United Nations Spatial Data Infrastructure (UNSDI)
Proposed Technical Governance Framework

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On behalf of OCHA

Table of Contents

List of Figures

List of Boxes

Name	Version	Date	Description
PB	0	4 October	Draft doc structure and bullet points
RA	0.1	7 October	Fleshed out points
PB	0.2	2 November	Part 1 initial draft
RA	0.3	6 Nov	
PB	0.4	7 November	Restructure, draft work-plan and governance framework
RA	0.6	7 Nov	Solution elements
PB	0.11	8 Nov	Further Edits
PB	0.14	19 Nov	Final draft for consultation
RA	0.15	19 Nov	Interim consultation distribution

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EXECUTIVE SUMMARY

The UNSDI will be a "system of systems" that evolves over time to create a growing capacity to meet the challenges of efficiency, responsiveness, global overview and capability building that is required. Essentially, the UNSDI is an enabling framework, and it provides governance structures and key resources to establish a blueprint for the establishment of interoperating operational SDIs within UN clusters, agencies, programmes and national capacity building efforts.

Accordingly, the **governance framework** for the UNSDI needs to be a robust structure that creates coherence between the many different governance activities happening at many levels through the system of systems that will realize the UNSDI vision. The robustness of this structure is dependent on understanding all the aspects that need to be addressed (scoping the problem), the overall shape of the structure (the architecture) and a mechanism to fill the structure in with details (a governance methodology).

The governance framework proposed exploits best practices within the UN information management space, UN-auspiced domains, existing SDI initiatives, international standards bodies and general information systems design.

This document is presented in three parts:

Part 1 describes the document, the scope and approach of the consultancy.

Part 2 describes the contexts within which the UNSDI and its governance framework will be developed. This part of the document also details the key requirements for the governance framework. These descriptions are not exhaustive, but are intended to identify the factors that will distinguish an effective UNSDI from the current limited capability.

Part 3 of the document describes the proposed set of measures ("a solution") required to meet the requirements from each of the perspectives that affect such a system. This holistic architectural approach ensures that all concerns identified can be addressed systematically. A work-plan is presented that comprises discreet projects that build key elements of the UNSDI capability. This work plan should be combined with the business priorities and resourcing model to establish an initial capability for the UNSDI that provides sufficient governance to meet the technical requirements and mechanisms to manage the ongoing evolution of the UNSDI.

This document is an initial draft, a "straw man" based partly on the work of UNGIWG, but also extended to include feedback and experience from the implementing community and other identified best practices. It is hoped that the "separation of concerns" within the sections of this document make it possible for stakeholders to focus on the areas of concern and expertise they can bring, and to then provide feedback to identify any critical gaps in the knowledge, scope or analysis. The solution can then be refined to be the most practical possible approach that addresses all the critical issues that have been identified by the stakeholders.

The solution is based on the realities of reusability of resources: these resources have to be building blocks with known size and behavior, and there is an optimum size for any such building blocks to provide convenience, flexibility and manageability. It is simpler to build a house out of bricks than randomly sized stones and gravel, and it is easier to build a school program using a modular curriculum than by employing subject experts. Essentially the UNSDI needs to support a common understanding from both the user and the producer as to what, where and how such building blocks can be created.

PART 1 - INTRODUCTION AND BACKGROUND

1. Introduction

1.1 Purpose and scope

This document presents an analysis of the context and requirements of a UNSDI governance framework together with a proposed solution comprising a practical governance framework for a notional UNSDI architecture and a work-plan to build key elements of UNSDI.

This initial draft of the document is intended to be used as a key stakeholder engagement tool to support the process of stakeholder assessment of and input to the analysis of the context and requirements of the UNSDI as well as the proposed solution.

1.2 Distribution

This draft consultation document is intended for distribution to UNGIWG members **only**. The document is not intended for further distribution pending assignment of copyright.

1.3 Organisation

Part 1 provides an introduction comprising a description of the document, an outline of the scope, deliverables and approach of the consultancy together with guiding principle for the analysis and proposed design.

Part 2 of the document describes key aspects of the (governance, technology and information) contexts within which the UNSDI and its governance framework will be developed and evolved (sections 3, 4, and 5). Section 6 details the key requirements for the governance framework.

Part 3 of the document provides a description of the proposed solution. Following a conceptual overview of the governance framework presented in section, 7, key elements of the proposed solution described using five viewpoints are presented in section 8. Each of the viewpoints addresses different aspects of the system and enables the 'separation of concerns' that supports both a complete, consistent, solution and simplification of that into specific sets of details. The final section

(section 10) provides a work-plan that comprises discreet projects that build key elements of the UNSDI capability and address critical challenges that relate to each of the 5 viewpoints or aspects of the UNSDI.

The document is intended to be a living document that reflects the articulated requirements, feedback and ultimately design decisions that are taken by the stakeholder community.

2. Consultancy terms of reference

This section provides a brief description of the background to the UNSDI initiative and outlines the scope of the consultancy and the approach used to tackle the problem of governance framework design. The section also articulates some important guiding principles that informs the design of the UNSDI.

2.1 Background

Any complex problem needs to be resolved by breaking it down into smaller problems that can be tackled using the resources available. Infrastructures, by definition, provide benefits to multiple stakeholders, so the problem is further complicated by making sure that there is a mandate and business driver for each part of the solution.

In the case of a Spatial Data Infrastructure, the scope of the problem is well documented, but the breakdown of the problem into smaller units is still an emerging process. It is necessary for the UN to determine the fundamental factors influencing the ability to "divide and conquer" the problem of improving information management and access. One acknowledged constraint is that the UNSDI will be a synthesis of activities undertaken by UN agencies and stakeholders, and not a single massive system replacing many existing systems.

The key enabler for implementing the UNSDI is thus a **governance framework**, so that the roles and responsibilities of each participant can be clearly defined. Identification of key roles provides a framework for targeted implementation planning of the critical shared components. It is important to have a technical blueprint for a UNSDI to identify specific requirements, but to minimize the extent to which this depends on current technologies.

2.2 Objectives

The primary objective of the consultancy is to develop a conceptual framework for the resolution of governance issues through the creation of appropriate governance mechanisms. Specifically the framework must:

- articulate the scope of technical/operational governance and its relationship to enclosing institutional governance processes and realities, and with reference to the UNSDI Compendium (Henricksen, 2007) and the Strategy for Developing and Implementing UNSDI[1] document;
- detail key aspects of the operational/technical governance as it relates to the UNSDI as an enabling and integration tool for operational infrastructures within UN agencies, national jurisdictions and regional or international collaborations;

[1] *Ibid*

- highlight and make recommendations regarding critical priority technical governance issues that need to be addressed by the UNSDI in reference to key Use Cases and associated roles for major actors.

The governance framework presented in this document is to be discussed at a UNGIWG meeting scheduled for 28 to 30 November in Bangkok, Thailand. Key governance issues will be identified through the consultancy for discussion during the meeting. It is anticipated that decisions will be made at the meeting to enable the implementation of agreed governance components.

2.3 Consultancy deliverables

The principle deliverables from the consultancy are:

a. A document describing the UNSDI Technical Governance Framework, including an executive summary.(this document)
b. Draft terms of reference (TOR), for various roles adopted by UNGIWG within the technical governance structure (see section 9.1 **Fout! Verwijzingsbron niet gevonden.** of this document)
c. A guidance note which will help the Chair of the technical governance session(s) to conduct a structured discussion and decision making process on priority issues and the way to address them.
d. A draft project work plan for the development of the UNSDI technical architecture. The outline of a project plan will be prepared for the Bangkok meeting for discussion. This document will be more fully fleshed out based on the deliberations of the Bangkok meeting.

2.4 Consultancy approach

2.4.1 Overview

The approach of the consultancy was to examine, with the aid of specific examples of needs, the interoperability requirements implied by the scope of the UNSDI. Taking a broad view, with practicalities in mind, an overall governance framework will be derived, through which the development of specific governance and technical interoperability arrangements can be facilitated. Although the details of such arrangements are beyond the scope of the framework, specific examples are included to explain the simplifying abstractions of the conceptual framework. It should be noted the detail of these examples is purely illustrative, and not proscriptive, since there is no intention to preclude meaningful stakeholder participation or technical validation processes.

Breaking the scope of the problem into more manageable pieces was a key aspect of the approach. This was undertaken using a relatively formal system modelling approach, with emphasis on identifying the actors and Use Cases involved in the governance processes implied by the establishment of a UNSDI. Best practice in SDI architecture provides a basic separation of concerns, whereby the problem can be broken down into a set of issues with minimal interdependence. A systematic analysis of the governance requirements for establishment of each architectural component was undertaken.

Having identified the governance use cases, the actors (who initiate use cases) and their roles, it is possible to map the roles and responsibilities to the institutional architecture developed in a parallel effort by UNHCR. Where gaps and incompatible function-to-institution mapping is identified, these will be used to inform discussions about the institutional governance framework.

2.4.2 Stakeholder engagement

Comprehensive stakeholder input to the governance framework will be achieved primarily through the UNGIWG 08 meeting in Bangkok. Drawing on best practice and prioritised action areas allows the consultation to focus on critical issues and identifying gaps in the needs analysis.

While developing the governance framework, targeted stakeholder engagement will be used to capture representative stakeholder requirements. This was achieved by:

- Review of existing materials from relevant SDI initiatives to capture governance requirements
- Discussions with selected stakeholders whom had identified challenges in the governance realm typically through on-going initiatives in the UNSDI space.

2.5 UNSDI Guiding Principles

- Adoption of a Geospatial Enterprise approach as advocated in the UNSDI Compendium
- The UNSDI project will implement the minimum necessary to realize effective access and reuse of existing and future UN information resources;
- The UNSDI will be implemented through support for improved interoperability between components of UN operational systems and external resources;
- The UNSDI will provide a common mechanism for (bi-directional) sharing UN information resources between the UN and external stakeholders, thereby enabling whole-of-UN access to external resources where appropriate.
- The UNSDI will be an implementation of emerging best practice, and will adopt and adapt solutions before invention of new approaches;
- The needs of UN internal information management will be used to scope a governance framework, however each aspect will be examined to identify its role in a wider integration between the UNSDI and other domains;
- Some components may exist to enable integration and management of the UNSDI, and these may have specific governance requirements;
- Each component needs to have a specific role, governance arrangements and functionality that is useful to stakeholders – i.e. can be relied on for a particular purpose;
- Each component must be implementable today, and be re-implemented with improved technologies at any time in the future;
- Need to support broad improvements instead of mandating strict adherence to ideals, whilst still developing aspirational targets for those people developing new systems;
- Simplicity of individual components is key, rather than the system as a whole;

- Simplicity of use should prevail over simplicity of implementation, and likewise simplicity of deployment should take precedence over implementation of technology;
- UN specific scenarios will be used to explain the general principles identified, however they are intended to be illustrative, not proscriptive, as to how to achieve UNSDI goals.

PART 2 - CONTEXT AND REQUIREMENTS

This section of the document describes pertinent interrelated aspects of the reality in which the UNSDI exists and which must be factored into UNSDI design. The section covers institutional and governance context, data and information context and the technology context of the UNSDI.

