Archeologia e Calcolatori
35.2, 2024, 63-74
doi 10.19282/ac.35.2.2024.08

SHARING LINKED OPEN DATA WITH DOMAIN-SPECIFIC DATA-DRIVEN COMMUNITY HUBS – ARCHAEOLOGY.LINK IN NFDI4OBJECTS

1. Introduction

FAIRification and sharing of open data is an important part of the German National Research Data Infrastructure (NFDI) (Hartl *et al.* 2021) and its archaeology-related consortium NFDI4Objects. NFDI4Objects represents an interdisciplinary community dealing with material remains of human history from around 3 million years and involves numerous disciplines from the humanities, cultural studies and natural sciences with an archaeological and historical focus (Bibby *et al.* 2023; Thiery *et al.* 2023b).

A considerable role in all these initiatives to interconnect and link research data is reserved for Semantic Web technologies such as the Resource Description Framework (RDF) (Klyne *et al.* 2014) applied using Linked Open Data (LOD), which became widely known by the work of Sir T. Berners-Lee (2006; cf. Schmidt *et al.* 2022) and Linked Open Usable Data (LOUD) (Sanderson 2018; Raemy, Sanderson 2023). Creating LOUD is a challenge. Within the research area of archaeology, specific digital methods such as the SPARQL Unicorn approach (Thiery *et al.* 2020) and its research tool implementations, such as the SPARQLing Unicorn QGIS Plugin (Homburg, Thiery 2024) and the SPARQL Unicorn Ontology Documentation (Homburg, Thiery 2024) may help and have been applied within the NFDI work.

Services which are offered by NFDI4Objects are domain-specific data-driven hubs to publish and share research data, Linked Open Data (LOD), ontologies, community-driven vocabularies and authority files, such as *thesauri*. E.g., the data hub for standards data and terminologies (DANTE) (Helms 2018), the iDAI.world (Fless *et al.* 2021) and the vocabularies in museum documentation (https://museumsvokabular.de) are making a variety of archaeological terms, objects, geospatial data and time periods available. The data hub ‘archaeology.link’ (https://archaeology.link) – hosted by the LEIZA – offers, e.g., LOD, *thesauri* and ontologies and creates a network within the virtual Archaeological Knowledge Graph and the Linked Open Data Cloud.

This paper demonstrates the content, challenges and possibilities of this data hub. It consists of five thematic parts: 1) Semantic Modelling using the Linked Archaeological Data Ontology (LADO), 2) the publication of domain-specific Linked Open Data, 3) community-driven vocabularies, 4) ontologies, and 5) the development and publication of research software.

2. The data hub 'archaeology.link'

The archaeological data hub and framework 'archaeology.link' is a collaborative hub for publishing data from project cooperations; it presents research data, ontologies, related research tools and web services for e.g., Linked Open Data technologies within the scope of the archaeological fundamental research carried out by the LEIZA and its cooperation partners in joint projects. This platform complements the LEIZA Archaeological Data Processing Web Service (ADP; https://www.rgzm.de/adp). 'archaeology.link' comprises Linked Open Research Data such as the Linked Archaeological Data Ontology (LADO), Linked Open Samian Ware (from the Samian Research database), Linked Open African Red Slip Ware (from the ARS3D project), Linked Open Ships / NAVISone Maritime Thesaurus (from the NAVISone project), and Linked Open Data / FAIRification tools, e.g., Alligator, Academic Meta Tool (AMT) or re3dragon. 'archaeology.link' includes also projects strongly connected to the community-hub Wikidata and comprises bidirectional links. Connected Wikidata projects are, i.e., Linked Open Samian Ware (https://t1p.de/wp-losw), African Red Slip Ware digital (https://t1p.de/wp-arswd), ARS3D (https://t1p.de/wp-ars3d) or NAVISone (https://t1p.de/wp-navone).

The following sections provide an overview of the content, possibilities and challenges of 'archaeology.link'. It comprises use-case examples of semantic modelling, i.e. modelling LOD of ARS3D/BB-5KBC and CeraTyOnt (§3), community-driven vocabularies such as the NAVISone maritime thesaurus (§4) as well as research and FAIRification tools, i.e. TiGeR and Alligator.

