Integrating Geospatial Standards and Standards Strategies Into Business Process

An Open GIS Consortium (OGC) White Paper

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Abstract: *This chapter explores the requirements and solutions for integration of geospatial standards and interoperability strategies into government and commercial business processes. It also looks in a general way at the necessity and difficulty of making a corporate commitment to interoperability. As the recent Delphi survey on standards [1] emphasized, "Standards provide the ability to leverage IT investment in unforeseen ways." Most business processes that could benefit from geospatial information don't yet benefit because spatial information has been locked in non-standard systems, or "stove pipes". A committent to interoperability and to standards unlocks this foundational information type, leveraging current IT investments in unforeseen ways. However, with geospatial data and processing as well as with other kinds of data and processing, it is clear that while technical interoperability is necessary, it is not sufficient. Therefore, the use of standards and interoperable architectures are secondary to an understanding of a given business process and how geospatial data and services and by extension standards can best be used.*

1 Introduction

As this chapter evolved, I quickly discovered that the requirements for integrating standards into business process are the same whether they are geospatial standards or financial standards. In all cases, the use of standards requires a commitment to interoperability. Therefore, much of this chapter has to do with achieving interoperability in an enterprise and the focus is as much on the use of standards in general as it is on geospatial standards in building the interoperable enterprise.

Enterprise Application Integration, Web Services, E-Government, Federated Architectures, Information Sharing – these are just a few of the catch phrases we hear everyday in the Information Technology Community. Typically, as part of the business process – or workflow - in these application areas, a fundamental requirement is the access, use, and integration of distributed, often disparate, content and related processing services. This requirement cannot be met without an overarching reliance on standards and an enterprise wide commitment to the concepts of interoperability. By it very nature, such a commitment incorporates an open systems philosophy.

In the 2003 Delphi Survey [1], portability of data and leveraging existing IT investments for the future were overwhelmingly the most significant benefits in using standards. In follow-up interviews, respondents were consistent in their observation that, although these benefits are not a new and

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sudden realization, the imperative to leverage standards in realizing these benefits is. While, in the past, vendor lock-in may have been considered a bitter pill that one had to swallow in order to deploy a solution rapidly, it is no longer acceptable. The increased value and liquidity of data and applications that result from standards has become much clearer to IT providers, buyers, and suers. Within this context, there is a clear and sudden shift in attitudes towards software standards. The climate of economic constraint and risk aversion along with the mandate to integrate systems on both sides of the firewall has created a shift in the sense of imperative to adopt software standards.

Perhaps no other industry has such an enormous investment in legacy data as the traditional geospatial industry. Over the decades, governments and businesses have spent tens of billions of dollars collecting and maintaining geospatial information. Leveraging this investment is critical to meeting the requirements for many government and business enterprise applications. Integrating standards into solutions and integrating standards strategies into business processes provides the path forward to achieve this goa.

“The development of universal standards for geospatial data transmission would exponentially increase the use of the information worldwide for numerous functions including national security, environmental management and crime mapping”, said Thomas Kalil, special assistant to the president for economic policy for the National Economic Council at the (Clinton) White House.

"The ability to manage and make sense of the information will be the challenge of the 21st century," Kalil said. "Open standards and interoperability are crucial to making a market take off...and there's opportunity to integrate geospatial information and geospatial processing with the World Wide Web.

Government officials and organizations around the world are now stating the same requirement: *geospatial interoperability standards and interoperability need to be an integral part of their applications and business processes*

2 What Is The OGC?

The OpenGIS Consortium (OGC) is a global industry consortium that envisions “A world in which everyone benefits from geographic information and services made available across any network, application, or platform”. Inherent in this vision is the requirement for geospatial standards and strategies to be an integral part of business process.

The OGC consists of 255+ members - geospatial technology software vendors, systems integrators, government agencies and universities - participating in a consensus process to develop, test, and document publicly available interface specifications and encodings for the geospatial industry. Open interfaces and protocols defined by OpenGIS® Specifications are designed to support interoperable solutions that "geo-enable" the Web, wireless and location-based services, and mainstream IT, and to empower technology developers to make complex spatial information and services accessible and useful to all kinds of applications.