3. Institutional and governance context

3.1 Scope and definitions

3.1.1 Governance

*"**Governance** makes decisions that define expectations, grant power, or verify performance. It consists either of a separate process or of a specific part of management or leadership processes."*[2]

Governance aims to develop and manage consistent, cohesive policies, processes and decision-rights for a given area of responsibility.

3.1.2 SOA governance

A narrower scope of definition applied to network services within a Service Oriented Architecture (SOA) approach , such as those envisaged as a key enabler of the UNSDI data access strategy is:

"SOA governance is about managing the quality, consistency, predictability, change and interdependencies of services".(Stanek, 2006)

Wikipedia also provides a useful set of typical issues that are likely to emerge in SOA:

- *Compliance to standards or laws: IT systems require auditing to prove their compliance to regulations like [Sarbanes-Oxley]. In a SOA, service behavior is often unknown*
- *Change management: changing a service often has unforeseen consequences as the service consumers are unknown to the service providers. This makes an impact analysis for changing a service more difficult than usual.*
- *Ensuring quality of services: The flexibility of SOA to add new services requires extra attention for the quality of these services. This concerns both*

[2] http://en.wikipedia.org/wiki/Governance

the quality of design as the quality of service. As services often call upon other services, one malfunctioning service can cause damage in many applications.

Some key activities that are often mentioned as being part of SOA governance are:

- *Managing the portfolio of services: planning development of new services and updating current services*
- *Managing the service lifecycle: meant to ensure that updates of services do not disturb current service consumers*
- *Using policies to restrict behaviour: rules can be created that all services need to apply to, to ensure consistency of services*
- *Monitoring performance of services: because of service composition, the consequences of service downtime or underperformance can be severe. By monitoring service performance and availability, action can be taken instantly when a problem occurs."*

3.1.3 Operational/technical governance and institutional governance

It is of critical importance is ensure that there is no gap between the institutional mechanisms and the technical implementation requirements. This has proved to be the biggest single barrier to effective interoperability in the past, and is typified by lack of a publication and change control process for common elements.

For example, a typical scenario is where two or more organizations agree to share a common vocabulary, and create copies of that vocabulary within database systems without formally publishing the vocabulary and agreeing change control processes. Over time each organization adapts and extends the vocabulary, and interoperability is compromised when the data is then accessed via a common mechanism. This situation is so common as to almost characterize the current situation.

For the purposes of this exercise, we distinguish between three critical areas of governance:

- Institutional governance, relating to the roles and responsibilities UN agencies have in the ongoing use and contribution to the UNSDI and its enabled outcomes;
- Framework governance, relating to the development of an initial capability and ongoing institutional support for the critical enabling components;
- Technical governance, relating to the specific governance requirements of components of a functional UNSDI.

In general, an issue can be regarded as a technical governance issue if there is an artifact to be governed. Such an artifact is something that either:

  - specifies an agreement about how some aspect of a component will behave
  - deploys a component that implements these agreement

3.2 Separation of governance concerns

- Approach – stepwise targeted approach to implementing
- Established business drivers for usage of shared resources
- ID cases where deliverable and user are ready to go
- Every component of SDI need to ID who is responsible

- ID what is basis for governance

3.3 Inter and intra SDI governance

Conceptually, the UNSDI is conceived as being built from SDI building blocks. From this conceptual position, the governance problem space has been divided into inter-SDI and intra-SDI governance realms.

For individual SDIs to interoperate and thus share resources, agreements defining interoperability expectations between the SDIs need to be in place. These agreements need to be governed so that they can be adopted, adapted, discovered, used and retired. This critical set of governance capabilities is termed **inter-SDI governance**.

Within individual SDIs there is a need for publish interoperable services that deliver seamless data for users. This is achieved through agreements that determine policy-level (e.g. SDI participation), technology-level (e.g. protocols, services, software) and information-level (e.g. data models, metadata, common vocabularies) level interoperability.

Rather than duplicating effort to re-create agreements between stakeholders within an SDI it is proposed that agreements are inherited from existing SDIs (with which the SDI wishes to align itself) and adapted as required.

The governance of agreements together with the assets produced using them i.e. the technical, information and other resources of the infrastructure, is termed **intra-SDI governance.**

3.4 Evolving nature of governance approach

- Governance arrangements take longer to develop than anything else.
- Need flexible responsive governance
- Need effective transition from interim to longer term.
- Partitioning governance – so that progress can be made
- Articulate dimensions of governance – start process

3.5 Addressing intangible SDI success factors

As stated in the UNSDI compendium "influence of intangible factors such as the people, procedures and the work cultures involved wield 80% of the responsibility for the success or otherwise of the SDI." Although attempting to tackle these intangible success factors is beyond the scope of the technical governance framework, analysis and resultant proposals are cognizant of the need to mitigate these risk factors.

The solution design attempts to find approaches to address factors such as operating environment and culture, varying levels of commitment and the complex, often politicised nature of relationships between actors within the UN.

Key issues to be addressed in this context are:

- Engagement with and roles of IT folks in UNSDI and SOA governance

- Engagement with management to win the support for UNSDI and the paradigm shifts that shared resources and SOA imply
- Stimulating, supporting changing working practices – move from stovepipes to services

3.6 Governance dimensions of an UNSDI

3.6.1 Overview

The UNSDI governance framework needs to take into account the multiple stakeholders who will be directly and indirectly affected by the establishment of improved information access and management.

These stakeholders are many and varied, and are best understood by exploring the different "dimensions" of the UNSDI. Each of the aspects described below represent a valid way of dividing the scope of the UNSDI challenge, and in total provide a basis to identify the simplest common approaches that can be used to define component behavior, and hence an implementation strategy.

Obviously, there may be natural correspondences between stakeholders as identified in different dimensions, for example national jurisdictions are natural data providers to global users, and global programs (in particular Earth Observation) are data providers to national users.

3.6.2 Multi–domain

The United Nations activities cover a broad range of domains and the operations of single agencies typically require data spanning multiple domains. The UNSDI must enable the development of common applications that are able to utilise data from different sources. For effective data integration across jurisdictions, common semantics and data models are required within each domain. Harmonisation across domains is also required to ensure the consistent treatment of objects that are included in a number of different domains. It is a desirable end goal to provide seamless data integration, where the end user does no need to be aware of differences in data management, however the more pragmatic goal is to enable a continual evolution of improvements in data integration.

The need for the harmonization of data models within and across domains implies:

- governance of common modelling aims and institutional processes across domains
- use of standards and common approaches to data modelling
- modular models components that are interoperable and that can be reused

3.6.3 Multi-jurisdictional

UN operations cover multiple jurisdictions. The jurisdictions that fall within the mandate of UN entities (programmes, funds and agencies) also varies from agency to agency.

To effectively use information for decision making, the UN needs to collate, generate and use data covering a number of jurisdictions. To be able to integrate data products

seamlessly across jurisdictions, a mechanism for supporting development and use of common standards is required.

Although national standards for data sets, data products and services that enable integration of data within a national SDI may exist, there is a need to harmonize and standardize standards across SDIs and jurisdictions.

The standardization between two jurisdictions implies the existence of a higher governing authority. When attempting to standardize across two global or regional SDI that comprise multiple domains and multiple jurisdictions, the UN is best mandated to tackle this challenge.

3.6.4 Diverse participation capabilities

It is clear that there is a large variation in geospatial technology uptake within the UN as well as the degree of understanding of and participation in the UNSDI. Technical governance must therefore support a broad spectrum of participation so that stakeholders with varying levels of technical skills, geospatial requirements and commitment levels can effectively participate in the SDI effort.

3.6.5 Multiple interoperability level support

There are likely to be different interoperability requirements and expectations between stakeholders within and between SDIs. The UNSDI will need provide mechanisms to support interoperability at the following levels of interoperability:

- Organizational interoperability – consistent policies laws, business cases
    - Am I authorized to access it
    - is it of use
- Technical interoperability
    - protocols and syntax –determines ability to share data, processing and tools
- Information interoperability
    - Common structure - ability to integrate and transform data if the information is structured consistently
    - Agreed semantic - agreed descriptions and definitions to ensure that information can be understand and use

3.6.6 Differing context and requirements for UN SDIs

A UNSDI component may have significantly different governance requirements for different uses, even if the technical details are identical. The most obvious split is between operational systems, systems activated in response to a crisis, systems used to optimize planning processes and research. Some systems, such as monitoring systems, may be used in multiple roles.

3.6.7 Temporal change

Establishing the initial capability and organizational governance architecture of the UNSDI will require a project administered by a single UN agency. It is anticipated that the UNSDI project, having achieved stated objectives, will become a programme and thus attain a more permanent status in the UN system. This is a known

organizational change. In addition, current UN reform may lead to as yet unknown changes in how business is conducted by the UN.

The technical governance framework must therefore be separated from the institutional framework that governs the UNSDI. In addition the framework must be able to adapt to anticipated system-wide re-organization that are likely to lead to shifting business practices, rules and institutional roles and relationships of key stakeholders involved in the UNSDI effort.

The governance framework must also transcend any current SDI implementation technology paradigm. The governance structure must therefore be clearly separated from the system technology as the governance framework will in fact enable the transitions between technology paradigms.

3.7 UN reform

In 2000 the then UN Secretary General, Kofi Annan produced a report that provided recommendations for "renewing the UN*"* to meet the challenges facing the world in the new millennium (Annan, 2000). In addition to the need to become more effective and efficient, the report highlighted the need for the UN to '*….increasingly serve as a catalyst for collective action, both among its Member States and between them and the vibrant constellation of new non-state actors".* The report also highlighted that the United Nations should *"harness the power of technology to improve the fortunes of developing Countries".*

Both statements highlight key potential roles of the UNSDI in mediating between domains and jurisdictions to enable SDI interoperability and of assisting developing countries to develop SDI capabilities.

More recently, the UN Secretary-General's High-Level Panel made a series of recommendations to "*overcome the fragmentation of the United Nations so that the system can deliver as one"* (United Nations, 2006). The report recommended focusing on improving UN efficiency and effectiveness, system-wide coherence and management reform.

From the foregoing and as noted in the UNSDI compendium (Henricksen, 2007) it can be concluded that the UN system recognises that there is a need to '*move with the times*' in order to deliver on its mandate and thus UN reform to some degree is inevitable.

The UNSDI will be implemented during a period of major reform within the UN. This represents a threat as well as an opportunity. The threat is that the institutional context of the UNSDI will be evolving and structures, staffing roles and relationships between UN stakeholder organizations are likely to change.

The UN reform process can also be viewed as an opportunity. In an ideal world the analysis of critical UN business processes using structured, transparent business process analysis tools could add significantly not only to the design of technical system but to the broader institutional systems of the UN.

The governance framework must be flexible enough to adapt to these changing institutional reality.

4. Data context

4.1 Interoperability

Currently, geospatial data are held in a range of heterogeneous, proprietary data standards and formats. Although technical interoperability has been achieved through the use of web services and the ability of geospatial applications to read other non-native data formats, increasing emphasis is being placed on the need to standardize data structure and semantics, through the use of data models.

