

# INNOVATE ISO FOR EPA AND IDAHO FINAL REPORT

**Date:** 2/27/2014

**Agreement Number:** G12AC20135

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## EXECUTIVE SUMMARY

Innovate! Inc. (Innovate) collaborated with the US EPA Environmental Dataset Gateway (EDG) and the State of Idaho – INSIDE Idaho metadata clearinghouses to evaluate the requirements for transitioning from FGDC CSDGM metadata to ISO 19115. Both organizations currently contribute metadata records to Data.gov and have many years of history in metadata creation and development. This project investigated the steps required to transition the EDG and INSIDE Idaho to ISO metadata. The outcomes of the project included:

- The Metadata Transform Test utility, a web application that provides a common testing platform for a variety of metadata transformations:
  - FGDC CSDGM format to ISO 19115, 19115-2, and 19110
  - ArcGIS 1.0 format to 19115 (experimental)
  - 19115, 19115-2, and 19110 upload and validation
- Presentations at industry conferences
  - FGDC Metadata Working Group
  - Esri International User Conference in San Diego, CA
- A new public website dedicated to sharing metadata resources
- Publicly accessible documentation and video tutorials
- A major EDG upgrade to Esri Geoportal version 1.2.4
- Concrete plans to upgrade the EPA Metadata Editor (EME) to accommodate ISO metadata
- Support for ISO metadata within the INSIDE Idaho development servers for their catalog database and website including the ability to leverage NOAA-produced xml-transformation and style sheet files

Innovate staff invested a significant amount of time to understand the intricacies of ISO metadata—an investment that will allow Innovate to help other organizations transition smoothly from FGDC CSDGM to ISO.

## PROJECT NARRATIVE

In this project Innovate developed a recommended migration route from FGDC CSDGM metadata to ISO metadata for the US EPA (<https://edg.epa.gov/>) and the State of Idaho metadata clearinghouses (<http://insideidaho.org/>). We evaluated the current options for transitioning to ISO, researched the future of ISO from the perspectives of various organizations, laid concrete plans for long-term transitional strategies, developed interim solutions, transitioned sample records using these interim solutions, and shared our results at industry conferences.

Both the EDG and INSIDE Idaho are robust metadata clearinghouses that store metadata adhering to the FGDC CSDGM standard. Each organization has a desire to identify best practices for migrating to the ISO 19115 metadata standard. Both organizations have a well-documented process for creating, sharing, and leveraging FGDC CSDGM metadata. Each group desired to investigate how best to streamline and facilitate creation, query, and display of ISO metadata, without re-architecting current systems. Making data easier to document will lead to more data being made available via these and other metadata clearinghouses.



## DEVELOPMENT OF CSDGM TO ISO TRANSITION STRATEGY

In the first phase of this project (Task 1), Innovate collected information about the EDG and INSIDE Idaho. Innovate staff organized Project Kickoff and Key Information Gathering meetings (onsite and via webinar) with subject matter experts from each clearinghouse. These meetings assessed the clearinghouses' current status, identified project goals, and predicted challenges. Over the course of these meetings, Innovate staff met the following objectives:

- Developed a list of participants for each clearinghouse
- Developed a list of subject matter experts for each clearinghouse (website architecture expert, metadata collection expert, outreach expert, etc.)
- Created list of overall desires, outcomes, and stumbling blocks as identified by subject

matter experts

- Gathered information on previous ISO metadata activities at the clearinghouses
- Provided education on methods available to convert FGDC metadata to ISO metadata records

After concluding the information-gathering meetings, Innovate conducted an in-depth examination of the current business processes and technical architecture of the EDG and INSIDE Idaho (Task 2). Innovate worked with clearinghouse staff to diagram the architecture, specifically the touch points of the clearinghouse to the individual metadata records, databases, and other components that make up the search mechanisms of the site. This will ensure that when the transition to ISO conversion occurs, the clearinghouse website will continue to function. The following steps were taken to accomplish this task:

- Met with subject matter experts to develop website architectural diagrams for search and retrieval of metadata records
- Met with subject matter experts to determine existing data flows for metadata coming into clearinghouses
- Determined existing data outflow for data going out to Data.gov and other locations
- Determined other data flows that are supported by the existing metadata

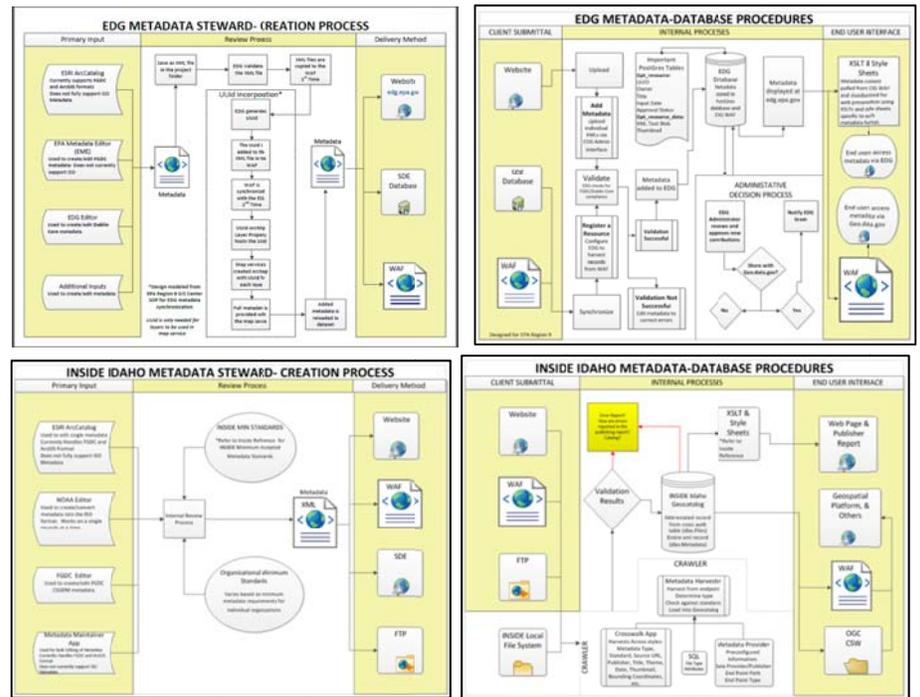


Figure 1: Architecture diagrams for EDG and INSIDE Idaho (see Appendix for larger versions)

Innovate staff created architecture diagrams for each clearinghouse using Microsoft Visio software (see Figure 1 and Appendix). The diagrams show how metadata are processed both by the data steward and the clearinghouse. These diagrams were used to identify critical components affected by the transition to ISO metadata.

## ESTABLISHED EXPERTISE IN CSDGM TO ISO CAPABILITIES

### BUILDING UPON NOAA'S EFFORTS

Innovate staff invested a significant amount of time to understand the intricacies of ISO metadata. The Innovate team leveraged the valuable work done by NOAA by attending their online ISO training sessions, utilizing online tools and documents for transforming and styling XML, and meeting individually with Jacqueline Mise of NOAA to discuss techniques for transitioning to ISO. The Innovate team worked closely with NOAA to understand tools used for processing CSDGM and ISO metadata records. These tools included NOAA's online resource Docucomp (<http://www.ngdc.noaa.gov/docucomp/recordServices>), a web application designed to convert CSDGM records to ISO 19115-2, as well as commercially available software provided by Altova and Oxygen. These tools eventually served as the basis for Innovate's multi-standard transform web application.

### EXPLORING XML

This project required Innovate staff to delve into a wide variety of XML files while performing manual edits. We tested and gained proficiency in several XML programs:

- Docucomp
- Altova XML Spy
- Oxygen
- ArcGIS
- GeoNetwork Open Source

Docucomp and ArcGIS both offered strong editing capabilities, along with a few drawbacks. Docucomp provided a simple, user-friendly interface, but users needed to be aware of exactly which type of record they were working with and which type of record they were trying to create. For example, a Docucomp user could run into problems when working with a record in ArcGIS format. We were unable to tailor Docucomp's functionality in order to control the transformation for required business processes within the EDG or INSIDE Idaho. ArcCatalog provided a wide variety of metadata tools and transforms, but the namespaces used by ArcCatalog were problematic.