Thus, OGC envisions the full integration of geospatial data and geoprocessing resources into mainstream computing and the widespread use of interoperable, commercial geoprocessing software throughout the information infrastructure.

3 What does it take to integrate geospatial standards and a standards strategy into your organization?

So how can geospatial standards and a standards strategy become part of an organizations business process? Organizations will need:

1. An overarching commitment to interoperability and standards with the proper focus on geospatial standards;
2. A commitment to collaboration;
3. A commitment to define a geospatial interoperability and information framework that meets the business process requirements of the organization;
4. A commitment to the collection and maintenance of geospatial metadata;
5. A commitment to retraining and educating staff and management.

These commitments may seem self-evident. However, if the organization does not fully embrace the tenets of interoperability and interoperable architectures, then long-term success in integrating geospatial processes into an organization's overall business processes may be problematic. Typically what is required is a change in the corporate culture and this can be difficult: *A tactical-only solution is a waste of money – you need to adopt an Enterprise solution that addresses business context and people.*

What do we mean by Interoperability?

Together with terms like "metadata" and "joined-up thinking", this word is increasingly being used in information management discourse across all of our information gathering institutions. The meaning of "interoperability", though, remains somewhat ambiguous, as do many of the benefits of "being interoperable". Therefore, the following definition of interoperability is suggested.

> To be **interoperable**, one should actively be engaged in the ongoing process of ensuring that the systems, procedures and culture of an organization are managed in such a way as to maximize opportunities for exchange and re-use of information, whether internally or externally. [2]

Based upon this definition, it should be clear that there is far more to ensuring interoperability than using compatible software and hardware, although that is of course important. Rather, assurance of effective interoperability will require often radical changes to the ways in which organizations work and, especially, in their attitudes to information. Within this context, the organization committed to interoperability needs to consider the following interoperability focus areas:

- Technical: This is the "nuts and bolts" of software and hardware interoperabity. This is where the work of the OGC and other standards organizations can be leveraged. Technical interoperability typically consists of selecting and implementing the appropriate software and/or internet interface specifications, common content encodings for transmission, and so forth. Quite often, within the enterprise, technical interoperability is the easiest to achieve in any given business process.
- Semantic [6]: More than any other type of digital content, geospatial content is an extremely rich content domain that requires special attention. The enormous variety of encodings of geospatial data and its semantics makes it particularly challenging to process requests for geospatial information. Work in the area of GIS interoperability and the work led by the OGC

addresses some basic issues, primarily related to the geometry of geospatial features. Within an organization seeking to integrate geospatial data and standards into business process, it is vitally important that there is agreement on the proper use of metadata (see discussion on metadata). Proper metadata provides the foundation for semantic intoperability. The next level of semantic interoperability may require an organization to address issues related to differing data models, classification schemes, and so forth.

- Institutional: In order to share geospatial information within an organization or between organizations, Institutional interoperability needs to be addressed. Institutional intoperability typically consists of defining the "rules of engagement" when two or more organizations need to share information. A typical example is in an emergency management services business application. When an emergency event occurs, the logistics staff will need immediate access to information from police, fire, cities, counties, state, and Federal agencies. During a crisis, there is no time to work out issues related to data sharing, such as privacy, confidentiality, accuracy, symbology, and so forth. These need to be worked out beforehand. Even within a single enterprise, institutional interoperability issues such as ownership of given data sets, common symbology, and cost sharing need to be discussed and resolved.

- Political/Human: the decision to make resources more widely available interoperable business processes has implications for the organisations concerned (where this may be seen as a loss of control or ownership), their staff (who may not possess the skills required to support the new, interoperable enterprise and a potentially a newly dispersed user community), and the end users. Process change, and extensive staff and user training are rarely considered when deciding whether or not to release a given resource, but are crucial to ensuring the effective long-term use of any enhanced business process.