Communities that are actively building SDI using SOA approaches have realized that in order to move beyond simple visual integration of data from geospatial web services, there is a need to develop and use standardized data models (or application schema) for domains and to harmonize data models across domains and jurisdictions. This need becomes increasingly critical as thematic and jurisdictional SDIs attempt to interoperate to build national, regional and global SDIs.

Many data modeling activities are already underway within subject domains, often under the auspices of UN sanctioned bodies Examples include geosciences, marine, meteorology, land cover, and land administration. Efforts to harmonize data models have commenced and experiences to date have uncovered some very important challenges in the governance sphere.

The UNSDI governance effort will need to incorporate governance mechanisms to support harmonization and integration of cross-domain data modeling initiatives if true data interoperability is to be achieved.

Box 1 Need for data models - UNEP East African consultation

At the UNEP Regional (East African) Consultation of the Governance of the UNSDI, participants identified the following as demands of SDI customers related to data standards and models (Wilson, 2007):

- aligned, reconciled, harmonised data items
- standardised vocabularies for data items, services and attributes (thesaurus for domain specialisation)
- 3rd party like UN to assist in data harmonisation and data standards

Box 2 UNJLC Transport data modelling[3]

UNJLC recently completed the development of the first version of a transport data model. The UNSDI-Transport focus was on semantics – i.e. to ensure that whatever database structure a given agency chose to implement, it would have a common core set of attributes and value domains on which to base data import/exports.

The starting point for scoping semantic definitions was a compilation of the most common practices in logistics data collection and data storage. Consultation with logisticians were used

[3] Based on conversations/correspondence with Olivier Cottray UNJLC October 2007

to further refine and clarify requirements. The result of the consultation was a list of objects definition with attributes and value domains. The object model was using ESRI's Geodatabase model[4].

Although the model was developed by UNJLC based on requirements of logistics users, the process was cognisant of the need to be compatible with the evolving UNSDI as well as other related modelling efforts. The UNSDI-T team are now exploring integration/harmonization of the semantics of the UNSDI-T with other transport data modelling efforts such as the CODATA open source 1:200,000 map project.

The following general (UNSDI related) and specific data modelling governance challenges were identified by the team during the modelling process:

General UNSDI governance

- Who has ownership of the various components of the UNSDI?
- Although there is a 'natural mandate' for certain agencies over specific parts of the UNSDI, should this mandate/authority be formalised, if so how?

Data modelling

- What is the mechanism for updating schema and how is consensus built?
- Is there to be a set timetable for updates and how can participation be effectively achieved (i.e. having too many unstructured contributors becomes unmanageable)
- Requirements (for data model) can come from the consumers in an ad hoc manner - how can this input be improved
- Need to advocate for a culture of disaggregated indicators/attributes that can be recombined as needed as the basis for a UNSDI.
- Need to determine structured and documented mechanism for translation from external data models to UNSDI and vice versa (e.g.: when integrating a national road data model into UNSDI, there will be some value mapping to be done. On what basis are equivalencies determined?).

Box 3 The need for data models – WFP SDI proposal

WFP conducted an SDI needs assessment to develop a proposal for a WFP SDI as part of the UNSDI effort (WFP & ITHACA, 2007). The assessment focused on the needs of WFP GIS user departments (ODAP, ODAV and UNJLC). One of the principle needs identified was to define implement maintain and distribute common data sets for use across all geospatial data departments. The development of a data model was identified as being the critical first step to achieving the data reliability, integrity, standardization and metadata integration.

Box 4 Geoscience data harmonization case study - GeoSciML and INSPIRE[5]

INSPIRE data specifications are being developed for key data sets. These data specifications will be the result of a harmonisation process based on existing (national) data specifications and, where available, user requirements and use cases provided by INSPIRE stakeholders.

There are ongoing discussions regarding approaches to harmonisation of data modelling efforts for geoscience data in a global domain (GeoSciML) and a jurisdictional context (INSPIRE).

[4] See UNSDI-T webpage www.unjlc.org/mapcenter/unsdi

[5] Based on discussions between INSPIRE and GeoSciML communities

The GeoSciML International effort takes the position that it cannot become dependent on a local or regional framework, especially one with immature governance and technical processes. It cannot therefore become based on an INSPIRE generic conceptual model.

The mechanisms available for resolving this include the development of a profiling methodology within the INSPIRE conceptual model, to allow adoption of the GeoSciML model. To achieve this, both frameworks may need to agree on common profiling mechanisms, so that on the one hand GeoSciML can identify the target objects for such profiling in a way that makes it easy, and INSPIRE would need to apply the profiling mechanism.

An alternative option would be for the INSPIRE Generic Conceptual Model to be replaced by an internationally recognised equivalent, such as a UN endorsed, and eventually ISO standardised toolkit. It is likely that the profiling mechanism would still however be required to achieve implementation.

In any event, the fact that both modelling exercises draw from a common ISO basis makes it feasible to consider addressing the governance issues and achieving a common data model between INSPIRE and the international community of practice.
Geoscience data harmonization case study - GeoSciML and INSPIRE

4.2 Data management, distribution and use

UNSDI stakeholders will have markedly different requirements and responsibilities according to whether they are delivering data or acquiring it. Many stakeholders will participate in both roles, and generally any data provider will require access to ancillary data as part of the data generation process.

4.3 Data concentrations and silos

The concentration and nature of data available for a particular phenomenon significantly determines the resources required to manage and distribute that data. Global satellite based monitoring requires archival capabilities that need an ongoing well resourced mandate. Individual projects may create information whose re-use and potential value is unknown, but requires little overhead to manage and make available.

Data that could potentially be re-used are often held in isolated ‘silos’ that are, to varying degrees accessible within the project, unit, department, or organization that is data custodian as well as outside of the organization. The data are stored in different storage formats with different data structures and semantics with and without metadata.

4.4 Custodianship and sources

A priority task in the creation of any SDI is the determination of core common geospatial data and the identification of custodian responsible for creation and maintenance of the data set. Lack of clarity about authoritative sources of data leads to:

- Duplication of effort to produce and maintain data sets
- Administrative overhead to synchronize data sets

- Confusion for users about point of truth

In addition there is a need to determine point of truth for data sets i.e. where data can be obtained from, and to determine how to synchronize multiple copies of the same data set available from multiple locations.

Box 5 Single/multiple authoritative sources and supply points for data sets
Participants at the Regional (East African) Consultation of the Governance of the UNSDI discussed issues related to desirability of having single or multiple authoritative data sources and the supply options (Wilson, 2007) . Issues raised include:

- Desirability of having a single authoritative source for data and does this mean a single point of supply
- Desirability of having multiple authoritative sources for data where there could be direct competition, confusion in the minds of users (customers), different sources based on scale (duplication without generalisation), competition from private suppliers, different access/pricing arrangements
- Desirability of having multiple points of supply. Raises issues of contemporaneity and synchronizing of data holdings
- Due to bandwidth limitations, there is s need to store local copies of data . Again raises issues of contemporaneity and synchronizing of data holdings

5. Technology context

5.1 Emerging Technical Factors

5.1.1 Significant patterns

This section deals with the significant emerging factors in the technical aspects of SDI, and in particular those that specifically rely on or implement technical governance. This section in particular attempts to identify emerging best practices that are not already addressed in the UNSDI Implementation Strategy.

5.1.2 Service Oriented Architectures

Service Oriented Architectures (SOA) are, like most such concepts and terminology, subject to a fair amount of self-serving narrowness of definition around particular technologies. The core description from Wikipedia[6] provides a useful overview. Issues highlighted in **bold** are of critical importance to the UNSDI strategy.

*"Relative to earlier attempts to **promote software reuse** via modularity of functions, or by use of predefined groups of functions known as classes, SOA's atomic level objects are 100 to 1,000 times larger, and are associated by an application designer or engineer using orchestration. In the process of orchestration, relatively large chunks of software functionality (services) are associated in a non-hierarchical arrangement (in contrast to a class's hierarchies) by a software engineer, or process engineer, using a special software tool which contains an exhaustive list of all of the services, their characteristics, and a means to record the designer's choices which the designer can manage and the software system can consume and use at run-time.*

***Underlying and enabling all of this is metadata** which is sufficient to describe not only the characteristics of these services, but also the data that drives them. XML has*

[6] http://en.wikipedia.org/wiki/Service-oriented_architecture

been used extensively in SOA to create data which is wrapped in a nearly exhaustive description container. Analogously, the services themselves are typically described by WSDL, and communications protocols by SOAP. ***Whether these description languages are the best possible for the job, and whether they will remain the favourites going forward, is at present an open question.*** *What is certain is that* ***SOA is utterly dependent on data*** *and services that are described using some implementation of metadata which meets two criteria.* ***The metadata must be in a form which software systems can consume to dynamically configure to maintain coherence and integrity, and in a form which system designers can understand and use to manage that metadata.***

The goal of SOA is to allow fairly large chunks of functionality to be strung together ***to form ad-hoc applications which are built almost entirely from existing software services****. The larger the chunks, the fewer the interface points required to implement any given set of functionality; however, very large chunks of functionality may not be granular enough to be easily reused. Each interface brings with it some amount of processing overhead, so there is a performance consideration in choosing the granularity of services. The great promise of SOA is that the marginal cost of creating the n-th application is zero, as all of the software required already exists to satisfy the requirements of other applications.* ***Only orchestration is required to produce a new application.****"*

In the context of the UNSDI, the actual form of the services are not the critical issue, so much as the ability to **encapsulate, describe** and **re-use.** Services may be network-accessible or even CD-distribution, but the implications for governance relate to the ability of service behaviors and metadata to be broken down into standardized chunks that can be used to "orchestrate" the provider/consumer interaction.

5.1.3 Web services and conformance profiles

Improved access to data is the rationale for SDI establishment. This is achieved by through establishment and publishing of services that enable access to data. One family of standards that are available to implement this function is the Open Geospatial Consortiums Web Services specifications. These define the semantics of spatial operations and provide bindings to common network protocols.

Such web service specifications are necessarily broad since they provide common semantics across a variety of possible implementations. In general, these specifications have many optional elements that may be seen as necessary within a shared resources framework, such as detail of metadata about available data. The specifications, for the most part, make no restriction on the type, meaning or identification of the data itself. Differing implementation choices for aspects of services can significantly reduce information interoperability. For example if one data publisher users a particular concept of time (e.g. a season indicated by the first day of the season) for a service and second publisher users a different time format as well as different semantics for start and end date for the temporal extent of a data set, it is not possible to search for and use data in a consistent manner across two services.

Within the broader IT sector, it has been found that general standards, such as the W3C Web Services protocols, are not sufficient to achieve interoperability by them selves. A community will general need to agree on a common **profile** to ensure that a compatible set of options are chosen.

Box 7 Conformance Profiles

- After many years of failure to achieve interoperability between different vendor systems implementing W3C Web Services standards, a new governance body was formed to publish a set of common profiles: the Web Services Interoperability Organization (http:///www.ws-i.org)
- Includes all major vendors, including those instrumental in the W3C specifications
- Creates "conformance profiles" that can be used to actually test conformance as well as specify.
- Establishes an ongoing process for adding profiles as required.

