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Recent applications of Knowledge Organization Systems: introduction to a special issue

Philipp Mayr[1] • Douglas Tudhope[2] • Stella Dextre Clarke[3] • Marcia Lei Zeng[4] • Xia Lin[5]

Philipp Mayr (philipp.mayr-schlegel@gesis.org; philipp.mayr@gesis.org)
Douglas Tudhope (douglas.tudhope@southwales.ac.uk)

[1]GESIS - Leibniz Institute for the Social Sciences, Unter Sachsenhausen 6-8, 50667 Cologne, Germany
[2]Hypermedia Research Group, Faculty of Computing, Engineering and Science, University of South Wales, Pontypridd CF37 1DL, UK
[3]Information Consultant and Chair, ISKO UK Luke House, West Hendred, Wantage OX12 8RR, UK
[4]School of Library and Information Science, Kent State University, Kent, Ohio, USA
[5]College of Computing and Informatics, Drexel University, Philadelphia, PA 19104, USA

Abstract This special issue of the International Journal of Digital Libraries evolved from the 13th Networked Knowledge Organization Systems (NKOSs) workshop held at the joint Digital Libraries conference 2014 in London. The focus of the workshop was 'Mapping between Linked Data vocabularies of KOS' and 'Meaningful Concept Display and Meaningful Visualization of KOS'. The issue presents six papers on the general theme on both conceptual aspects and technical implementation of NKOS. We dedicate this special issue to our long-term colleague and friend Johan De Smedt who died in June 2015 while we were editing the special issue.

Keywords Networked Knowledge Organization Systems ■ Linked Data vocabularies ■ Interoperability ■ KOS mapping ■ Spatial and temporal Gazetteers ■ Compositionality of KOS relationships ■ KOS digital heritage applications

1 Introduction

Knowledge Organization Systems (KOS), in the form of classification systems, thesauri, lexical databases, ontologies, gazetteers, and taxonomies, more than ever play a crucial role in digital information management and applications generally. Carrying semantics in a well-controlled and documented way, Knowledge Organization Systems serve a variety of important functions: tools for representation and indexing of information and documents, knowledge-based support to information searchers, semantic road maps to domains and disciplines, communication tools that provide conceptual framework, and a conceptual underpinning for knowledge- based systems. New networked KOS (NKOS) services and applications are emerging, and we have reached a stage where many KOS standards exist and the integration of linked services is no longer just a future scenario.

The European NKOS network has held a long-running series of annual workshops at the European Conference on Digital Libraries (ECDL), latterly reformed as the International Conference on Theory and Practice of Digital Libraries (TPDL). For details of North American and other NKOS network events, see[1]. Typically, recent advances of KOS have been reported and the NKOS workshops, e.g. including the

Simple Knowledge Organization System (SKOS) W3C standard, the ISO 25964 thesauri standard, the CIDOC Conceptual Reference Model (CRM), Linked Data applications, KOS-based recommender systems, KOS mapping techniques, KOS registries and metadata, social tagging, user-centred issues, and many other topics. Special issues on Networked Knowledge Organization Systems (NKOS) have been published in Journal of Digital Information in 2001[1] [6] and 2004[2] [11] and in New Review of Hypermedia and Multimedia in 2006[3] [12]. A comprehensive and well cited review article on KOS was published in 2004 [7].

This special NKOS issue of the International Journal of Digital Libraries has evolved from the 13th NKOS workshop[4] held at the joint Digital Libraries (DL) conference 2014 in London, a joint event of the TPDL Conference and the Joint Conference on Digital Libraries. Following the workshop, a general call for papers was issued. The papers in the issue span broad themes of KOS mapping methods, composition- ality of KOS relationships, spatial and temporal gazetteers, KOS digital heritage applications (three of the papers report on different aspects of the European ARIADNE project on digital archaeological infrastructure).

2 Dedication to Johan De Smedt

We dedicate this special issue to our long-term colleague and friend Johan De Smedt who died in June 2015 while we were editing the special issue. Johan was involved in two of the presentations at the 13th European NKOS workshop [4,5] preceding this issue and was recently active in the development of the ontology expressing the new ISO thesaurus standard. His work lives on, embedded in several of the standards and other tools contributing to the NKOS programme.

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[1] http://nkos.slis.kent.edu/.[1]
  https://journals.tdl.org/jodi/index.php/jodi/issue/view/8.

[2] https://journals.tdl.org/jodi/index.php/jodi/article/view/109/108.

[3] http://www.tandfonline.com/toc/tham20/12/1.

[4] https://at-web1.comp.glam.ac.uk/pages/research/hypermedia/nkos/nkos2014/programme.html.

3 Special issue papers

The issue presents six papers on both conceptual aspects and technical implementation of NKOS. These papers are introduced and referenced below.