- Legal: Within the Geospatial domain, there are very definite legal implications to implementing the interoperable enterprise, especially if, as part of a given business process, geospatial information is going to be made available to a new set of constituents. In cases where organisations wish to disclose information, there are legal implications to such a decision. In most countries, the most obvious implication is adherence to privacy and confidentiality laws with potentially strict stipulations over use and publication of personal data, and the checks placed upon Government to protect civil liberties, which have the added effect of reducing Government's ability to exchange certain types of data in the most effective manner. Where resources have been compiled from different sources (County land use information plotted on a satellite image owned by a satellite processing company, for example), there may be Intellectual Property Rights (IPR) issues. A well-known example of copyright in the UK is allowable use of Ordnance Survey maps. For example, what is allowed within an organisation may not be permitted on the World Wide Web where anybody conceivably has access.

In all cases, the organization must provide a supportive infrastructure that allows the key constituents to collaborate in a non-adversarial environment.

Why commit to interoperability?

Without a corporate or enterprise commitment to interoperability and a concept of open systems, an organization cannot effectively integrate geospatial data, services, and processes into their overall business processes. Historically, spatial data and technology have been implemented as "stove-pipes" internal to a given department or an organization. As a result, over time the enterprise implements systems from multiple geospatial technology vendors, each system accessing mission specific repositories of spatial data – and none of these systems or content holdings are interoperable.

Today, these same enterprises are faced with the requirement to share data and resources between departments and also with out-of-enterprise partners. There are many drivers for this market force,

including better customer service provision, improved revenue generation, cost sharing, better return on investment, and so forth. Traditionally, the knee-jerk reaction by many organizations to the requirement to share data and technology has been to standardize on a single vendor platform and a single content model. This is short sighted tactical thinking and does not address the longer term requirements of an enterprise – especially as one considers the requirement to collaborate more with external organizations, the availability of new spatial content sources, the pervasiveness of the Web, and the continued rapid evolution of hardware and software technology.

In today's IT and standards climate, it is no longer necessary to adopt a single vendor approach. Further, legacy investment in training, applications, content, and processes dictates a strategic commitment to interoperability. As Susan Cromwell [3] from the State of Arkansas points out, "The (State) GIS Forum members wouldn't "buy into" standards that meant they'd have to change software or that would make data acquisition cumbersome. Data in the state's clearinghouse couldn't be locked up and available only to users of some products."

By implementing an interoperability philosophy (or policy) coupled with defining and implementing the appropriate interoperability architecture and framework for an organization, it is possible to implement enterprise wide sharing of geospatial content – independent of but sensitive to the content model, content location, and content ownership. It is also possible to leverage, protect, and even extend the value of legacy applications.

Build the Interoperable Enterprise Through Collaboration

Implementation of geospatial standards and interoperability cannot be done by decree. While an executive level statement or policy supporting a commitment to interoperability is required, implementation of any such policy rests with the employees of the organization. Therefore, a collaborative approach to defining and implementing geospatial standards and interoperability is required. The organization must build an Interoperability Team and this Team must be enfranchised with the authority to make recommendations that result in organizational and technology change. This interoperability Team must include users, IT professionals, technology providers, and key executive management (the champion for interoperability). The Team must adopt a consensus approach – much like a standards organization such as the OGC – to discussing and resolving issues, requirements, and recommendations. Above all, this interoperability Team must utilize a business centric methodology.

This Team would have a number of responsibilities, including:

- Defining the interoperability and standards vision for the enterprise;
- Defining and documenting an information and interoperability framework for the enterprise;
- Defining and documenting an approach to consistent metadata collection and maintenance;
- Recommending procurement language that incorporates the organization's vision and mandate for the use of standards – and specifically geospatial standards.

By being very clear in defining the vision, information, and interoperability framework for the use of geospatial and other standards, the Team can communicate a very clear message not only to their technology providers but also to other staff in the organization.