WS-I has established 3 working groups that address different aspects of the problem:
Sample Applications Working Group - Illustrate best practices for implementations on multiple vendor platforms
Testing Tools Working Group - Develops self-administered tests to very conformance with WS-I profiles
Requirements Gathering Working Group - Captures business requirements to drive future profile selection

To ensure interoperability within a data access and distribution context service profiles are needed that contextualize the generic services e.g.

- use a community agreed vocabulary to describe services objects - (service metadata)
- use a community agreed vocabulary to describe geographic objects (content metadata)
- use a community agreed vocabulary in specific attributes (information modeling)

Currently, there is no standard way to describe profiles. However, some key requirements for profile handling include:

- Need for profiles to be machine readable to enable exploitation of services
- Need to manage changing profiles
- Ability to determine conflict when there are multiple dependencies and separately governed parts of a profile

Need for profiles to be discoverable (by the service developers) to support service instantiation

Box 6 SDI Service Profiling requirements – an emerging pattern

Several Australian jurisdictional and domain based SDI projects have reached similar conclusions about the importance of service profiles, ideally parts of which are derived/inherent from externally governed communities.

- Water Resources Observation Network
- Marine Portal
- Queensland Government Enterprise architecture project
- GeoSciML Testbed

Initial implementations have been tested as an open source software project including:

- Placeholder SDI profiles;
- Software to aggregate hierarchies of profiles into a single specification inheriting requirements from parents;
- Software to create human readable documentation packages
- Conformance testing tools

Further discussion on the theory and links to the software can be found at https://www.seegrid.csiro.au/twiki/bin/view/AppSchemas/ServiceProfiles

This toolkit is still at a proof of concept stage, but has already demonstrated that the WS-I approach, coupled with the "ISO19106 –Profiles" model allows significant improvement in the way interoperability requirements can be specified, harmonised and published.

To enable real interoperability of data delivered through services common data product specifications including consistent data models (for the data output or exposed by services) is required. For the same type of data (e.g. roads) is delivered via two services (e.g. from neighboring NSDIs), unless the data has common data model, data from the different services cannot be accessed and used consistently. This is a key enabler for the creation of common applications that use data from, multiple services.

5.1.4 Open Source and Reference Implementations

The success of the World Wide Web was based on two main factors:

1. provision of a strongly governed infrastructure (DNS)
2. provision of a free reference implementation of both server and client (browser) components.

*"a **reference implementation**... is a software example of a standard for use in helping others implement their own versions of the standard. A standard is much easier to understand with a working example in hand."*[7]

Many aspects of the UNSDI will be unfamiliar to stakeholders, and some will require attention to detail to achieve the efficient scalability required for the UNSDI. Some components will be critical for success, and require careful testing and sponsorship of relevant standards. Each component critical for the UNSDI to operate, as defined by the expectations of the high-level use cases, should have a proven and accessible reference implementation.

The UNSDI Compendium recognizes the important potential role of the Free and Open Source Software (FOSS) movement in enabling the UNSDI. It is therefore important that reference implementations using FOSS are developed to provide concrete examples of how technology components can be stitched together to build an SDI .

The recently approved UNOCHA Policy on Geographic Information Systems and Geospatial Data Management (UNOCHA, 2007) sets out the OCHA approach to the

[7] Wikipedia (http://en.wikipedia.org/wiki/Reference_implementation)

use of open source software (OSS). It states that OCHA will attempt to *'mitigate software costs through increased usage of appropriate open source geo-spatial software'* that complies with OpenGIS specifications. It further states that OCHA will in the longer term move towards OSS software provide that it is *inter alia* '*fully supported globally and adopted as a standard within the UN Secretariat'*

In order to maximize the potential role of FOSS (in particular, OSGEO), in the UNSDI and facilitate the important potential role of the FOSS community the UN needs to determine an effective engagement strategy.

Open Source is free to use, but not cost-free to build and maintain. Therefore a key element of the engagement strategy should be an investigation of how UNSDI can support relevant FOSS efforts.

- Need for UNSDI to set interoperability targets for commercial software developers to meet
- For commercial software, particularly ESRI (as currently represents a major proportion of the geospatial technology used by the UN) need to develop a test bed so that commercial vendors can test interoperability of their products against targets established by the UNSDI

5.1.5 Registries

5.1.5.1 Overview

If a resource cannot be found it cannot be used. Just as importantly, if the provenance of a resource cannot be identified, it is difficult to use in any real fashion. Registries are thus a critical element of distributed data infrastructures. Registries are the mechanisms by which artifacts related to agreements (e.g. a service specification) or their implementation (e.g. a service instance) can be published and discovered,. and any data resources can be made available for re-use. The sets of resources available are called **registers** (ISO 19135).

From a technical perspective an industry-standard "meta-model" for registries[8] has been developed, which underpins such technologies as UDDI, and ebXML Registry/Repository. Thus, the behavior of registries and registers can be identified at an abstract level, even if the implementations are varied.

The governance of registries is usefully described in ISO 19135 "Procedures for registration of Geographic Items" (ISO, 2004). This standard provides a clear, concise and practical articulation of the various actors and roles. Application of this meta-model has been found to be a highly effective way of identifying the pragmatic realities that face any real world implementation.

5.1.5.2 Role of registries in an SDI

"When combined with a portal, a registry acts as the hub of a distributed data infrastructure as it presents users with an aggregated view of infrastructure content compiled from numerous heterogeneous sources." (Tandy & Thomas, 2006).

[8] (ISO/IEC 11179, 1999)

For content to be aggregated into a single view they must adhere to standards and the publication of these standards (into registers) enables their discovery, re-use and application, thus leading to practical interoperability.

To date the majority of registry implementations within SDI implementations can be characterized as containing (Tandy & Thomas, 2006):

- Metadata about resources that can be downloaded
- Links to locations where those resources can be accessed

The challenge is to understand what metadata is actually required. The UNSDI has not emerged automatically out of metadata describing data sets, and this pattern is consistent globally. The architectural perspective of an SDI makes it clear that there are in fact many aspects to operational interoperability, and the **set of agreements that define aspects of service behavior** are the required metadata artifacts.

The role of registers is quite simple: any time an artifact is required to realize an agreement between a data provider and a user - such as a service location, data model, vocabulary, service profile, organization identifier, service level agreement, schema, query template etc – a **register** must be established at a **registry** that **both parties know about.**

Determining what registers are required and which actors play what roles in the ongoing process of creation and maintenance of registers is the key to understanding and building effective SDI governance.

The obvious conclusion here is that an SDI must maintain a register of registers at the very least, so that all parties can find where such metadata is located.

5.1.5.3 ISO 19135 registry conceptual model

According to ISO 19135 a **register** is a *"set of files containing identifiers assigned to items with description of the associated items"* and a **registry** is an *"information system on which a register is maintained"*

The conceptual model shown in Figure 1 presents the relationship between the various organizations that play roles in management of a registry and registers (ISO, 2004).

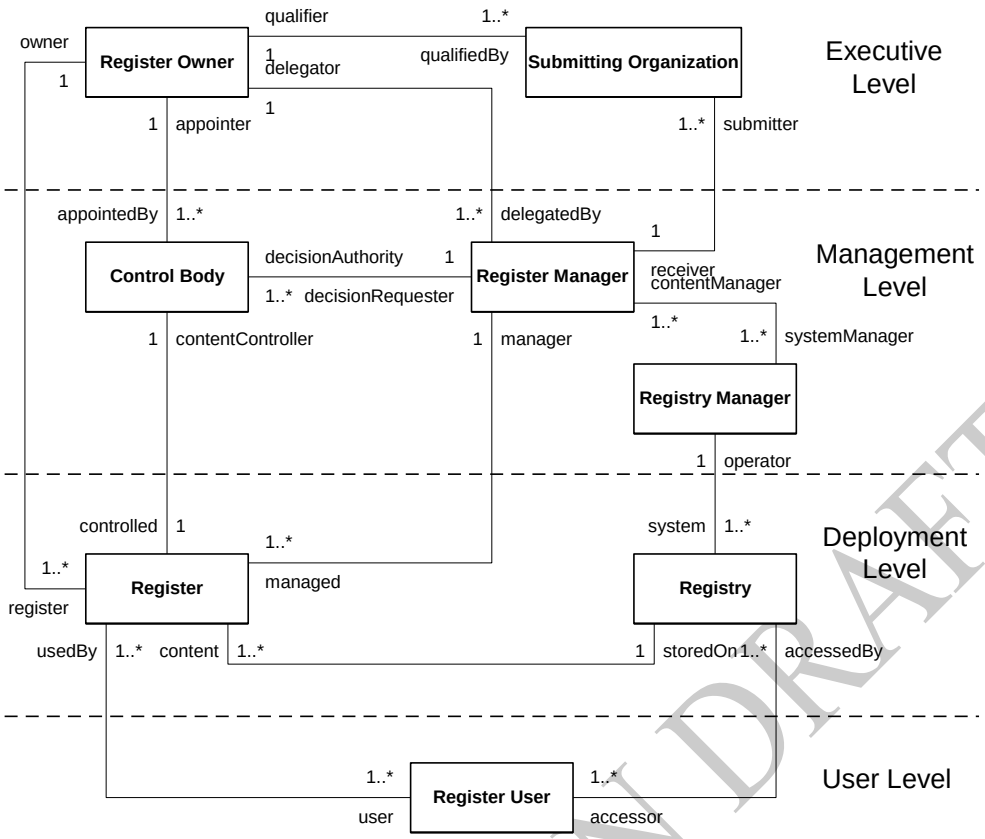

Figure 1 Role of Organization in register management (ISO 19135)

Registration management roles and the key responsibilities of each role are as follows:

Register owner

- Establishes one of more registers
- Responsible for the management dissemination and intellectual content of the register
- Can act as register manager or can **appoint** another organization to act as register manager
- Specifies criteria which determines which organizations can act as submitting organizations (to make changes to the register)
- May serve as the control body or may **delegate** role to sub-group within the organization

Register manager

- role delegated by Registry owner
- may manage multiple registers. A
- register manager may own and operate the registry that holds a register or it may delegate operation of the registry to a registry manager
- accepts and manages proposals from submitting organizations
- passes proposals to the control body for decisions
- reports to the register owner at intervals

Submitting organization

- register manager determines whether an organization is qualified to submit requests to change registers in accordance with the criteria established by the register owner.
- manages the submission of proposals to the register manager appeals to the register owner initiated from their stakeholders.

Control body

- group of technical experts appointed by a register owner to decide on the acceptability of proposals for changes to the content of a register
- makes decision on proposals provided by the register manager

Registry manager

- responsible for the day-to-day management of a registry.
- may engage a third-part service provider to perform this service.
- ensures integrity of registers held in the registry
- provide means for electronic access to the registry for register managers, control bodies, and register users.

