



Towards semantically interoperable metadata repositories: The Asset Description Metadata Schema

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ABSTRACT

The divergent interpretations of data, the lack of common metadata and the absence of universal reference data hinder governments from seamless data exchange, information systems integration and the delivery of cross-border public services. To overcome this, governments develop e-Government metadata repositories to store reusable data models, schemata, taxonomies and codelists. We use the term semantic interoperability asset to refer to these types of resources. These repositories however differ in their scope, target group, implementation technologies and end-user interfaces. Although, the semantic content they include can often be reused, even bypass the domain it was originally designed for, their physical isolation and the heterogeneity of the assets' descriptions hamper the reusability of common concepts and cross-repository search. To deal with these challenges, this paper introduces the Asset Description Metadata Schema, an initiative of the ISA programme of the European Commission, which aims to deliver a common metamodel for semantic interoperability assets.

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1. Introduction

Nowadays in the European Union, there is an increasing demand for cross-border and cross-sector delivery of electronic public services, which emphasizes the need for semantic interoperability between public administrations Europe-wide. Semantic interoperability between public administrations at the pan-European level requires sharing common metadata models, which are in turn the fundamental building blocks for information systems interoperability and integration. By definition metadata refers to “*data about data*” that identifies, describes or facilitates the retrieval, usage and management of digital resources. Metadata exists at multiple levels within an information system describing different aspects of the resources inside such as its structural metadata, and administrative metadata, i.e., creation date, access mechanism, etc. [1].

Metadata schemas are sets of elements designed for a specific purpose, such as for describing a particular type of information resource. The definition or meaning of the elements themselves

adds a new type of metadata known as the *semantics* of the schema, which ensure that the precise meaning of information is understood and preserved throughout exchanges between parties, e.g., different public services collaborating in the provision of a cross-border e-Government service.

Henceforth, we refer to these models using the term *semantic interoperability asset*. A semantic interoperability asset is as a collection of reference metadata elements that sharing them among governments would contribute to increased interoperability across organisational and geographic boundaries. Examples of semantic interoperability assets include codelists, taxonomies, XML schemas, ontologies, UML diagrams and reference collections of data.

Reusing semantic interoperability assets not only saves modelling and development time and effort but also helps building interoperable systems [3]. For instance, reusing SEMIC.EU's Core Person Specification,¹ which is the result of collaborative work of approximately 100 experts, to model the person concept in different information systems across Europe, will automatically enable their semantic interconnection.

In this vein, governments as well as the European Commission are sharing their metadata on the Web to encourage their re-usability and consequently facilitate interoperability. This has led

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¹ See <http://www.semic.eu/semic/view/snnav/Conformance/specification.xhtml>.

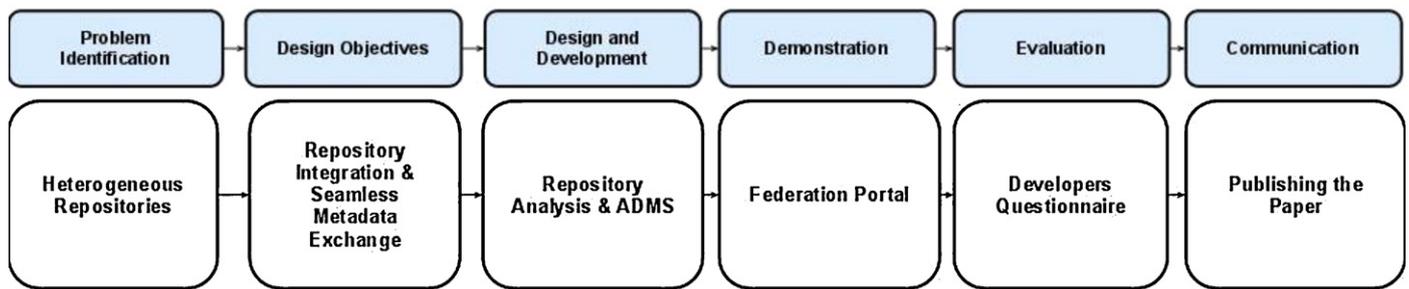


Fig. 1. Research methodology.

to a new kind of repositories focusing primarily on semantic interoperability assets, such as Digitaliser.dk in Denmark, the ESD toolkit standards lists in the UK and the European Union repository SEMIC.EU.