Given GeoNetwork's steep learning curve, XML Spy and Oxygen were our preferred XML editors when used in conjunction with the transformation files developed by NOAA. However, a

significant investment of time and effort is also required to gain proficiency in XML Spy and Oxygen—especially for those without previous XML experience. It is not realistic to expect data contributors to the EDG and INSIDE Idaho to work with either of these XML editors. In order to streamline data contributors' workflow, manual XML editing should be eliminated or kept to a minimum.

Due to the EDG's current configuration, it is not possible to validate ISO 19115-2 metadata records, and 19115 records required performing some manual edits. Innovate staff completed extensive testing to determine the source of EDG validation errors and to develop solutions to the most common errors. These solutions are detailed in the Help documentation produced for this project. As a result of this testing, the EDG team determined that it was necessary to upgrade the EDG to the latest release of Esri Geoportal; this upgrade was completed in January, 2014. The EDG is now running Esri Geoportal version 1.2.4. Thanks to the upgrade, the EDG can now be configured to accept ISO records. This process is currently underway.

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## TRACKING ESRI'S PROGRESS

Since the majority of data contributors to both the EDG and INSIDE Idaho use Esri products, it is important to keep abreast of Esri's latest metadata activities. With the release of ArcGIS 10, Esri's approach to metadata changed dramatically.

In ArcGIS 10, Esri made significant changes to their metadata workflow. Upon opening an FGDC CSDGM record in ArcCatalog, the user is prompted to upgrade the record. The upgrade process converts the FGDC CSDGM record to Esri's new metadata format: ArcGIS 1.0. The record can then be transformed within ArcCatalog and exported to a variety of formats. This solution is designed to provide one metadata editor that lets users author metadata content for all metadata standards. By working with all metadata in a single environment, ArcGIS users can have the same metadata experience across standards. This experience will remain constant despite ongoing changes to the standards themselves. The Innovate team met with Aleta Vienneau of Esri to discuss the long-term strategy for metadata in ArcGIS and how this strategy fits the needs of the EDG and INSIDE Idaho.

## PRESENTATIONS/OUTREACH ACTIVITIES

The Innovate team presented on this project at two conferences, including one major industry conference.

### FGDC METADATA WORKING GROUP

**Date:** June 19, 2013

**Location:** Webinar

**Presenter:** Dan Spinosa, Innovate

**Presentation available at:**

<https://www.fgdc.gov/grants/2012CAP/InterimFinalReports/135-12-2-VA-MetadataWG-20130619v3.pdf>

### ESRI INTERNATIONAL USER CONFERENCE

**Date:** July 9, 2013

**Location:** San Diego, CA

**Presenter:** Dan Spinosa, Innovate

**Title:** Best Practices of Metadata - Moderated

**Paper Session:**

Implementing ISO Metadata for EPA and Idaho Geospatial Clearinghouses

**Abstract:** Planning for, testing, and implementing a transition from the FGDC Content Standard for Digital Geospatial Metadata (CSDGM) to the International Organization for Standardization (ISO) metadata is a major task that involves a number of considerations. This transition at the clearinghouse level will play a key role in the National Spatial Data Infrastructure (NSDI) as US organizations adopt the latest ISO metadata standard. This project will identify a process, plan, and workflow for two major geospatial data clearinghouses transitioning from the FGDC CSDGM to the ISO 19115-2 metadata standard. Innovate! Inc. will leverage resources (personnel, tools, practices and content) from the US EPA Environmental Dataset Gateway (EDG) and the State of Idaho – INSIDE Idaho metadata clearinghouses in evaluating the requirements for transitioning to the ISO standard. This project will assist data contributors and clearinghouses since both may utilize tools such as ESRI's ArcGIS Catalog to edit metadata.