Register user

- Different categories of register users are
    - Developers of standards and specifications want to re-use items specified in a register
    - Data producers want to use in their products items specified in a register
    - Data users want to understand the meaning of register items used by a data producer
    - System developers want to provide a capability to use register items in data production, interchange, or consumption
- register owner may set terms and conditions for different levels of access to the register for different categories of users

5.1.5.4 Role of registries in the UNSDI

As we have seen, the UNSDI will be primarily concerned with the registration and reuse of interoperability enabling agreements and resources. At the core of the UNSDI is the means to adopt and adapt appropriate approaches and make them available.

This in turn will create a network of resources that the UNSDI can index and make available to the community.

5.1.6 Ontologies

Ontologies are formalised agreements about the identity and description of concepts. At the simplest level these are simple word-lists, but in general the UNSDI will need to manage relationships between sets of simple vocabularies, cross-walks etc.

The conceptual view of ontologies can greatly inform the creation of governance mechanisms to deal with data modeling, vocabulary development and re-use.

The ontology community classifies ontologies into three main types:

- Upper level – used for broad discovery examples include vocabularies within the Global Change Master Directory (GCMD)
- Core level – relating to common behavior and business process
- Domain level – focusing on the data content and how its described

This stratification of the conceptual space into distinct levels of abstraction provides a natural framework for the governance of semantic aspects of interoperability.

The UNSDI will **not** be driven by the development of an ontological framework. However an ontological **view** can be automatically extracted from a coherent set of reusable patterns, supported by reusable resources. This ontological view will enhance the discovery function, and probably the ability to orchestrate the use of multiple services to access and process data.

It is beyond the scope of this document to discuss the roles, theories and toolsets of ontologies.

5.2 Legacy systems and migration

5.2.1 Currently heterogeneous systems

The UN system landscape is heterogeneous and is a behavioral artifact– a function of UN culture and organization which reflects the broad range of domains and needs that the system spans.

Although efforts to develop geospatial enterprise solutions are well underway within the UN, the majority of geospatial solutions continue to be locally developed for limited (agency, domain and geographic) use. They are typically designed to meet specific local project or agency goals and necessitate system users to negotiate access bilateral agreements to access data, create ad hoc data models and generate data, obtain and clean data, customize application and workflows and produce bespoke information products.

5.2.2 Migration to services

In order to rationalize legacy systems there is a need to move from (short-term) technology driven system lifecycles towards a stable, yet evolving "system of systems". Achieving the creation of a shared and interoperable system landscape requires migration of existing systems and practices to a services model using a service oriented architecture (SOA) approach.

However, services are more costly to implement than locally appropriate solutions and benefits (to users that are beyond the immediate scope of a project) are hard to justify in the context of the project that is paying for them.

Managerial support and funding will be required to achieve this major conceptual shift. Awareness raising, education, return on investment (ROI) studies will all be required to communicate the business case for moving to a service model and to generate sufficient political will and organizational change to make it happen.

5.2.3 Governance implications

Service Oriented Architecture (SOA) approaches using web services, has been identified as the technology paradigm for UNSDI implementation. The technical governance challenges related to building and sustaining an SOA are addressed by the technical governance framework as outlined in section 7.

However, there are also significant organizational challenges particularly with regard to shift in organizational culture and funding models necessary to build and grow an SOA and the migration of legacy systems and their entrenched workflows to a systems model.

Although operational/technical governance framework design is cognizant of the need to address these institutional challenges, this and other intangible SDI success factors will need to be addressed within the institutional governance framework.

5.3 Constraints

5.3.1 Resourcing

- Current UN agency and project based-funding models make sharing large IT project costs across agencies challenging
- Although UNSDI will be funded as a project, only a portion of project costs will be available to fund governance activities
- Difficult to justify large up-front costs when returns occur much further downstream and largely benefit agencies that are not the funders

5.3.2 Governance realities

- Starting configuration dictated by institutional constraints of the UN system
- Needs to be distributed NOT centralized (reference UNSDI compendium)
- Likely evolution form project to programme

6. Requirements

This section of the document identifies the capabilities and characteristic of the UNSDI. These requirements are one of the main inputs to the system design process. These requirements should accurately reflect stakeholder consensus regarding the critical business needs that the system must address

6.1 Current situation and need for change

Currently in order to share resources providers and users of resources negotiate bilateral arrangements. These are ad hoc, costly (especially in time, effort and skills capacity) to negotiate, and cannot be found and re-used by others. Figure 2, below illustrates this situation

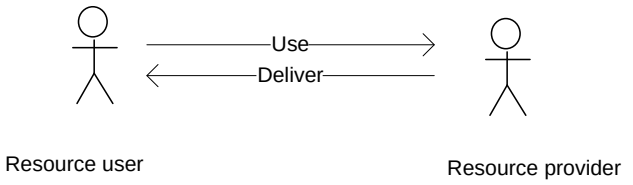

Figure 2 Current arrangements for sharing resources

If this situation is viewed across multiple agencies the situation rapidly becomes unworkable.

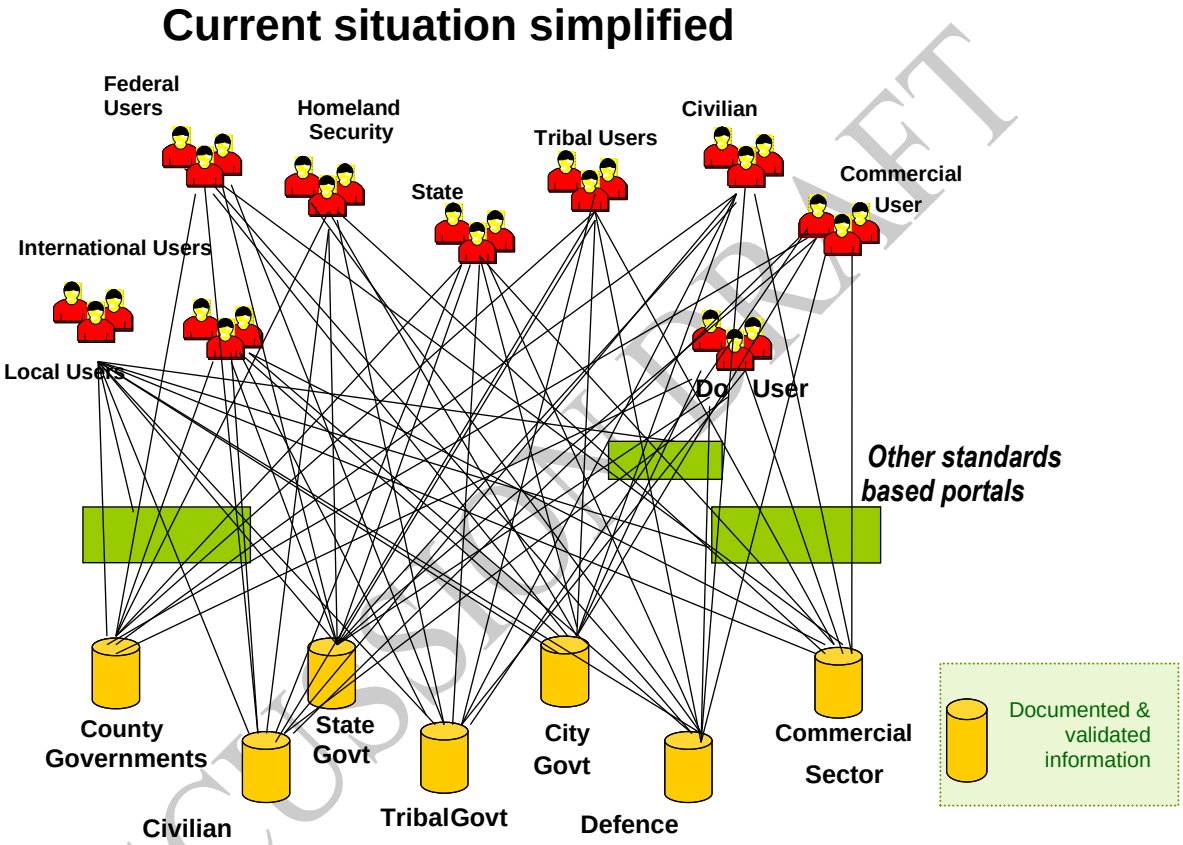

Figure 3 Multiple bilateral agreements[9]

The creation of a shared infrastructure is therefore necessary to rationalise and improve access to resources. This is achieved by a provider publishing resources using the capabilities provided by an infrastructure. These capabilities include reusable resources and precedents from many similar activities, such as software tools, data models, access policies, data quality procedures, metadata descriptions, conformance testing tools, discovery aids etc). The infrastructure then supports multiple users discovering and re-using these resources. This pattern is illustrated in Figure 4, below.

[9] source OGC notional architecture (ref needed)

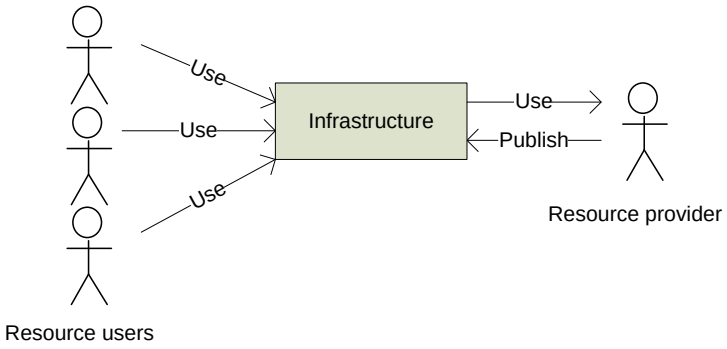

Figure 4 The publish and re-use pattern

The same publish and re-use pattern can also be applied to solving problems of interoperability between infrastructures i.e the ability for users from one SDI to find and re-use resources that have been published within the operational context of a different SDI. This is illustrated in Figure 5, which shows the relationship between the UNSDI and an SDI that is a 'member' of the UNSDI.

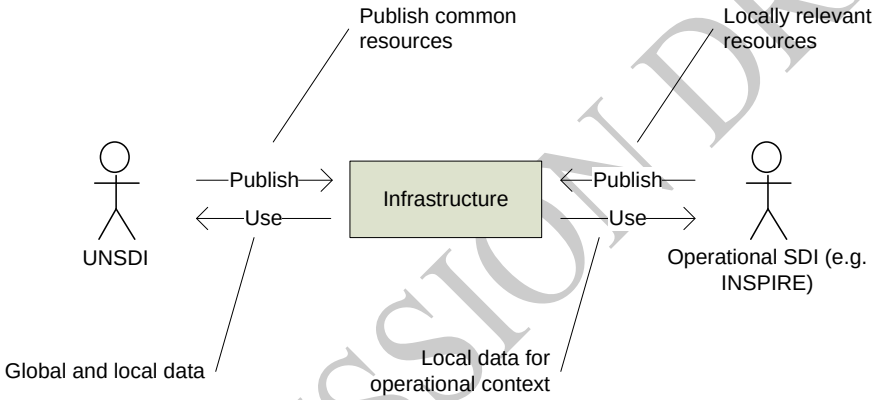

Figure 5 Publish and re-use pattern between SDIs

Resources in the context of this discussion include agreements about how the infrastructure behaves as well as the data access services that expose data products that are the *raison d'etre* of the infrastructure.

