Agenda

- Harmonization principles for SDIs
- Development stages and examples:
  - assembly, transformation, validation and publication
- Experience of partners
  - Finland examples
- Comparisons to SDI’s overseas
- Risks and Mitigation Strategies
- INSPIRE trends
- Consuming INSPIRE
  - Reading
  - Building value added services

INSPIRE - Goals

- Assist EU environmental management
- Extend Member States’ SDIs using:
  - Common data model
  - Open standards
- INSPIRE SDI should:
  - Combine spatial data from different sources
  - Share spatial data between public authorities

INSPIRE - Challenge

- You want to meet INSPIRE data provision requirements, but your data is organized rather differently

Harmonization concepts

- Harmonization: implied INSPIRE requirement.
- Disparate sources must be mapped to a common destination data model to support integration
- Core to the harmonization workflow is a process called schema mapping.
- Delivered by services based on open standards
**SDI Harmonization Approach**

Typical stages:
1. Evaluation
2. Assembly
3. Transformation
4. Validation
5. Publication

*Spatial ETL* concept (Extract, Transform and Load), as applied to INSPIRE SDI’s

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**Evaluation**

- Assess destination schema and data requirements
- Assess source datasets and schema
- Consider fundamental differences in representation, resolution
- Closely inspect actual representative datasets

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**Data Assembly**

- Assess the diversity of source data types involved.
  - vector, raster, CAD, GIS, database, text, XML, web, 3D, sensor and non-spatial
- Address format and semantic translation requirements
- Decide how to perform necessary joins
  - ID joins, spatial relates, nearest neighbor, one to many relationships

*Goal is to build a data structure to correspond with INSPIRE requirements*

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**Translation**

*FME supports reading from a wide array of data formats and types*

- 300+ formats, with more added each year
- CAD, GIS, XML, raster, database, non-spatial, 3D
LGII – Lithuania Geospatial Portal Translation Support

File Formats:
- AutoCAD DXF / DWG
- ESRI Personal Geodatabase
- Shape
- MapInfo TAB
- Microstation Design V8
- GML
- GIF / PNG
- JPEG
- TIFF
- ERDAS IMG
- ECW

Coordinate systems:
- LKS94
- WGS84
- ETRS89
- 1963
- Pulkovo 1942
- UTM (34, 35 zones)

Other data sources:
- WFS
- SDE
- Files

LGII Highlights

- Support for diverse range of formats required by member agencies.
- Solution combines FME, ArcGIS and con terra tools
- Conversion rules critical for harmonization process
- Centralized workflow and common data model simplified source to destination mapping
- FME Server supports sharing for LGII partners, business, education and research institutions, NGOs
- LGII provides real value with broader access to seamless data via a common INSPIRE schema

LGII Geoportal Central System Components

- con terra’s SDI Suite
  - Content and user management
  - E-Commerce and accounting
  - Reporting
- ArcGIS Server
  - WxS services (WMS, WFS, WCS)
  - Catalog services (CAT)
  - Metadata harvesting (CSW, WAF)
  - Spatial data editing, redlining functionality
- FME Server
  - Data conversion for download
  - Transformation between data schemes, data models and formats

Data Transformation - Schema

- Reshape source data to match required destination schema
- Schema mapping
  - feature type
  - attribute name
  - new attribute creation
  - code lists
  - conditional value mappings
Data Transformation

Schema Mapping in FME

Feature Type Mapping in FME Workbench

Attribute Mapping in FME Workbench

FME Data Model Restructuring: Attribute Names & Values

- Value Mapping

FME SchemaMapper: INSPIRE geographic names

Names mapping

FME Workspace

Name & value mapping

INSPIRE Pilot: Swedish Protected Sites

- Swedish EPA project with Metria of Sweden
- Read from 3 different data sources (pilot):
  - Swedish Protected Areas
  - Helsinki data commission (Helcom)
  - European Natura2000 habitats
- Perform required joins, generate IDs
- Transform to INSPIRE schema
- Load INSPIRE-like staging database (PostGIS)
- Publish INSPIRE web services based on staging database
Helsinki Commission Source Data

Schema Restructured for Loader to Staging Database

Results in Staging Database

FME Import to Staging Database: Swedish NVR Importer

* Data provided by Lantmäteriet, the Swedish mapping, cadastral and land registration authority

Protected Sites Schema Mapping:
NVR to INSPIRE

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| source datasets to INSPIRE using FME Server.

Swedish Protected Sites Update

- Swedish Environmental Protection Agency
- **Production system for download services** following on the successful pilot last year.
- Metria hosts the protected sites view services.
- Metria performs schema mapping for five protected sites source datasets to INSPIRE using FME Server.