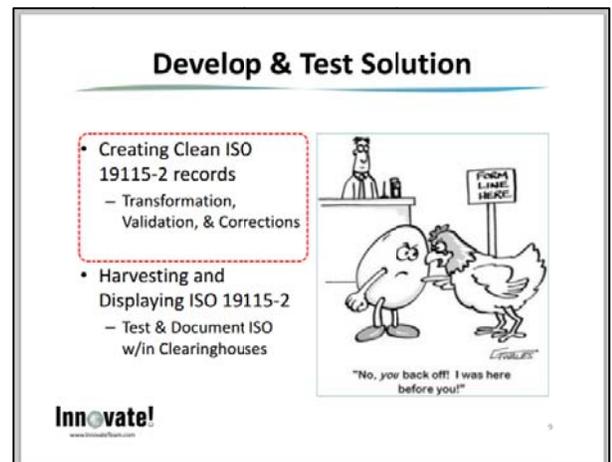


Figure 2: Slide from FGDC Presentation

## DEVIATIONS FROM THE ORIGINAL PROPOSAL

Generally Innovate did not deviate from the original proposal. Tasks 1 and 2 revealed a need to focus on technical aspects rather than policy or procedural elements. Both agencies desired to support the ISO standard though it was not formally stated in policy. Instead, support was limited by their metadata catalog systems and metadata publishing tools rather than restrictive policies. The results of Tasks 1 and 2 demonstrated the tight bond between authoring valid ISO metadata and cataloging those documents for search and display. As a result, staff focused on technical aspects of ISO translation and adapting existing business systems to support the standard.

## CHALLENGES AND SOLUTIONS

The transition to ISO is a complex process, and at this point ISO is still on shifting ground. The ISO standards are changing, the ArcGIS workflow for ISO is evolving, and clearinghouses do not all use the same ISO schemas. There is a lack of user-friendly ISO editing programs, which means that the transition to ISO is a daunting task for most GIS professionals. At this point anyone who wants to work with ISO must commit a significant amount of time to understanding the nuts and bolts of the standard and getting comfortable with XML.

### CHALLENGE: XML EDITING LEARNING CURVE

The process of learning to manually edit ISO records is not trivial. It requires a substantial knowledge of both the ISO standard and XML in general, along with access to and knowledge of appropriate XML editing software. Generally speaking, contributors to the EDG and INSIDE Idaho are accustomed to using intuitive metadata editors. Most EDG contributors create FGDC CSDGM records using the EPA Metadata Editor (EME), which provides a graphical user interface that eliminates the need for users to dig into XML. INSIDE Idaho contributors use a variety of editors and author data in both CSDGM and ArcGIS formats. It is not reasonable to expect metadata stewards to become XML/ISO experts in order to contribute ISO records to the clearinghouses. Therefore, new user-friendly ISO metadata editing tools need to be developed.

### SOLUTION: NEW ISO EDITING TOOLS

In order to maintain clearinghouse users' experience while transitioning to ISO, it will be necessary to develop new metadata editing software. EDG users will require a new ISO-compatible version of the EME. INSIDE Idaho users could also use an ISO-compliant version of EME or use the ArcGIS metadata editor included in ArcGIS 10 and higher.

As a direct result of this project, the EPA, in cooperation with Innovate, has committed to making the next release of the EME (version 4.0) compatible with ISO. The Innovate team is reimagining the EME to create a simplified, modern user interface to guide users through metadata creation and editing. The EPA recently upgraded the EDG to the latest release of Esri's Geoportal. The upgrade allows ISO 19115-2 records to be cataloged by the EDG. Now that the EDG is technically capable of accepting ISO records, the EDG team can move forward with the policy and planning aspects of the ISO transition.