3.1 Ceri Binding and Doug Tudhope: Improving Interoperability using Vocabulary Linked Data

NKOS workshops offer a highly focused and supportive environment in which speakers are not only able to expose their successes but also discuss the difficulties they faced. The paper 'Improving Interoperability using Vocabulary Linked Data' by Binding and Tudhope [2] is an example of the value of this approach. Techniques such as Linked Data and inter-vocabulary mapping offer enormous potential for cross-searching multiple data sets indexed with different vocabularies. In theory, interoperability is simple, but Binding and Tudhope reveal the practical challenges of making the theory work. Among the challenges they uncovered were disparities in the quality of indexing. The authors make the point that Linked Data rests upon layers of technological standards, where the standards have not been applied consistently as was shown to happen with the controlled vocabularies intended to ensure consistent indexing the links will fail. Semantic interoperability remains a tantalizing prospect. The paper argues the need for a review phase when mapping between concepts of different vocabularies. The case study goes on to present a mapping tool that makes available contextual data to assist informed mapping decisions.

3.2 Shu-jiun Chen et al.: Alignment of conceptual structures in controlled vocabularies in the domain of Chinese art—a discussion of issues and patterns

Semantic interoperability also remains a basic challenge in multicultural and multilingual KOS projects, as demonstrated by the work of the AAT-Taiwans effort in aligning the Art and Architecture Thesaurus (AAT) that is more western art-based with the National Palace Museum (NPM) Vocabulary that represents Chinese art-related terminology. Chen et al. [3] call for attention to those issues being different from individual concept-concept mapping that does not consider conceptual structures, term-term translation, and string-string conversion. Some obvious examples include the concept of Chinese export porcelain in a western culture and Kraak in relation to the ceramic styles in different regions of the world. These are different from the situation such as the legendary creature unicorn referred to in various cultures. When dealing with cultural-related concepts that cannot be exactly aligned in vocabularies due to discrepancies in the conceptual structures, the research team sorted out four patterns of the situations and developed a set of models to guide the team in proposing revisions or enhancing the overall structure. The analysis enabled the team to understand what can be done to enhance the interoperability of both vocabularies and use in a virtual national union catalogue for cross-lingual searching and browsing.

3.3 Vladimir Alexiev et al.: On the Composition of ISO 25964 hierarchical relations (BTG, BTP, BTI)

Alexiev et al. [1] address issues arising from two recent important developments for the NKOS community: (i) the publication of the new ISO standard on thesauri (ISO 25964) together with the corresponding data model and OWL ontology; (ii) the publication as Linked Open Data of the Getty Art and Architecture Thesaurus and other Getty vocabularies. The authors are concerned with the potential of ISO 25964's expression of the specialized hierarchical relationships as OWL properties (broaderGeneric, broaderPartitive, and broaderlnstantial). The particular contribution of this paper is to define extended versions of these properties and analyse which combinations are appropriate for fine-grained retrieval over chains of properties. Application to the Getty AAT is discussed informed by experience in the implementation of its linked data. The authors' analysis of 'compositional semantics' makes a significant step towards more complex query expansion and semantic services.

3.4 Ryan Shaw et al.: The sharing-oriented architecture of the PeriodO period gazetteer

Shaw et al. [10] introduce a new type of architecture for NKOS, called sharing-oriented architecture, and exemplify it with the design of the PeriodO gazetteer. To introduce their architecture, they present a comparison of sharing-oriented architectures and service-oriented architectures (SOA). In their definition, the PeriodO period gazetteer documents definitions of historical period names. The authors note that to be included in the gazetteer, a definition must (a) give the period a name, (b) impose some temporal bounds on the period, (c) have some

implicit or explicit association with a geographical region and (d) have been formally or informally published in some citable text or data set. The proposed architecture and data set are novel, promising, and based on state of the art. The article shows some details of lower-level data modelling and serialization approaches. The authors analyse their PeriodO data model, its representation using JSON-LD and the management of changes to the PeriodO data set.

The digital heritage application focus is continued in the next two papers.

3.5 Franco Niccolucci and Sorin Hermon: Representing gazetteers and period thesauri in four-dimensional space-time

In the first paper, Niccolucci and Hermon [8] continue the theme of gazetteers, and rather than the previous paper's focus on time periods, their focus is on place name gazetteers which must address the assignment of a point or spatial extent to a given place name. In particular (going beyond the ever-present issues of synonyms and homonyms), Niccolucci and Hermon address directly the thorny issue of the varying nature of the spatial extent associated with a place name over time. They draw upon a recent development in the CIDOC CRM, the CRMgeo extension. The paper describes and proposes a refinement to CRMgeo that affords a discretization of space and time that can approximate the real space-time extents occupied by events. The discretization makes possible an approximation of a gazetteer entry as a four-dimensional space-time volume. This provides a solid theoretical basis for addressing both time-varying location appellations and space-varying period appellations.

3.6 Paola Ronzino et al.: CRMBA a CRM extension for the documentation of standing building

Ronzino et al. [9] propose an extension to the CIDOC CRM ontology (ISO 21127) widely used in digital heritage. The CIDOC Conceptual Reference Model provides a core ontological framework with wide scope, and recent years have seen the emergence of extensions for particular domains. The well-illustrated paper describes CRMba, a CIDOC CRM extension developed to facilitate the discovery and the interpretation of archaeological resources through the definition of new concepts required to describe the complexity of historic buildings. For

example, new classes define the physical relations of the archaeological stratigraphic units, which help to understand the series of a building's construction phases. CRMba delineates and describes the specific semantics of different components of buildings and the functional spaces within buildings and complexes. The aim is to make explicit their physical and topological relations through time and space, thus permitting a record of the evolution of the structure over time.

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