However, the full potential of metadata repositories is currently not fully exploited as these repositories did not for see exchanging their data with other systems. Many legal, organizational, technical and semantic barriers exist. Examples of these barriers include the lack licensing and quality assessment information of their content, the use of different formats and terminology as well as their physical isolation [2].

ISA,² the European Commission programme on Interoperability Solutions for European Public Administrations, is leading a working group effort to define a standard model to describe semantic interoperability assets. Representatives from more than 10 EU Member States, standardization bodies and top-league research institutes participate in the working group. The work presented in this paper is part of this initiative. It is in fact one of the inputs given to the working group in order to initiate the standardization process.

Summarising, the main research challenge to be pursued in this paper is facilitating the sharing and re-use of semantic interoperability assets by overcoming heterogeneous and not aligned Asset Metadata and physical isolation of the hosting repositories.

The remainder of the paper is organized as follows: Section 2 describes our research methodology. Section 3 presents an extensive study of related metadata description models. The analysis of existing repositories is described in Section 4. In Section 5, we introduce ADMS, the Asset Description Metadata Schema as an RDF model to represent semantic interoperability assets. Feasibility study and evaluation of the model are presented in Section 6. Finally, Section 7 concludes the paper and discusses our future research direction.

2. Research methodology

The work in this paper has been based on the Design Science Research Methodology (DSRM) [5]. DSRM incorporates principles, practices, and procedures required to carry out research in information systems and meets three objectives: it is consistent with prior literature; it provides a nominal process model for doing DS research; and it provides a mental model for presenting and evaluating DS research in information systems. Selecting DSRM ensures that there exist clear links and a smooth transition between the design and development of our model and its application and evaluation in the case study.

DSRM includes six activities: problem identification and motivation, definition of the objectives for a solution, design and development, demonstration, evaluation, and communication.

We define these activities in the context of our work as follows (see also Fig. 1):

- i. *Problem identification and motivation.* Our research problem is driven by the following challenge: semantic metadata models – the actual means of semantic interoperability between e-Government systems – are locked in heterogeneous, distributed and isolated metadata repositories that differ in metadata models and technologies.
 - ii. *Objectives of the solution.* The objectives of this work are summarized in the following:
 - a. To enable the integration and semantic interconnection between distributed e-Government metadata repositories; and
 - b. To facilitate the discovery, access and reuse of semantic interoperability assets.
- The objectives will be realized through:
- a. A mutual agreement on the meaning of concepts describing an asset;
 - b. A new metadata exchange model to identify types of the reusable resources, facilitate their discovery and ensure minimum consistency of metadata across e-Government repositories; and
 - c. The definition of a conceptual architecture for the federation of these repositories.
- iii. *Design and development.* We first analyse a selection of e-Government repositories and models to determine the characteristics of the proposed exchange model (Section 4), and then specify an RDF vocabulary to enable their semantic interconnection. This vocabulary is termed Asset Description Metadata Schema (ADMS) (Section 5). The adoption of RDF and the realization of the Linked Data principles [4] allows publishing metadata in a uniform and machine-readable manner and creates semantic links between them on top of the existing Web infrastructure.
 - iv. *Demonstration.* We introduce a federation architecture and implement the federation portal prototype to demonstrate the usage of ADMS as a common metadata model.
 - v. *Evaluation.* We run an evaluation exercise and collect the feedback of 20 developers who need e-Government metadata in their daily tasks. Both Demonstration and Evaluation steps are explained in Section 6.

3. Related work

Many efforts are directed towards enabling interoperable information systems through consistency and uniformity in the way that information is described, stored and retrieved, especially in complex organizations such as governments. However, only few exploit metadata to describe semantic interoperability assets in a

² See http://ec.europa.eu/isa/index_en.htm.

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