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## CHALLENGE: DISCREPANCIES AMONG ISO SCHEMAS

At present, there is no single authoritative repository of ISO schemas, meaning that different ISO tools validate to different schemas. This may present a problem to clearinghouse contributors whose clearinghouses validate to different schemas than ArcGIS does. For example, the EDG currently validates to a different ISO schema than does the ArcGIS metadata editor. While the differences between schemas appear to be small and insignificant, the resulting problems disrupt business workflows and confuse and frustrate metadata stewards.

Official ISO schemas are currently found in several separate locations:

1. ISO repository for public available standards:

[http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO\\_19139\\_Schemas/](http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/)

Date of schemas: 2007-08-11

2. OGC schema repository:

<http://schemas.opengis.net/iso/19139/20070417/>

Date of schemas: 2007-04-17

Additional OGC schema repository: <http://schemas.opengis.net/iso/19139/20060504/>

Date of schemas: 2006-06-04

3. ISO AP schemas: <http://schemas.opengis.net/csw/2.0.2/profiles/apiso/>

Date of schemas: 2007-07-19.

The difference in the schemas located in the OGC repository is the GML versions. The version dated "2007-04-17" uses GML 3.2.1, while the version dated "2006-06-04" use

GML 3.2.0. The major difference is that GML 3.2.0 schemas are defined in the namespace <http://www.opengis.net/gml>, whereas GML 3.2.1 schemas are defined in the namespace <http://www.opengis.net/gml/3.2>.

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#### SOLUTION: ISO OFFICIAL SCHEMA REPOSITORY AND EDG UPGRADE

This situation should be remedied with the eventual release of “one true” set of ISO schemas with the release of 19115-1. Unfortunately the metadata community is dependent upon the ISO for this repository. The repository is currently in development, but there is no release date yet. When the ISO provides a single repository of official schemas, Esri has indicated that their ArcGIS Desktop product will validate against those schemas. Future releases of the EDG and INSIDE Idaho will also validate against the official schemas.

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#### CHALLENGE: QUESTIONS ABOUT ENTITY/ATTRIBUTE INFORMATION

The current transforms fail to completely address entity/attribute information in FGDC CSDGM records.

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#### SOLUTION: NOAA RESOURCES AND ISO 19115-1 RELEASE

Since these questions were related to ISO 19110 records, the solutions were outside the scope of this project. However, entity/attribute issues should be resolved with the release of ISO 19115-1. For the time being, NOAA offers help resources that address entity/attribute information.

## PUBLICLY ACCESSIBLE DELIVERABLES

This project has resulted in a collection of publicly accessible multimedia deliverables:

### TOOLS AND RESOURCES

- **Metadata Transform Test Utility:**

<http://metadata.innovateteam.com/metadatatransformtool/>

An experimental tool to transform and validate stand-alone metadata records to the ISO 191\* series

- **Innovate Metadata Resources Page:**

<http://metadata.innovateteam.com/>

A resource center providing links to tools, useful websites, presentations, and help documents

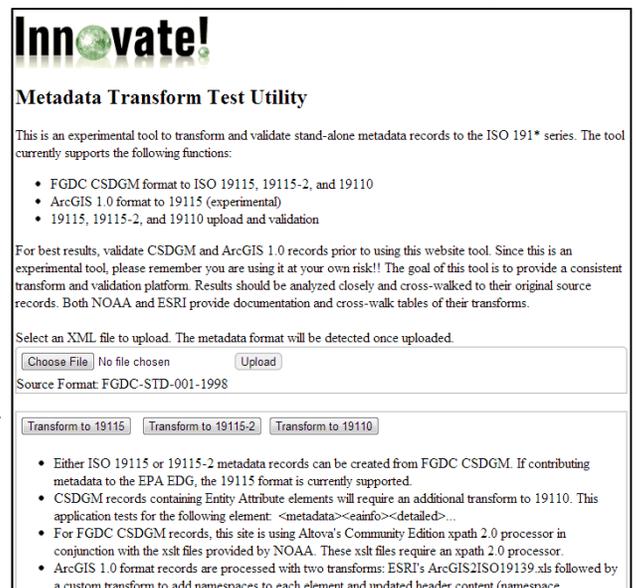


Figure 3: Metadata Transform Test Utility

### HELP DOCUMENTS:

- **Metadata Key Terms**

Glossary of important terms related to ISO metadata and XML in general, with links to additional information

