Harmonizing and Using Numismatic Linked Data in Digital Humanities Research and Application Development: Case DigiNUMA

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Abstract. This paper outlines the ongoing work in the DigiNUMA project for creating solutions in data harmonisation, analysis, and dissemination of pan-European archaeological and numismatic Cultural Heritage, using linked data and semantic web technologies. The project focuses on Viking Age (800–1150 AD) Finnish and English numismatic data as a case study. A broader context is gained by harmonizing collection data of the National Museum of Finland, the British Museum, and the Fitzwilliam Museum in Cambridege to be compatible with the international Nomisma.org ontology, and by creating tools that can be used to work with other Nomisma.org datasets as well.

1 Introduction and Related Work

During the recent years the number of archaeological finds made by the public across Europe, mainly through hobby metal-detecting, has grown considerably. Coins form a special case with the finds worth concentrating one for several reasons. Coin finds are relatively easy to recognise when found in the ground with a detector and are usually the most numerous object type reported by the public.[3] Coin types can be identified more precisely than other common finds, producing higher quality record data and making them specially suitable for Digital Humanities (DH) analysis; for example, dates and places of minting can often be determined with reference the existing numismatic scholarship. Coins also moved a lot internationally, making harmonizing and comparing international data especially relevant.

DigiNUMA – Digital Solutions for European Numismatic Heritage[3] [4] is an ongoing research project that responds to a set of new needs in Cultural Heritage (CH) data management, research, and dissemination using Linked Open Data (LOD). The project collaborates with two international LOD data projects in archaeological CH: ARIADNEplus[4] [5] and Nomisma.org[5] [6]. ARIADNEplus is

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[3] Project homepage: https://seco.cs.aalto.fi/projects/diginuma
[4] https://ariadne-infrastructure.eu
[5] http://Nomisma.org

a pan-European research infrastructure and aggregation project for all archaeological data, while Nomisma.org concentrates on numismatic data.

The project contributes to the state-of-the-art by developing new tools and approaches for DH data-analyses on numismatic collection data based on the Nomisma.org ontology framework. Another contribution of the DigiNUMA project is to create a generic semantic portal model, application, and LOD service for archaeological coin finds based on the "Sampo-model" [1] and Sampo-UI framework [2], a new part of the "Sampo" series of portals[6].

2 Data and Ontologies

Datasets As a case study the project concentrates on Finnish and English Viking Age (800–1150 AD) coins, selected owing to high degree of geographic circulation (therefore diversity in different national collections) of coins from this period in north-western and northern Europe and beyond into western Asia. In Viking Age Finland monetised economy did not exist, with coins being valued for their metal as silver bullion: consequently the medieval Finnish collections are international with some 4000 German coins, 2000 Islamic dirhams, and 1000 English coins. DigiNUMA will draw upon this existing numismatic data maintained by the Finnish National Museum Coin Cabinet and the Finnish Heritage Agency. In order to provide an international comparison, and to identify and avoid possible biases inherent in national numismatic datasets, DigiNUMA will also investigate English early medieval coin data from the British Museum, and data from the Corpus of Early Medieval Coins at the Fitzwilliam Museum in Cambridge.

Nomisma.org There is a strong existing foundation for numismatic linked data. Nomisma.org[7] is a project started by the American Numismatic Society in 2010, to facilitate the presentation of numismatic concepts using Linked Open Data.[7] Nomisma.org ontology has been developed for years, and more than 30 different institutions have provided datasets[8] for the project.[6] Nomisma.org ontology includes a wide collection of numismatic terms, and DigiNUMA project will aim to create data that is compatible with Nomisma.org.

While the current data in Nomisma.org datasets can sometimes have errors and inconsistencies, the fundamental fact that a series of international datasets, arriving from institutions with divergent collections managements histories and policies, have nevertheless been described using a similar ontological framework makes it possible to reuse applications created in DigiNUMA project for analysis and dissemination of this diverse body of numismatic data. This demonstrates the significant potential of LOD and data harmonisation approaches in bringing together and creating added value from international and traditionally heterogeneous CH material.

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[6] Sampo portals: https://seco.cs.aalto.fi/applications/sampo/

[7] http://Nomisma.org

[8] See: http://Nomisma.org/datasets

3 Using the LOD Service and Applications

LOD Service The harmonized data together with ontologies is published as a LOD service on the Linked Data Finland platform[9] that is used in three ways: 1) the data can be filtered and uploaded and reused in external DH tools and applications. 2) The SPARQL endpoint can be used for data analyses using tools such as the YASGUI editor[10] and Jupyter Notebooks. 3) A new semantic portal "CoinSampo" is being developed on top of the SPARQL endpoint that can be used without programming skills. It demonstrates how the LOD service can be used effectively in application development. All data and software developed in DigiNUMA will be published openly using the CC BY 4.0 license, whenever this is allowed by the original data providers' copyright.

