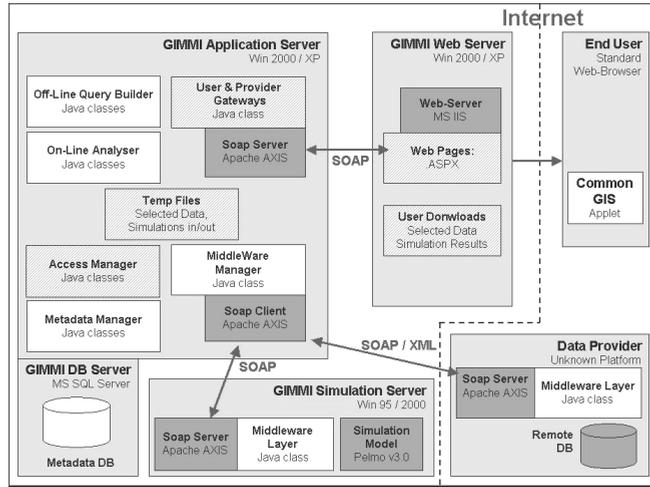


Figure 2: the GIMMI architecture

Figure 3 and 4 foresees a new approach: the main design idea has been that a GIS and an SDI project must follow a series of already established rules and laws contributing to the technological innovation of the Public Administration.

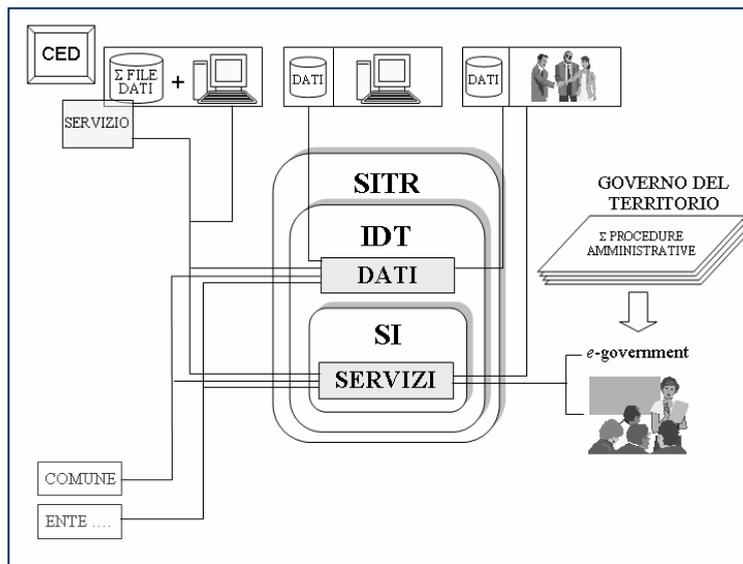
A life cycle of such a project should follow the Deming PDCA (Plan\_Do\_Check\_Act) model, where the P.A. starts from the definition of the Strategic Plan and the Feasibility Study, from which derives the tender documentation that professionals in charge of the control and monitoring use as reference during all the project while the appointed general contractor is asked to realize the system components under their strict control.

All the controls and the step by step evaluations of the objects which will be released by the project are based on the performances approach and on the integration evaluation in order to insure an interoperable development of the whole system.

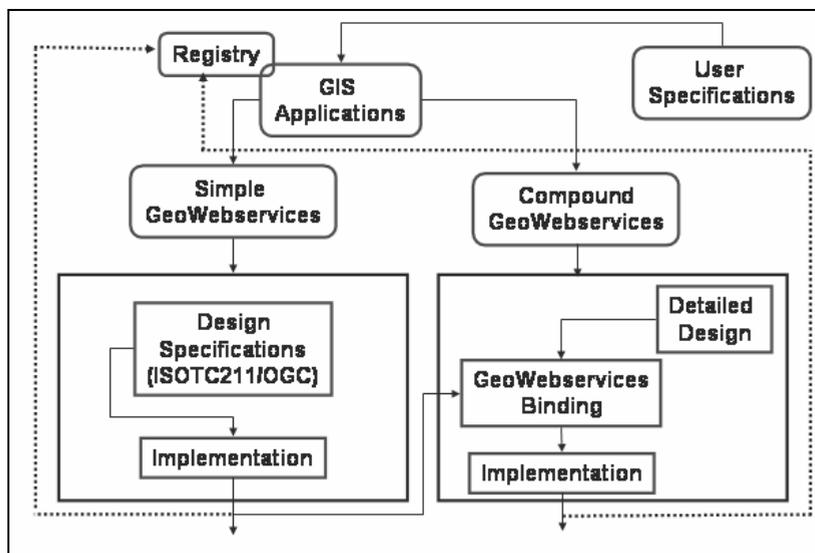
This approach has been chosen for this kind of project in order to manage the fact that IT is highly dynamic specially in the GI field and since the Public administration needs may change according to societal and political changes.

The general architecture is considering the participation to the SDI of several types of users according to the main principle (inherited from INSPIRE) that different partners may contribute to the SDI by data and services.

The technical solution which represent the back bone of the system are the cooperative web services: complex and multi services finalized to perform the activities of the offices are based on simple web services either GI services or traditional e-government and IT services.



**Figure 3:** a modern architecture having in the core the main information system and the services. Data and SDI ( IDT in Italian language) are immediately close by the main core and forming the second inner level of the entire system which is named SITR. Different kinds of active users , simple users and service and data providers are within the SITR through the SDI ( IDT ).



**Figure 4:** the figure is representing two families of geoweb services . They both should be considered as essential in designing the SDI and GIS in order to satisfy the user specifications which drive the GIS application provided by the whole system. According with the often offerend and day after more common availability of basic geoweb services the compound web services need detailed modular design.

## CONCLUSIONS

It is day after day more clear that the design process for the SDI has to be retained as one of the most relevant part of the process of SDI setting up. Today more than yesterday this principle has to be applied according with the axiom that the GIS are in some sense more “easy to design “ than the modern SDI considered as a highly complex systems.

The author believes that more and continuous effort has to be invested in discussing and analyzing different design solutions in order to fully understand the invariants of the projects and the methodology followed by the designers. Moreover it should be clear that the current research is seeking for new effort in studying the relationships of the technical solutions and developments with the theory of user needs satisfaction and the public administration demand.

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