- **The Environmental Dataset Gateway: Transitioning from FGDC CSDGM to ISO 19115**

Overview of the current status of the EDG transition, along with the current workflow for transforming an FGDC record to ISO and contributing it to the EDG

- **EPA Metadata Editor Validation**

Guide to validating FGDC CSDGM metadata with the EME

- **EDG Validation Troubleshooting**

Guide to manually correcting common EDG validation errors

- **Using the Metadata Transform Test Utility**

Guide to using the MTTU to transform FGDC/ArcGIS records to ISO and validate records.

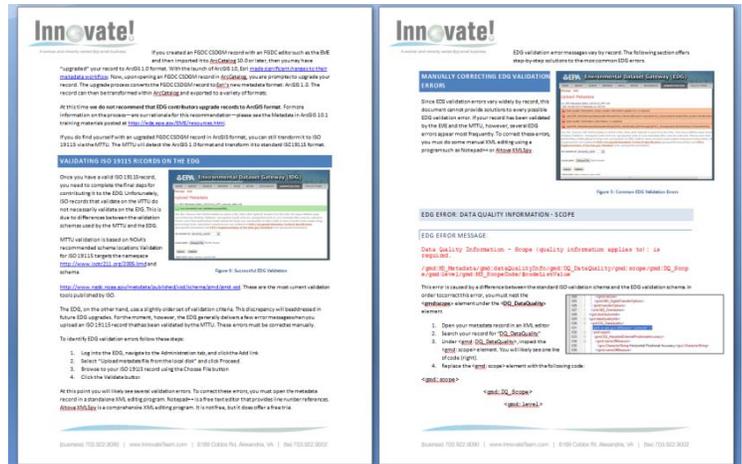


Figure 4: Help documents available online

## HELP VIDEOS

- **ISO Overview**
- **Metadata Transform Test Utility Demo**
- **Correcting EDG Validation Errors**

## COMPLETED ACTIVITIES AND PLANNED ACTIVITIES

### COMPLETED ACTIVITIES

### EVALUATED CURRENT EDG AND INSIDE IDAHO WORKFLOWS AND CONFIGURATION

Innovate conducted an in-depth examination of the current business processes and technical architecture of the EDG and INSIDE Idaho (Task 2). Innovate worked with clearinghouse staff to diagram the architecture, specifically the touch points of the clearinghouse to the individual metadata records, databases, and other components that make up the search mechanisms of the site.

### ACQUIRED ISO AND XML EXPERTISE

Innovate staff surveyed the current state of ISO geospatial metadata and evaluated the existing options for transforming records into ISO formats and creating ISO records from scratch. In order to build upon the efforts of other organizations, the Innovate team attended ISO training sessions conducted by NOAA and followed up by meeting with NOAA staff. Innovate also met with Esri to discuss the future of metadata in ArcGIS and in upcoming versions of Esri Geoportals Server.

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## COMPLETED TESTING AND TROUBLESHOOTING

Innovate performed extensive testing on the EDG and INSIDE Idaho, evaluating the clearinghouses' current ISO capabilities, the clearinghouses' potential for future ISO integration, and obstacles to the transition to ISO. These obstacles included a lack of ISO editing tools and discrepancies between various ISO schemas used for validation.

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## DEVELOPED INTERIM SOLUTIONS

Since ISO metadata is still in flux, with standards changing and mainstream tools such as the ArcGIS metadata editor evolving, the workflow for transitioning the two clearinghouses to ISO is not yet streamlined. Long-term solutions will require the creation of new editors (e.g. an ISO-compatible version of the EME). Although these permanent solutions are beyond the scope of this grant, the Innovate team did develop interim workflows for data contributors who wish to transform their existing metadata records to ISO or add ISO records to the two clearinghouses. The main component of the interim solution is Innovate's Metadata Transform Test Utility, which provides a common experimental platform for ISO transformation and validation.