3. Semantic modelling using 'archaeology.link'

The Linked Archaeological Data Ontology (LADO; prefix lado) (Thiery 2022) is the core of the semantic model (based on the Web Ontology Language; OWL; prefix owl) used in the 'archaeology.link' data hub. LADO is based on CIDOC-CRM (prefix crm) and its extensions, the Provenance Ontology (PROV-O; prefix prov) (https://www.w3.org/TR/prov-o/), Simple Knowledge Organization System (SKOS; prefix skos) (https://www.w3.org/2004/02/skos/), the Geographic Query Language GeoSPARQL (https://www.ogc.org/standard/geosparql/; prefix geosparql) and many others. All classes are derived from owl:Thing, prov:Entity and crm:E1_CRM_Entity. Individual Objects are instances of lado:InformationCarrier (subclass of crm:E22_Human_Made_Object); individual spatial locations are instances of, e.g. lado:Location or lado:DiscoverySite (subclass of

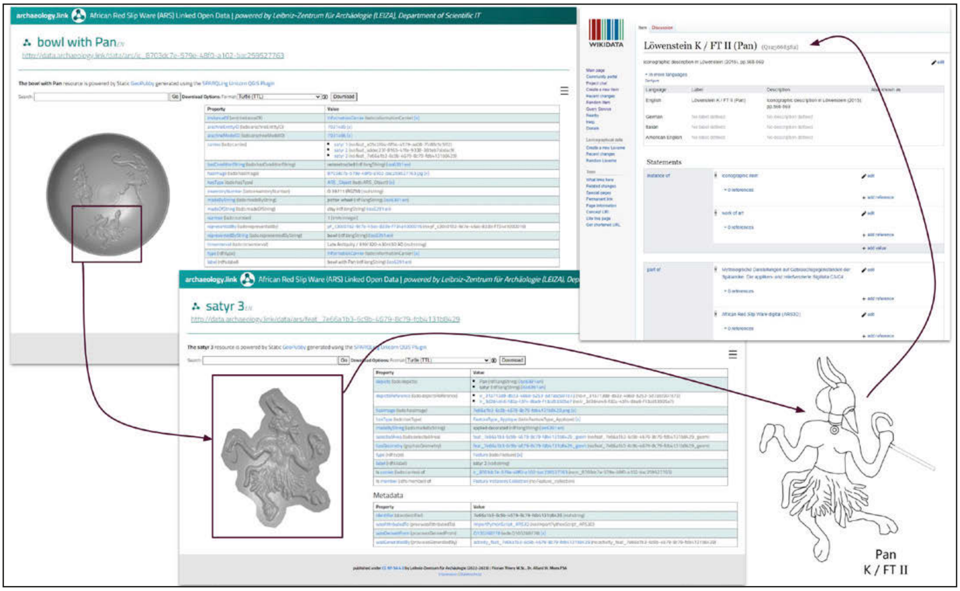

Fig. 1 – LOD representation of ARS3D-object 'bowl with pan' (O.39711/LEIZA collection), one feature (satyr 3), and its describing source (zu Löwenstein 2015, 713) as well as Wikidata (Q110892439) (left/middle: F. Thiery; right-top: Wikidata Community; right-bottom: with permission of S. zu Löwenstein).

skos:Concept crm:E53_Place, geosparql:SpatialObject and pleiades:Place); individual agents such as persons are instances of lado:ActorEntity (subclass of skos:Concept, crm:E39_Actor).

The data hub includes several datasets from various international cross-domain projects, e.g., the LOD of the Samian Research database (Thiery *et al.* 2023a), the African Red Slip Ware digital project (ARS3D) (Thiery 2023a), the NAVISone repository (Thiery 2023c) as well as further data from specific projects (e.g., from a PhD Thesis by S.C. Schmidt: Thiery, Schmidt 2023). Some of the data is also integrated into Wikidata and interlinked via a backlink (wd:P2888; exact match), e.g., the Samian Ware production centre La Graufesenque (Q102763431 ←→ samian:loc_pc_2000001). It is envisaged that – after a discussion within the Wikidata community – a Wikidata property will establish the coupling between primary databases and the secondary database and community hub Wikidata.

Using the SPARQL Unicorn Ontology Documentation (Homburg, Thiery 2024), it is easily possible to create browsable HTML documentation pages based on SPARQL queries. Fig. 1 shows the HTML-LOD representation of the ARS3D object 'bowl with pan' with an applied feature and

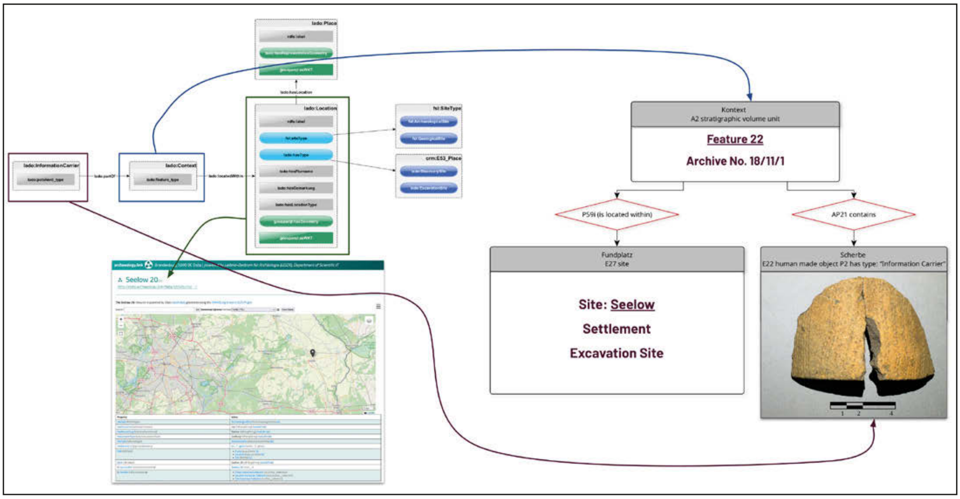

Fig. 2 – LOD representation of a BB-5kBC object from 'Feature 22', found at the archaeological site 'Seelow' (left: F. Thiery-S.C. Schmidt; right: S.C. Schmidt).