Some examples of the type of agreements about infrastructure behaviour include:

- **Service specifications and profiles** - agreements adopted by the community about service specifications and conformance profiles to be used when building and publishing services
- **data models** - developed and adopted by the community and used within data products,
- **portrayal rules** - for map products.
- **Registers of governance actors types** - lists of the actors involved in governance of the infrastructure and the roles they play so that stakeholder can find out who to contact regard a specific data model or a query how to subscribe to and publish resources to the infrastructure.

This need to develop and promote a variety of standards that enable sharing of resources has been clearly articulated by UNSDI stakeholders (see Box 7). This requirement necessitates governance mechanisms and resources.

Box 7 A clear need for standards

The MySDI[10] initiative aimed at capturing geospatial information access and dissemination expectations. With regard to expectations of the UNSDI regarding standards the following comments were made;

- Promote use standards and common protocols and guidelines and recommended standards for data sharing (UNHCR)
- Encourage proprietary systems to adhere to interoperability standards (UNOCHA, FIS)
- Advocating of standards by objective external body and promotion of simple standardised data access policy templates (UNEP)
- Promotion of metadata standards and ensure support for future data and services (UNOSAT)

6.2 General requirements

The goal of the governance framework is to reduce organizational challenges to creating, growing and achieving interoperability between SDIs. The key to achieving this (at least in terms of technical/operational governance) is the governance of artifacts that describe, or are an implementation of interoperability agreements (and expectations) between stakeholders within an SDI and between SDIs.

The entire governance framework must be scalable, based on resource availability and commensurate with the volume of resources (data, services and agreements) that are being governed.

It is anticipated that the short and longer-term governance configurations will be different as the challenges and resourcing levels will change as the infrastructure grows. The governance approach therefore must offer a means of creating common threads between short and long term requirements.

The governance framework needs to be flexible and adaptive and ensure that it is able to easily govern and adapt itself (structure, organization, strategy and policies) to meet changing organizational, technology and business realities.

6.2.1 Inter-SDI governance requirements

For SDIs to interoperate, and thus share resources, agreements defining interoperability expectations between the SDIs need to be in place. Existing of agreements implies a governance framework that deals with all aspects of the agreement lifecycle:

- Identification
- Creation
- Adoption
- Harmonization (within and between domains)
- Modification and retirement

[10] See http://www.ungiwg.org/mySDI.htm

In addition, management of the artifacts that describe the agreements will also be required so that they can be discovered and used.

6.2.2 Intra-SDI governance requirements

In addition to the governance of agreements between SDI the UNSDI governance framework will also need to address the internal operational governance challenges of individual SDIs comprising the UNSDI.

Rather than duplicating effort to re-create agreements between stakeholders within an SDI it is proposed that agreements are inherited from existing SDIs and adapted as required.

It is anticipated that many of the agreements required to establish a (UN)SDI instance will be adopted from existing SDIs with which the SDI wishes to align itself. The standards may need to be adapted to the context of the SDI and the adapted agreements will need to be managed (published, accessed and used) within the SDI to ensure conformance.

6.3 Governance of data model and harmonization processes

Data model harmonization provides an opportunity to link data from different operational domains to address a specific problem. Harmonization does not imply a single common data model (though this has been attempted), but rather the ability to effectively develop independent data models but still share enough common elements to enable pragmatic linkages of data where appropriate.

For example, if flood warning, land use and forestry management data systems share the same concepts and identifiers of rivers and catchments, such data can be linked to improve knowledge about the systems. Or if transport logistics data and humanitarian needs share common gazetteer of place-names this will aid effective relief planning.

The challenge is, of course, that related domains developing their own internal governance arrangements need to be able to tap into a common governance arrangement to actually share common concepts. It is unrealistic to assume that any individual domain will be able to fill this role, and hence the criticality of the UNSDI to provide such a mechanism.

INSPIRE recently developed a draft "Methodology for the Development of Data Specifications" which articautles a process for addressing data model harmonization (see Box 8).

Box 8 INSPIRE methodology for the development of data specifications

The recently published INSPIRE draft methodology for the development of data specifications outlines a process for data harmonization through the development of data specifications (INSPIRE Drafting Team "Data Specifications", 2007). The steps of this process are:

- **Capture user requirements** described as use cases and application scenarios.
- **Analysis of current situation** carried out in parallel to user requirements to assist in identifying the relevant data harmonisation aspects.

- **Gap analysis** to identify user requirements that cannot be met by the current data offerings
- For each gap, a data **harmonisation approach** is developed and agreed.
- **Application schema** developed to document the approach to filling gaps .
    - Schema describes required spatial object types (with constraints, properties)
    - Described in a conceptual schema language – UML.
- **Development of data specification** comprising:
    - At least: specification scope, data product identification, data content and structure, reference systems, data quality, data product delivery, and metadata.
    - Optionally information on; maintenance, data capture, portrayal
    - Application schema (abstract-level in UML)
    - Feature catalogue
    - GML application schema (implementation-level in XML)
- **Testing** – data specifications tested within a pilot under real world conditions.
- **Monitoring** - tracking costs/benefits of harmonisation efforts

6.4 Architectural governance

The architecture of the UNSDI is the mechanism to ensure that each component is properly designed to fulfill a certain role, and that each component required is identified. It also provides for practical engineering and technology choices to be made and related back to that basic need. The reality is that technology changes, data volumes grow, use will change over time, and better ideas will emerge.

The UNSDI will evolve over time. Yet, there will be an ongoing need to assess the best way to accommodate new challenges and opportunities, as well as communicate to stakeholders the current recommended practices.

In particular, a successful UNSDI will engender creation and integration of many related SDI implementations, which will continually test and refine the overall architecture. For example, an initial architecture for the UNSDI and key cluster activities will need to evolve into one that supports and integrates national SDIs. Additional subject domains will bring different types of data and processing.

The architecture becomes a **contract** between the implementers of systems and the UNSDI that the systems can be built in a way which will work within the broader system. Analysis of this within a single domain, within a single jurisdiction, has clearly identified the general nature of this problem.

The UNSDI technical governance framework should therefore ensure that an agreed notional architecture can be developed and maintained through effective governance mechanisms to ensure a shared architectural view of the UNSDI.

Box 9 The Australian Ocean Portal SDI - Need for a shared architectural view

Reflections on the experiences of developing an Australian Oceans Portal (Finney, 2007) highlighted the need to maintain a shared architectural view of the infrastructure. This is required to mitigate the risk of loss of architectural and technical coherence due to; changing system requirements as the system and its users mature, and the development and divergence of sub-infrastructures based on competing standards.

It is crucial therefore that the architecture itself includes maintenance functions for the architecture, and that the functions are properly resourced with both governance mechanisms and a permanent capability that can be called upon to address needs as they arise.

These needs will occur across all the activities in developing the UNSDI, but in particular:

- Development of data models
- Design of core service types
- Addressing engineering aspects of scalability
- Evaluating role of new technologies
- Driving improvements to technologies
- Design and governance of content (vocabularies)
- Design of purpose-specific SDIs
- Design of capability toolset for national SDIs

For example, the integration of numerical models or decision support tools into the UNSDI to meet a particular domain need will propagate into an extension of the architecture so that these capabilities can be broadly exploited. This extension will then be available to enhance national SDIs, or more likely, specific systems within the national jurisdiction. Such a problem requires a coherent approach for describing the services, data models, etc as well as ability to communicate the enhanced capability of the UNSDI.

The criticality of this task, and the broad range of technical skills required, means that a permanent capability needs to be established as a UNGIWG standing task group for example, with specific responsibilities and resources allocated to be both proactive and responsive to stakeholder needs.

PART 3 - PROPOSED SOLUTION

The solution section of the document contains four sections. The first section provides a conceptual overview of the governance framework.

The second section presents a proposed solution from a number of different perspectives. The section focuses on the identification and description of the critical governance functions that enable the creation of the UNSDI and an identification of the key actors who exercise these functions as well as their roles.

The third section describes a process of mapping registry management roles to institutional entities. This will enable the technical governance tasks to be assigned to organizational entities so that the technical governance can be implemented through institutional governance structures.

The final section relates more broadly to the whole UNSDI and presents a work-plan comprising a number of projects that build specific priority elements of the UNSDI. These components represent the critical mass of UNSDI that must be built for elements of the governance framework to be developed. Each of the projects addresses a critical aspect of the UNSDI highlighted in the viewpoints.

Presentation of the solution using a number of viewpoints (or perspective) which describe different aspects of the system such as business, information and enables readers to assess the solution from each of the different dimensions.

Stakeholder review of the proposed solution and the requirements provides an important opportunity to assess whether the proposed solution addresses the articulated requirements.

7. Governance framework - conceptual overview

7.1 Introduction

This section highlights the key aspects of the governance framework that is elaborated in more detail in the following section

Conceptually, the design of the governance framework is based upon the ISO 19135 conceptual model of registry management. The framework is presented as series of use cases based upon a conceptual SDI model (notional architecture) that reflects the underlying requirements of the UNSDI, informed by the limitations of past SDI implementation experience. It is proposed that this notional architecture be developed as a reference implementation in its own right, fully elaborated and refined through SDI implementation projects as a priority work plan item, and published as a reusable template.

Although the focus of the use cases is SDI governance, for completeness end-user resource discovery and access use case packages have been included.

Having identified the governance use cases actors (the 'who') and roles that they perform (the 'what'), the details of how governance is implemented can be elaborated.

Conceptually, the UNSDI governance framework comprises two separate but integrated tiers of governance:

- **inter-SDI governance** – enabling interoperability between SDIs through the creation and management of registers of UNSDI resources
- **intra-SDI governance** – dealing with the technical governance of SDI instances created with the UNSDI

The governance framework assumes that:

- The UNSDI governance institution will rely heavily on the delegation of responsibility for creation and maintenance of SDI resources
- Operational governance of components shared across (UN) SDI instances will be delegated by the UNSDI
- The variety of roles necessary to operate registries and registers are likely to need to be delegated
- An architecture together with use cases (that also address governance) can be re-used as a template by agencies or community that wish to create SDIs within the UNSDI

7.2 inter-SDI governance

This set of governance capabilities aims to ensure interoperability between SDI instances and includes:

- Policies, rules procedures, processes and tools for the management of entire lifecycle of artifacts that describe interoperability between SDIs
- A governed common reference architecture

7.3 Intra-SDI governance

The UNSDI is conceived as being a virtual system comprising a constellation of individual SDIs. These SDIs will be created individually or collectively by UN agencies or business units to meet shared geospatial business needs. It is anticipated that the UNSDI will act as an enabler for National SDIs (NSDI) creation, particularly in developing nations, that will also become part of the UNSDI constellation.

The focus therefore of internal governance is on the creation and operation of shared resources (agreements, services, data) within an SDI. The SDI notional architecture (illustrated by reference implementation(s)), is intended to act as a template for SDI creation and will include a modular re-usable template for internal governance of the SDI instance.