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## PRESENTED FINDINGS

Innovate's Dan Spinosa presented on this grant at the FGDC Metadata Working Group webinar and at Esri's 2013 International Users Conference in San Diego, California. The presentations focused on the lessons learned through this grant and challenges faced by the clearinghouses. Mr. Spinosa provided details on significant findings encountered during each phase of the project. Work on grant tasks demonstrated the tight bond between authoring valid ISO metadata and cataloging those documents for search and display. Business process diagrams were briefly shared as well as results of ISO translation, and storage within the clearinghouses.

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## MADE FINDINGS PUBLICLY AVAILABLE

In order to publish the findings of this project in one central publicly-available location, the Innovate team developed a website dedicated to metadata resources (<http://metadata.innovateteam.com/>). This site includes links to the Metadata Transform Test Utility, help documents and videos, useful websites, and other resources. This site will be updated as more resources become available.

## PLANNED ACTIVITIES

### DEVELOPED PLANS FOR LONG-TERM SOLUTIONS FOR EDG AND INSIDE IDAHO

Based on the results of this project, Innovate has made concrete plans with the EPA and INSIDE Idaho to develop longer-term solutions for the ISO transition.

### EDG

Due in part to the results of this study, the EPA recently upgraded the EDG to the latest release of Esri's Geoportal. The upgrade will allow ISO 19115-2 records to be cataloged by the EDG. The EDG team can now move forward with non-technical aspects of the transition to ISO.

### EME

The EPA has determined that the next version of the EME will be ISO-compatible. This is a significant upgrade that will greatly increase the value of the EME, ensuring that it will continue to be relevant and useful to EDG contributors as ISO becomes more prevalent.

### INSIDE IDAHO

The INSIDE Idaho clearinghouse uses a custom-built catalog built on Microsoft SQL Server and the .NET framework. However, it is readily extensible and can be customized to handle ISO-formatted records. Tests on development servers during this project assisted the clearinghouse with providing seamless support for the CSDGM, ArcGIS 1.0 and ISO 19115-2 metadata formats. Long-term, the clearinghouse desires to harvest all three formats while presenting cataloged records using the 19115-2 format. INSIDE Idaho accomplished this by modifying SQL Server tables, and ASP.NET web pages in conjunction with XML transformations and style sheet files developed by NOAA.

## STATUS OF METADATA SERVICE

Given the level of effort that would currently be required for data contributors to transform their existing EDG and INSIDE Idaho records to ISO, we do not currently recommend transforming existing records. For this project, the Innovate team transformed and contributed sample records to both the EDG and INSIDE Idaho for evaluation and testing. However, it is not yet practical to transform a substantial subset of records at either clearinghouse. Once adequate metadata authoring tools are available, existing FGDC records can potentially be batch-transformed to ISO. As it stands now, each transformed record would need to be manually edited before validating. Following the release of EME 4.0, EDG contributors can make the transition to ISO by following their usual two-step workflow:

1. Create/edit EDG-compatible records in the EME
2. Upload and validate records on the EDG

The INSIDE Idaho clearinghouse does not provide contributors with metadata authoring tools and could support ISO-formatted records once changes are finalized within the cataloging system. However, INSIDE metadata stewards would also benefit from an easy-to-use ISO-compliant metadata editor.

## NEXT STEPS

Based on the results of this project, Innovate will continue to develop and fine-tune recommended ISO solutions for the EDG and INSIDE Idaho, working closely with the clearinghouse staff to design solutions that will minimally impact the current end users of the site. Conceptually, the end users will experience no difference in search result speeds or other interactions with the site. Next steps include upgrading the EPA Metadata Editor to be compatible with ISO records and finalizing changes within the INSIDE Idaho cataloging system.

## WILL THE PROJECT ACTIVITIES CONTINUE AFTER THE AWARD IS CLOSED?

Yes. We anticipate that we will continue to publish educational documents and work with clearinghouse staff after the award closes. Since Innovate is responsible for administering and maintaining the EDG, our staff will remain closely involved with the EDG's transition to ISO.