Transformation: Geometry

- Non-spatial to spatial
- Geometry extraction (spatial to GML)
- Representation transform: CAD drawing lines with labels to GIS polygonal features with attributes
- Coordinate System Reprojection (ED50 to ETRF89)
- Simple to complex geometry
  - Source point and polygon data to multiple geometric representations (city as point / area, river as line / area)
  - Generalization and interpolation
    - Highly granular national and regional datasets often require thinning to be usable on pan-European scales

Validation

- INSPIRE schema validation (xsd's)
- Data integrity
  - Unique IDs
  - Geometric integrity (closed polygons)
  - Null values (nullable?)
  - Valid values: ranges and domain codes
  - Data gaps
  - Bounds
  - Network integrity
  - Custom validity rules specific to domain

Ensure data quality throughout the data transformation process.
Swedish Transportation Administration:
Validation

- System supports propagation of municipal and regional road data to national dataset
- Data model transformation and QC to translate 2.5 million road links into NVDB
- Transform between NVDB and INSPIRE
- Workflows automated by FME and FME Server
- Validation key to support upload services

Publication

- Produce INSPIRE compliant GML
- Provide discovery, view or download services, for WxS, GML and other desired formats
- Publish with FME Server or integrate with your geo web server of choice:
  - ArcServer (ArcGIS for INSPIRE)
  - Deegree
  - GeoServer
  - MapServer
  - Spatial Data Services

How to make data most accessible?

- Support for mandated open standards and OGC services
- Support for defacto industry standards, proprietary and legacy agency systems
- Possibilities for Invoke Spatial Data Services as a bridge
  - accepts user request
  - queries required INSPIRE OGC services
  - provides desired web service (KML, PDF)

Swedish Transportation Administration:
Invoked Services

- Supports estimation of new road costs related to archeological and protected sites
- Site potential using terrain model and historic coast lines
- WFS Sources:
  - The Swedish Transport Administration roads
  - Swedish EPA Protected sites
  - Swedish National Heritage Board Archaeological findings
- Result: PDF showing site potential
Publication: WPS Transformation Services

- Pilot project with National Land Survey of Finland by SpatialWorld
- WPS from Deegree
- FME Server integrated at the back end as the transformation engine
- To publish a new WPS service just author a workspace
- Can be as simple as one transformer (Input > Bufferer > Output)
- Or anything else you can imagine – the sky is the limit! (chain WPS’s)

Harmonization Stages: Geographic Names Example

- Technical University Of Munich
  - XMI mapping of UML schema transformation rules
  - Maps between AAA and INSPIRE data models
  - Uses FME to perform schema mapping based on XMI
- Nature SDI: Datasiel, Liguria Region, Italy
  - FME used for data harmonization and loading a staging database
  - Generates INSPIRE compliant protected sites GML for publication via WFS
- Croatian NSDI: Geoportal
  - By State Geodetic Administration (SGA)
  - Central register of base map, ortho, spatial units, cadastre
  - Database of geodetic control points
  - FME used primarily in data migration and updates
Example INSPIRE Solutions by FME Partners

- INSPIRE Solution Pack from con terra (more than 20 implementations across Germany and Europe)
- Metria, Sweden (Protected Areas Pilot; Swedish Department of Transportation)
- HNIT Lithuania (LGII)
- Technical University of Munich (multiple INSPIRE projects)
- AED Sicad (NAS to INSPIRE conversions)
- Spatialworld, Finland (National Land Survey)

con terra – FME INSPIRE Solution Pack Highlights

- Simplify data transformation and schema mapping for ArcGIS for INSPIRE
- Predefined FME Workbench templates help jump start the data migration and Harmonization process
- Connect your existing databases to the standardized ESRI INSPIRE Geodatabase
- Automate data load and update processes
- Quality assurance and metadata
- Publish once and use many times

Experiences from Finland

- GML to Shape conversion
- Data upload and validation

- What is Inspire?
- Annex I
- Annex II
- Annex III
- Services
- Spatialworld Oy
- Cleaning up data
- Data harmonization
- Data upload
- Publishing data

Problems in consuming Inspire data
- GML can be scary
- Nested structure vs flat structure
- Not many software can consume Inspire data
Reading Inspire GML

Renaming attributes

Get municipalities
**SDI Risks and Strategies – Resource Management**

**Risk:** Unknown demands on resources and requirements by users.

**Strategy:** Resource Management
- Clearly define users, domain experts and IT resources involved
- Separate schema mapping models from code
- Research user requirements and feed into design
SDI Risks and Strategies – Staged development

Risk: Complex system requiring large scale investment and long timelines before benefits are seen.