The use of a common architecture will ensure that (UN)SDI instances that are created interoperate with each other. In addition, interoperability with external SDI (beyond the UNSDI boundaries) will be ensured by the inter-SDI interoperability governance activities.

8. The UNSDI proposed solution

Key components of the UNSDI (that address critical business needs of the stakeholder community) are presented in this section. As noted earlier, it is not possible to design a governance framework in isolation, as obviously there would be nothing to govern! Therefore the solution proposes the development of the minimum required capabilities namely, a high-level notional architecture for the UNSDI together with some of its key components.

The proposed solution is described using elements of the Open Distributed Processing – Reference Model (RM-ODP) [11]. The RM-ODP is an international standard for architecting open, distributed processing systems and provides a conceptual framework for building distributed systems in an incremental manner.

The use of the RM-ODP provides a way of thinking about architectural issues in terms of fundamental patterns or organizing principles and provides a set of guiding concepts and terminology.

RM-ODP defines the following five viewpoints of a system each of which addresses different aspects of the system and enables the 'separation of concerns' during the analysis and solution design:

- **Enterprise Viewpoint** – describes with the purpose, scope and business context of the UNSDI.
- **Information Viewpoint** – focuses on the information dimension of UNSDI. Including the identification of information elements, and information flows.
- **Computational Viewpoint** – focuses on partitioning the UNSDI into functional components independent of any specific environment.
- **Engineering Viewpoint** – focuses on the practical realities of building the UNSDI from deployed components within a network infrastructure.
- **Technology Viewpoint:** Identifies possible technical artefacts for engineering mechanisms, computational structures, information structures and enterprise structures whilst being as independent of the other four viewpoints as possible. This independence will help to 'future-proof' the WRON.

This consultancy has focused on the elaborating the enterprise viewpoint through the development of (governance) use cases that describe required governance functions of the UNSDI.

However to develop the use cases, a notional architecture (based on the architecture expressed in the UNSDI Compendium) has been posited. Key elements of the notional architecture are described in the enterprise, information, technology and computation viewpoints.

The work-plan that is presented in section 10, describes a number of projects that build different dimensions of the UNSDI. Each of the projects addresses issues or challenges described in the RM-ODP viewpoints.

[11] ISO/IEC 1074

8.1 Enterprise viewpoint

The UNSDI governance structures will be established around a set of "Terms of Reference" for the Actors identified in a set of published Use Cases.

This approach allows for management of these roles and responsibilities that ensures critical aspects are properly documented and effectively assigned to appropriate UN bodies.

The set of actors and Use Cases will be fully documented as a priority activity in follow-on activities, however it is clear from analysis of best practice that the general nature of the architecture and roles are common.

Identifying and placing under appropriate governance the commonality of the architectures is one of the key activities that establishment of a UNSDI will undertake to enable more effective SDI integration in future.

8.1.1 Use cases

The articulation of the key uses cases and actors is a critical step in the process of elaboration of the governance framework. Having identified the critical functions necessary to enable technical governance, and the actors that exercise these functions it is possible to:

- Identify the agreements (and the artifacts that describe them) that need to be governed
- Map the actors and their roles to institutional entities and/or specific agencies and persons within the UNSDI project.

8.1.2 Use case scenarios

In order to illustrate critical dimensions of the UNSDI governance framework, use cases scenarios have been developed. The scenarios provide a narrative view of how key actors interact with the UNSDI to achieve specific goals. Actor names such as standard coordinator and UNSDI manager have been used to aid clarity. The actors and their roles and responsibilities need to be determined in a follow-on activity, that established the architecture itself under formal governance arrangements.

It should be noted that the scenarios **are illustrative only** and have been developed based upon articulated requirements of business needs. The scenarios do not represent complete requirements but instead illustrate key representative aspects of the governance framework. Additional scenarios can be developed at a later date to validate the use cases and by inference the notional architecture.

The use cases focus on the governance functions of the system as the end-user use cases for SDI are pretty well established. The use cases cover

Inter-SDI package:

- Creation of Humanitarian SDI, a UN SDI instance

Intra-SDI package:

- Creation of a data product specification for transport data
- Identification of authoritative data source
- Service profile discovery and implementation

Use cases scenarios illustrate aspects of the UNSDI capability that the work-plan proposes to build. The scenarios assume that certain capabilities of the UNSDI (primarily overarching governance UNSDI governance framework) are in place. These overarching mechanisms are referred to in the scenarios in order to provide context.

Use cases scenarios will need to be more fully elaborated once the principles for adopting this approach have been approved by the UNSDI and the use case models have been more elaborated in more detail.

8.1.2.1 Scenario 1 - Establishment of a humanitarian SDI

i. Background and Context

OCHA has been tasked with Cluster information management responsibilities at the country level. A significant dimension of this responsibility relates to geospatial data management and provision functions that need to be provided.

In order to meet its geospatial data Cluster Information Management obligations OCHA as well as to provide a shared platform for creation and management and sharing of geospatial data for emergencies OCHA proposes to develop a humanitarian SDI (HUM-UNSDI) under the umbrella of the UNSDI.

ii. Initiation of the HUM-UNSDI

Following consultation with key humanitarian actors, a proposal for the creation of a HUM-UNSDI is submitted to UNSDI Board by UNOCHA on behalf of the stakeholders in the HUM-UNSDI

The UNSDI Board approves the creation of a HUM-UNSDI. The UNSDI Manager advises the UNSDI registry administrator (who managers the key UNSDI registers and registry) of the change and a new SDI record is added to the register of SDIs

OCHA develops a project proposal for the creation of the HUM-UNSDI based upon version 2.5 of the UNSDI Architecture that was downloaded from the relevant register.

In accordance with the governance template contained in the architecture, a decision is taken by the community to appoint a HUM-UNSDI manager. OCHA is duly appointed to lead the HUM-UNSDI initiative. In accordance with the TOR for this role OCHA established the following HUM-UNSDI registers all of which were ‘owned’ by virtue of its role as SDI coordinator

iii. Hum-UNSDI Registers

- Register of HUM-UNSDI participants and their roles (i.e. those agencies that were signatories to the standard UNSDI MOU and to the HUM-UNSDI MOU. and the roles that they performed
- Register of data models – being developed

- Register of data modellers and initiatives
- Register of community vocabularies
- Register of service conformance profiles
- Register of services instances

iv. Register and registry management

Following community discussion and based on established USDI governance policies it is decided that:

- The management of 'SDI participant register' is delegated to the UNSDI registry manager who manages the registries of participants in other SDI instances as well as participants in the UNSDI. The register is therefore stored in the primary UNSDI registry.
- The register of HUM-UNSDI services (management of which has been delegated the UNSDI registry manager) is managed using the Geonetwork services registry. This registry is used to manage the service registers of the other SDI instances established under the UN umbrella
- a single registry would be created to store the other registers required by the HUM-UNSDI and that management of the registry would be delegated to Agency X.

v. Control Boards and Submitting organizations

Control Boards and submitting organisations for the new registers are determined in accordance with the guidelines and governance policy rules contained in the SDI architecture template.

Following community discussion, the following key SDI governance roles were assigned to specific agencies based on the template provided in the UNSDI architecture V2.5:

- Standards Coordinator Data (SCD) – Agency A
- Standards coordinator Services (SCS) - Agency B

vi. HUM-UNSDI scoping

Having established the governance roles and associated mechanism (registers and registries) the HUM-UNSDI project focuses on scoping the HUM-UNSDI in terms of data and functionality.

vii. Functional requirements

Using the UNSDI architecture V2.5, the community identified key functional requirements and necessary components of the HUM-UNSDI, namely:

- A portal to provide:
    - access to registries - of service instance (for general users) and other registries (for specialised community users) Web-mapping functionality to view sources of discovered data
    - to configure automatic updates for end users from capable data access services
- A number of registers (outlined previously)
- A number of web services:
    - Basic map portrayal services

- Transactional data access services to enable bi-directional synchronisation of field and centralised copies of geospatial data (e.g. gazetteer and administrative boundaries)
- Orchestration services that integrate and process data from several sources to generate automatically updated situation reports

Reference implementations were reviewed to identify appropriate commercial and OSS components to meet these functional requirements. The reference implementations also highlighted the need for the development of specialised service orchestration functionality.

viii. Data requirements

In order to determine data requirements for the HUM-UNSDI a humanitarian user group was formed. This group confirmed the recommendations of the OCHA GIS and Geospatial Data Management Policy regarding the key data sets required for humanitarian response

THREADS OF THE STORY CONTINUED…….

The following scenario threads trace specific aspects of data and service design and development process necessary to build the content and delivery elements of the HUM-UNSDI. The scenes are intended to illustrate key dimensions of intra-SDI governance.

8.1.2.2 Scenario 2 - Data Product Specification - Transport data modeling

The Standards Coordinator for data (SCD) creates a number of thematic data teams including one for transportation and appoints a team leader.

The transportation team leader first identifies relevant modeling initiatives, models and modelers that exist within and outside of the UNSDI. She searches the data model, UNSDI participants register (to identify data modelers), vocabulary, reference implementation registers using the search term 'transportation'
The search reveals:

- a transport data model (UNSDI-T) developed by WFP to support the standardized implementation of transport data storage models in GIS
- external transport modeling initiatives including an INSPIRE transport data specification development initiative
- an draft INSPIRE transport data product specification
- several UN agencies working on data modeling of rivers (part of the conceptual transport data model)

She invites a number of data modelers to join the transport data modeling team
Based on UNSDI data modeling guidelines set by the [Standards coordinator Data] (based on INSPIRE data product specification methodology) is used:

An early draft of the INSPIRE transport data product specification together with the UNSDI-T model are reviewed as candidate standards.

A review of the HUM-UNSDI reveals that it could not be adopted for the following (indicative) reasons:

- Scope is too broad as it includes features that are included in other UNSDI data model packages
- Scope is too narrow in other dimensions in that it does not address transport realities in contexts outside of Europe e.g. sub-Saharan Africa
- Data model structure and vocabularies are too detailed for practical application in emergency settings

The team therefore decides to adapt the data model using the proscribed methodology), comprising the following steps

- Articulation of user requirements through use cases and application scenarios obtained from a broad range of domain experts, and end user of both he information products and applications that produce them
- Gap analysis to determine unmet requirements and to meet them
- Modification of the data product specification:
    - Modification of the conceptual data model using (in UML) using a standard profiling technique informed by the UNSDI-T data model
    - Modification of the transport feature catalogue
    - Modification of the application schema (expressed in GML)
    - Creation of reference implementation in the form of Geodatabases for users wishing to adopt the data model as a storage model
- Test and refinement of the models

The Transport data product specifications and its key facets, (the conceptual model, application schema, features catalogue and reference implementations) are published to the relevant registers.

8.1.2.3 Scenario 3 - Authoritative sources – Administrative boundary data

This use case is intended to illustrate how the technical governance framework should support the resolution of a community assessment and decisions making-process regarding the identification and rationalization of the generation, management and delivery of core UN data sets that required for multiple SDI contexts.