## WHAT FORMAL OR INFORMAL ORGANIZATIONAL RELATIONSHIPS WERE ESTABLISHED TO SUSTAIN ACTIVITIES BEYOND PERFORMANCE PERIOD?

Innovate has longstanding ties with both INSIDE Idaho and the EDG, which will ensure that our activities continue beyond the performance period. This project has strengthened INSIDE Idaho's relationship with the EDG. As Innovate conducts additional outreach and training for this project, we will have the opportunity to build relationships with other regional and national organizations making the transition from FGDC to ISO metadata.

## NEXT PHASE OF THE PROJECT

This project has prompted several logical next steps:

### ADDITIONAL XML TRAINING

An in-depth knowledge of ISO standards requires a thorough understanding of XML. In order to conduct future training sessions (and train-the-trainer sessions), Innovate staff will pursue additional XML training and continuing education opportunities. We will focus in particular on the application of the ISO standard by metadata stewards and developers. NOAA provides excellent free training sessions that assist with efforts to stay current with ISO schema revisions. The agency provides downloadable resources that can be used by both trainers and developers. Esri's free videos are also a good resource for general ISO usage issues. Paid training opportunities will be considered on a case-by-case basis as funding permits. These would most likely focus on technical developer aspects of XML such as XSLT and .Net code generation for transforming, styling, and modifying documents.

### EME UPGRADE

Recent federal legislation requires agencies to support the Project Open Data (<http://project-open-data.github.io/>) and the Common Core metadata schema, making both spatial and non-spatial data available to the public. In addition, the ArcGIS Item Description format is becoming more prevalent with published services and resources using Esri products (ArcGIS Server, Online, and Desktop). The EME currently supports the CSDGM standard. In addition to support for ISO, development efforts are underway to expand support for Common Core and ArcGIS formats.

## EDG TRANSITION

In January 2014, the EDG completed an upgrade to the latest version of Esri Geoportal Server. This release provides expanded support for ISO 19115-2, Common Core, and ArcGIS metadata formats. The cataloging software has been customized by EDG and Innovate staff to support specific EPA business processes. These customizations have been integrated into the new release of Geoportal. With the technical architecture in place to support ISO metadata, the EDG team can now move on to the procedural and policy-related aspects of the ISO transition.

## INSIDE IDAHO

INSIDE Idaho is in the process of working with Innovate staff on implementing changes to their catalog system. Code developed through this grant and existing contracts has been deployed to INSIDE staging database and web servers. Testing, code integration, and stability enhancements are underway. Additional work will involve modifying and extending ISO style sheets developed by NOAA.

## DO YOU NEED FGDC ASSISTANCE?

We do not require FGDC assistance at this time. However, we do foresee a need for additional funding for in-depth training on development aspects of XML.

## FEEDBACK ON COOPERATIVE AGREEMENTS PROGRAM

The CAP Program offered a fantastic opportunity for the Innovate team to expand our comprehensive knowledge of FGDC CSDGM metadata into the realm of ISO. Thanks to this award, we were able to build substantial expertise in XML and various ISO 191\* standards while assisting the EPA and INSIDE Idaho with their transitional strategies. The Innovate team enjoyed working with the CAP Program team from start to finish of the project. Jennifer Carlino and the rest of the CAP team were well-organized, knowledgeable, supportive, and responsive.

The CAP Program assisted with the investment in time needed to learn the ISO process. The program provides flexibility to grant recipients in executing the grant, which encourages a learning and discovery process that can be adapted as information is acquired. Thanks to the CAP Program, each clearinghouse was able to explore the requirements for supporting ISO without expending substantial funds. Both clearinghouses operate with limited funds and staff resources. Outside resources provided the clearinghouses with additional staff as well as a fresh perspective.

# APPENDIX: ARCHITECTURE DIAGRAMS FOR EDG AND INSIDE IDAHO