CoinSampo Web Application The CoinSampo web application is currently in early development, and is based on the Sampo-UI framework[11]. While the application is mainly developed for the Finnish data, using an international Nomisma.org ontology makes it possible to easily use the application to work with other data as well.

To test the early prototype of CoinSampo application, and it's applicability to international data we have used the Seleucid Coins Online[12] dataset created by the American Numismatic Society. This dataset, like many others, can be downloaded from the Nomisma.org website. The dataset depicts coin types of the ancient Seleucid Empire. As an example of the application prototype, Fig. 1 shows the relative numbers of coin denominations associated with the mint of Susa as a pie chart.[13] It is easy to see that most of the coin types are of denomination "Tetradrachm". This can then be very quickly compared to numbers of other mints. The application will also include various maps that can be particularly useful for DH analysis. These kind of visualizations can be created quickly and without technical know-how using the application and it's faceted search functionality.

4 Discussion

Increasing the accessibility of CH data internationally, including its interoperability in scienctific analysis but also in lowering the threshold for anyone to access, learn, and create new knowledge is a critical issue in European heritage management. To this end, *DigiNUMA* seeks to develop a data service framework and a model for disseminating archaeological CH data within an international context. It will lay the groundwork for future collaboration and secure international and interdisciplinary networks between Finnish and European partners,

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[9] https://ldf.fi

[10] http://yasgui.triply.cc/

[11] https://github.com/SemanticComputing/sampo-ui

[12] http://numismatics.org/sco/

[13] The application uses the ApexCharts library https://apexcharts.com/ to create chart visualizations.
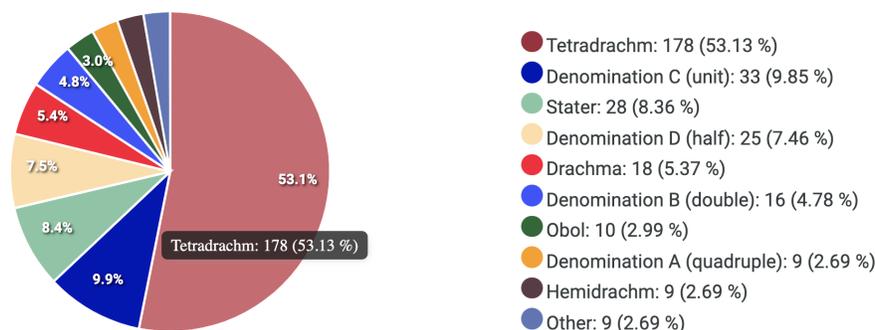
Fig. 1. An example of a visualization created with CoinSampo application showing coin denominations of Seluidic coins from the mint of Susa.

and develop solutions to current challenges in use of complex existing CH data resources.

References

1. Hyvönen, E.: Digital humanities on the semantic web: Sampo model and portal series. Semantic Web – Interoperability, Usability, Applicability (2022), submitted
2. Ikkala, E., Hyvönen, E., Rantala, H., Koho, M.: Sampo-UI: A full stack JavaScript framework for developing semantic portal user interfaces. Semantic Web – Interoperability, Usability, Applicability **13**(1), 69–84 (January 2022). https://doi.org/10.3233/SW-210428
3. Leahy, K., Lewis, M.: Finds Identified: Portable Antiquities Scheme. Greenlight Publishing, Witham (2018)
4. Oksanen, E., Rantala, H., Tuominen, J., Lewis, M., Wigg-Wolf, D., Ehrnsten, F., Hyvönen, E.: Digital humanities solutions for pan-european numismatic and archaeological heritage based on linked open data, submitted
5. Richards, J., Niccolucci, F. (eds.): The Ariadne Impact. Archaeolingua, Budapest (2019)
6. Tolle, K., Wigg-Wolf, D.: Improving data quality by rules: A numismatic example. In: Digital Archaeologies, Material Worlds (Past and Present), pp. 193–201. Proc. of the 45rd Annual Conference on Computer Applications and Quantitative Methods in Archaeology (2020)
7. Wigg-Wolf, D., Duyrat, F.: La révolution des linked open data en numismatique : Les exemples de nomisma.org et online greek coinage. Archéologies numériques **17** (10 2017). https://doi.org/10.21494/ISTE.OP.2017.0171