This scenario will need to be elaborated through stakeholder input.

8.1.2.4 Scenario 4 - Service design through profiling

This scenario is intended to illustrate the process of developing a service profile based on specific user defined data needs. Key steps in the scenario are;

- Based upon data product specifications provided by Standards Coordinator – Data (SCD), the Standards Coordinator Services (SCS) commences the process of developing a service specification to deliver the data
- SCS discovers existing service specifications used elsewhere in the UNSDI using the register of registers and the service profile register
- SCS assesses profiles and determines that specific constraints need to be placed on the service metadata to ensure that a required application (orchestration service) is able to query and filter data coming from a specific service type
- The SCS develops a profile and publishes a draft in the register

- A services publisher develops a test service based upon the profiles and conformance tested using machine readable profile obtained from the register
- The profile is refined to address semantic and technical issues and tested again
- Following successful testing of the test service a production profile is published to the register

8.1.2.5 Scenario 5 - Service instantiation - profile discovery and implementation

This scenario is intended to illustrate the process of discovery of service profiles by a service and the development and publication of an instantiation of the service.

A geospatial data manager in a UN agency wishes to publish security incident information to the recently established humanitarian SDI.

The geospatial manager, using the register of registers, registers of services profiles and data models finds that there is a service profile that meets his need (a generic WMS profile fro time-enabled point-based humanitarian information. There is no existing data model so the manager decides not to develop a data model for the service.

The manager also discovers a reference implementation for the generic WMS using OSS. Them manager obtains the OSS tools to implement the service, builds a service and tests the service using the machine readable service profile register and then publishes his service to the humanitarian SDI using GeoNetwork

8.2 Information viewpoint

- Develop and adopt a Data Model harmonization process and exercise this with the identified priority baseline data sets.
- Identify the set of registers that much be maintained
- Delegate responsibility for maintaining all baseline resources

8.3 Computational viewpoint

Data access, registry + machine-mediate use (deliberately leave user applications out of scope to simplify and minimize bias)

8.4 Engineering viewpoint

Challenges, options (e.g. using Google infrastructure for baseline data, warehouse vs point of truth , role of caching nodes)

8.5 Technology viewpoint

Open Source reference implementation, onus on proprietary tools to demonstrate how they comply to requirements or fit in as a logical extension.

9. Governance actors, responsibilities and institutional mappings

9.1 Actors and Terms of Reference

Having identified governance Use Cases and actors, Terms of Reference (TOR) for key actors will need to be defined. One of the major tasks of governance actors is the management of registers. The following section describes the process of mapping roles in registry management to organizations.

Governance of the governance establishment process (e.g. determining authority delegation decision rights) will need to be determined as part of the governance framework initiation.

9.2 Mapping roles to organizations

Registers are the key enabler to interoperability in a distributed environment as they enable resources to be published, discovered and used. A key responsibility of the governance actors will be to manage the registers that list the artifacts (agreements and their implementations) that underpin information interoperability.

As outlined in the ISO 19135 conceptual model for registration of items of geographic information, there are a number of roles in managing registers. It is clear that in most cases the 'owner' of a register will be the actor fulfilling the governance role being enabled by the register. However, other roles such as register and registry manger (delegated by the register owner), submitting organization (organizations that provide requests to changer register content) and control bodies (to adjudicate on change requests) need to be assigned to individuals and organizations so that governance can be implemented. These (ISO proscribed) register management roles are:

- **Register owner** – typically the organization that is responsible for the governance role that
- **Register manager** – agency or person to whom responsibility is delegated. It is anticipated that register management will often be delegated to specialized actors
- **Registry manager** – agency responsible for managing the information system in which the register is held. It is likely that many registers will be managed within a single registry. It is also anticipated that the UNSDI will comprise multiple distributed registers e.g. multiple registers containing service metadata, multiple registers containing data models
- **Submitting organization** – submitting requests to change registers (add edit delete items)
- **Control body** – an appointed panel of advisors who adjudicate on submissions for register changes from submitting organizations

The assignment of roles will need to be carried out following the elaboration of an architecture together with the governance use cases and actors that are identified. Governance process policies will need to be established to govern the process of role assignment, delegation etc.

10. Project work-plan

10.1 Overview

A work-plan is proposed that comprises a series of discrete but related projects that meet what are understood to be the priority needs of the UNSDI stakeholder community. The projects build different dimension of the UNSDI capability. These discrete projects also enable the stepwise creation and evolution of the governance capabilities that will be developed in parallel. This approach reflects the resource constraints, and tests the concept of adaptive governance as the infrastructure grows

Critical dependencies between projects will need to be analyzed in more detail to identify critical path tasks and to ensure projects and tasks are implemented in correct sequence.

10.2 Principles

The principles of the work-plan are as follows:

- Establishment of UNSDI by means of a series of sub-projects within the UNSDI project, that:
    - Validate principles of the UNSDI
    - Act as test case for flexible extensible governance framework
- Establish core initial capability
- Establish, adaption and evolution mechanism for the UNSDI that transcends the implementation context i.e. as the UNSDI implementation context moves from project to programme and possibly
- Stepwise approach to development of UNSDI capabilities and components together with the necessary adaptive governance capabilities

10.3 Scope of the work-plan

The work-plan focuses on five areas:

- **Architecture** -The creation and maintenance of a UNSDI architecture to support SDI creation
- **SDI development** - The creation of SDI instances that are nodes/systems within the UNSDI and the publishing of standardized data and services
- **Tools** - SDI 2.0, an SDI toolset with FOSS reference implementation
- **Data models** - development and harmonization and deployment of data models for priority geospatial data sets and the
- **Registry of SDI resources** - Implementation of registry for the management of SDI resources

10.3.1 UNSDI architecture project

Create, publish and create capacity to manage a coherent UNSDI architecture to test and support the process of extending and enabling operational SDIs to align their activities. The architecture will be developed based upon common elements of the requirements for the SDI instances that are created (sub-project 10.3.2).

As there are important interdependencies between the elaboration of the architecture and the creation of SDI instances implementation of these two projects will be need to be well coordinated.

10.3.2 Creation of UN SDI instances

The aim of this project is to establishment of a number of representative (UN)SDI instances to meet clearly articulated business needs of specific communities and through their implementation, demonstrate interoperability between the SDIs. In addition to components of the overarching UNSDI (e.g. aggregation services) that may be required, SDI instance test cases should reflect the widely divergent needs of different communities within the UN. Suggested test cases should include:

- Local emergency response SDI – e.g. to humanitarian SDI
- Global monitoring SDI e.g. environmental UNEP
- Capacity building e.g. e.g. the proposed Pakistan Provincial Mapping of UN Activities project – a potential country capacity building and NSDI development project

With regard to populating SDI with service and data the following provides an indicative process:

- Define core UN data access services – required across (UN)SDI instances based upon clearly articulated end-user demand e.g. International and Second Level Administrative Boundaries database and global, 30m DEM
- Define additional data sets required within each SDI instance e.g. humanitarian response base datasets coverage at 1:250,000 scale for countries vulnerable to disasters
- Establish data product specification development teams in accordance with agreed policies and working to agreed standards
- For the preceding three steps it is re recommended that an approach such as the INSPIRE "Methodology for the Development of Data Specifications" be used to capture end user data usage requirements through use cases and applications scenarios[12]
- Conformance profiles services developed for specific usage contexts
- Mapping of data models to service profiles e.g.
- Services instantiated, tested and deployed

Registers of artifacts (together with one of more registries to operate them) will be required to support this process (see section 10.3.5).

As noted in the preceding section there are critical dependencies between this project and the architecture project as the abstracted common requirements of the test case SDIs together with the requirements for the broader UNSDI will be used to define the architecture. In turn., the architecture will be used as a template for SDI creation. It is therefore clear that the two projects need to be well synchronized .

10.3.3 SDI 2.0 – a reference implementation

In parallel with the SDI development, the SDI 2.0 project is proposed. The aim of this project will be to develop a coherent collection of SDI tools, supported by a Free and

12

Open Source Software (FOSS) reference implementation. The proposed SDI 1.0 is a collation of independent best practice whereas SDI2.0 is designed to develop a toolset that support SDI implementation and operation. Critical elements of the project would include:

- Development and implementation of a FOSS engagement strategy and in particular a formalization of relationships with key FOSS SDI partners such as OSGEO
    - Reference implementations supported by FOSS and the ESRI environment
    - Create a test bed to support ESRI and other geospatial technologies reach compliance with common level of interoperability. (UN designs goals and pays for test bed and maintains control of interoperability agenda)

10.3.4 Modeling and harmonization of priority UN data sets

1. Create data model across key priority data set identified by OCHA geospatial policy document (UNOCHA, 2007) (clause 19). A key dimension of this project would be achieving harmonization with INSPIRE through the involvement of the UN in the INSPIRE data modeling process. This sub-project would have the following key outcomes:

- Harmonized data models for key data sets
- Identification and validation of critical cross domain data model harmonization methodologies leading to UN sponsorship as international standards through partnership with relevant bodies

The establishment of vocabularies (including governance of vocabularies) and determine relationship between them and data models in which they are used. Where existing vocabularies are not governed, governance will need to be developed

10.3.5 Registry creation

- Establish registries capable of managing diverse range of artifacts and the relationship between them
    - Sponsor a common set of register profiles required for an SDI e.g. A register of each set of actors required to manage SDI including for example:
        - Register of agencies
        - Register of policies (data sharing olicies, governance policies, SDI participation policies, technology policies)
        - Register of agreements (service level agreement, MOU for SDI participation, data licenses)
        - Register of data product specifications (including data models and feature catalogues)
        - Register of service specifications and profiles
        - Register of service instances
    - Creation and registration of resources and actors.

10.4 Work-plan implementation issues

- Initially, cannot build too many dependencies on other SDI initiatives and their governance arrangements

- Need different institutional configuration and resourcing for kick start and for long term governance as the infrastructure and resources grow
- Accept that parallel developments need to occur that need to be synthesized at a later date to prevent too many dependencies and risks
- Identification of project dependencies and critical path is necessary as well as strong project management to ensure correct sequence of project implementation

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Appendix 2 - Acronyms and abbreviations

TO BE COMPLETED…

ebXML - Electronic Business using eXtensible Markup Language, - a family of XML based standards sponsored by OASIS and UN/CEFACT whose mission is to provide an open, XML-based infrastructure that enables the global use of electronic business information in an interoperable, secure, and consistent manner by all trading partners.

FOSS - Free and Open-Source Software

ISO - International Standards Organization

IEEE - Institute of Electrical and Electronics Engineers, Inc.

OGC – Open Geospatial Organisation, Inc.

OSS - Open-Source Software

UDDI - Universal Description, Discovery and Integration (UDDI) - a platform-independent, XML-based registry for businesses worldwide to list themselves on the Internet.

UNGIWG – United Nations Geographic Information Working Group

UNSDI - United Nations Spatial Data Infrastructure

XML - Extensible Markup Language - a general-purpose markup language. It is classified as an extensible language because it allows its users to define their own tags

GCMD – Global Change Master Directory see http://gcmd.nasa.gov/