Strategy: Staged Development
- Small pilots to assess technical and business risks
- Identify targets for easy early value demonstration
- Test end to end with real data early to validate design and feed back into next phase of development
- Solicit responses from user community
- Evaluate how system supports existing workflows, use cases and user applications

Comparison with Foreign SDIs
- Canada: CGDI hosted by GeoConnections
  - Canada’s national geoportal
- USA: NSDI by FGDC
  - Federal government data distribution (fgdc.gov)
  - Free data available in a diversity of forms and formats
- Abu Dhabi SDI
  - Complex state level geoportal supporting 49 agencies (everything from cadaster and utilities to police)
  - 3D data model
  - FME used to support data upload from agencies, validation, synchronization, automation and apply ADSDI data content standards on incoming spatial data
- Aktiven.bg
  - Crowd sourcing for infrastructure problems
- Pan-National SDI’s: PCGIAP (Asia/Pacific), PC IDEA (Americas), UNGI, Africa Clearing House, GSDI

Comparison with Foreign SDIs
- Other SDI’s mostly national or region based
- Tend to focus on catalogs, metadata, and supporting standards
- Often less restrictive in terms of actual data content, schema and services
- Actual data and data content standards defined by authoring or coordinating agencies
- INSPIRE seen as leading the way - eager to follow lessons learned

INSPIRE Trends
- Integration between proprietary and open standards – especially as deployment moves to regional and local agencies
- Shift away from strict SDI focus and increased focus on how clients can consume INSPIRE services / GML
- More opportunities for spatial data and invoke services to bridge this gap
- Examples: machine to machine communication to provide seamless support for client application streams such as KML, PDF and open layers
- Success = User isn’t aware they are accessing INSPIRE
INSPIRE Compliant GML – Now What?

"How is anyone going to use INSPIRE?"
- FME allows you to consume INSPIRE compliant GML as well as create it.
- Why not build value on the web services every one else is investing in?
- Extract and flatten complex INSPIRE structures for use within your GIS applications

Add spatial data services to transform INSPIRE into data streams suitable for widely accessible client applications (PDF, KML, GeoJSON)

XML vs. Relational

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<th>Attribute1</th>
<th>Attribute2</th>
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</table>

Reading INSPIRE GML: with flattening
**Output to PDF**

**FME Tools for INSPIRE**

- Format translation
- Schema mapping
- String and list parsing and manipulation
- Data validation
- Database loading and extraction
- WFS, GML, XML: reading, validation, publication
- Web services: WFS, WMS, integration with others
- Metadata support
- Enterprise services with FME Server

**FME Tools for INSPIRE XML**

- GML reading and writing (3.2.1 and earlier)
- XML Reading – read virtually any XML and extract features
- XML Processing – validate, format, and update XML
- Geometry Extraction (features > GML objects)
- XML Writing - Write XML or GML no matter how complex
- XMLTemplater
  - FME merges attribute values into a template structure
  - Template per feature type and dataset
- XML Validation – validated to ensure compliance with INSPIRE schemas

**Complex GML Geometry: CityGML**
FME Tools for INSPIRE

FME provides a full range of tools for INSPIRE, our partners provide complete solutions:

- Data modeling interface makes it easier to handle schema mapping — no coding required.
- Automated workflows save time in creating and maintaining transformation processes.
- Self-documenting workspaces ease collaboration.
- Easily integrates with INSPIRE-compliant services:
  - leading OGC servers such as Deegree, MapServer and GeoServer
  - Esri ArcGIS Server
- Scalability and performance support quality of service requirements.

Summary: Challenges

- Disparate data sources and data models implied by range of INSPIRE themes
- Diverse range of skills required
  - Authors need knowledge of data, IT and complex INSPIRE rules
- Complexities in transformation from object to relational model and back
- Quality of service requirements
- Validation / QA
- Security

Summary: Solution Approaches

- SDI planning is informed by Harmonization principles
- Typical stages for SDI projects:
  - Evaluation, assembly, transformation, validation and publication
  - Examples demonstrate tools and approaches for putting these development steps can be put into practice
- Important to mitigate risks inherent in INSPIRE
  - Resource management, staged development
- INSPIRE trends
  - Integrating between open and industry standards
  - Consuming INSPIRE data
- Need for spatial data services to support common clients
- FME provides tools to support INSPIRE, our partners apply these to provide solutions

Thank You!

Questions?

For more information:

dean.hintz@safe.com
Safe Software
www.safe.com/inspire
www.fmepedia.com (examples)

lassi.tani@spatialworld.fi
Spatial World Oy