A commitment to define an interoperability and information framework

The Interoperability Team should focus on defining an interoperability and information framework. The Team should define an enterprise vision for standards and interoperability. For example, the US Government Federal Enterprise Architecture team defined a standards vision as:

> Standards. *Establish Federal interoperability standards*. The Federal Government should adopt and use voluntary industry standards in which the interrelationships of components are fully defined by interface specifications available to the public and maintained by group consensus. The Federal Government should acquire and integrate preponderantly only those components conformant to these standards specifications. Non-proprietary system architectures and solutions are the goal; however, initially only partially and selectively compliant systems may be attainable. [4]

With a vision in place, the Team must then define, document, and present a methodology for enterprise agility & interoperability of both IT and geospatial standards into business process that uses the following business centric operational guidelines [5]. Their approach:

- Addresses the root cause rather than just symptoms of integration problems by providing *semantic* and *pragmatic interoperability;*
- Is *business-centric;* shifting power to the users and business experts; managing Enterprise artifacts and governance through Communities of Interests (CoI);
- Provides visibility, accessibility, understandability, using open *declarative mechanisms* that allow for *mass customization* of diverse vocabularies and models within *heterogeneous environments;*
- Insulates business from the high rate of change of technology by dividing the problem into multiple levels and applying constraints properly to reduce complexity and promote reuse;
- Provides for Enterprise agility and prepares the Enterprise for new opportunities in doing business.

The Team should build a document that provides a RoadMap for going forward and that provides traceability from vision to implementation. However, this document should not define the physical implementation.

An excellent example of such a document is the UK's E-Government Interoperability Framework [6] that begins by stating:

> "Better public services tailored to the needs of the citizen and business, as envisaged in the UK online strategy, require the seamless flow of information across government. The e-Government Interoperability Framework (e-GIF) sets out the government's technical policies and specifications for achieving interoperability and ICT systems coherence across the public sector. The e-GIF defines the essential pre-requisites for joined-up and web enabled government. It is a cornerstone policy in the overall e-Government strategy."

A Commitment to Metadata

Perhaps more than any other data type, sharing of geospatial information within and between organizations requires a commitment to the collection and maintenance of metadata. The Team should work to define the core metadata elements that are required for any geospatial dataset. There is currently widespread global support to adopt the ISO Metadata (19115) standard to document and locate internal sources of geographic data. Any organization seeking to integrate geospatial standards into business process should consider adopting a profile of the ISO Metadata standard.

The ISO Metadata standard has an essential core of 21 data elements that have been agreed upon by member nations for consistent search and discovery of geographic information. However, the standard has the capacity to allow for more than 100 data elements that allow organizations to capture the level of detail they need to properly manage the characteristics of their geographic information holdings. The Team needs to reach consensus on accepting these 21 core data elements and /or define your organization's profile that identifies the additional data elements of the ISO Metadata Standard deemed necessary to support enterprise geospatial operations.

The work of the tram should also include establishing an internal core capacity for instruction of metadata creation and maintenance for geographic information.

A Commitment to Retraining and Educating Staff

There will be resistance to change. There will be fear, uncertainty, and doubt resulting from a change in corporate culture brought on by a commitment to the interoperable enterprise and the integration of geospatial standards into business process. These are normal responses in the face of change – especially when the organization does not include staff in the process of change. It is human nature to fight to protect "turf". Edict does not ameliorate fear of change and staff uncertainty.

Therefore, it is imperative that any organization committing themselves to interoperability and to using standards must also initiative staff training and communication programs. The staff needs to know and understand the planned changes and approaches to implementing technology for improved business process. They must have a forum for not only expressing concerns but also for providing input to the RoadMap and vision.

4 Conclusion

A truly interoperable organisation is able to maximise the value and reuse potential of information under its control. This is true whether we care considering spatial data or financial data. An interoperable organization is also able to exchange this information effectively with other equally interoperable bodies, allowing new knowledge to be generated from the identification of relationships between previously unrelated sets of data.

Changing internal systems and practices to make them interoperable is a far from simple task. But the benefits for the organisation and for those who make use of information it publishes are incalculable.