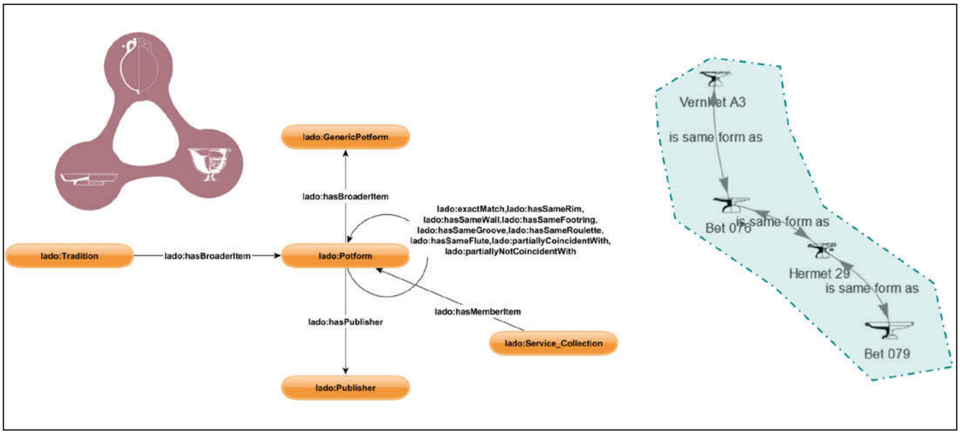

Fig. 3 – Excerpt of the Ceramic Typologies Ontology (CeraTyOnt) (F. Thiery, A.W. Mees).

its description source 'Pan K/FT II' (zu Löwenstein 2015), also stated in Wikidata as Q110892439. Fig. 2 shows the LOD representation as an ontology (left-top), a potsherd from 'feature 22', found at Seelow site (right), and the HTML rendering of this excavation site from the Brandenburg 5000 BC (Thiery, Schmidt 2023).

The data hub also comprises ontologies such as the Ceramic Typology Ontology (CeraTyOnt) (Thiery, Mees 2022a), the Alligator Ontology (https://leiza-rse.github.io/alligator/vocab/), and the TiGeR Ontology (https://leiza-rse.github.io/tiger/vocab/). Handling different typologies – developed in various European research traditions – poses a problem in archaeology, e.g. when studying *terra sigillata*. Few attempts have been made to control this methodological problem, which, e.g., also arises in the classification of amphorae (Isaksen *et al.* 2010). There are also different concepts for handling ceramic services covering the already in antiquity standardised types of Roman Samian (*terra sigillata*). There is currently no other method known for handling the different Samian form type variants within the current different scientific research traditions in Europe. If one would like to store typological information within Europe-wide used databases such as Samian Research, the question arises of which typology to use.

This project aims to present an online editor based on an ontology of *terra sigillata* typologies (CeraTyOnt) according to the CIDOC-CRM reference semantic model and its extensions. It allows for relationships and properties to be entered and the search result will include the associated forms and services in other typologies (e.g. the typologies of Bet, Hayes, Hermet, Vernhet, etc.) and will be published as interoperable LOD. Interoperability allows connections with other ceramic projects, such as the African Red Slip Ware 3D (ARS3D), in which forms defined by Hayes (Hayes 1972) play an important role (Mees, Thiery 2021). CeraTyOnt classes are, e.g., lado:Potform (derived from skos:Concept and crm:E55_Type), lado: Tradition (derived from skos:Concept and crm:E55_Type) or lado:Service_Collection (skos:Collection, crm:E1_CRM_Entity). CeraTyOnt properties are subclasses of SKOS properties (Fig. 3, left), e.g., lado:exactMatch (derived from skos:exactMatch) or lado:hasSameFootring, lado:hasSameRim, lado:hasSameWall (all derived from skos:relatedMatch). This semantic modelling leads to small graphs, as, e.g. visualised in Fig. 3 (right), where Vernhet A3 = Bet 076 = Hermet 29 = Bet 079.

This approach also provides modelling of the vagueness in those relationships using the Academic Meta Tool (Unold *et al.* 2019). A footring of an incomplete Dragendorff form 18 (Dragendorff 1895) can also be represented by form 18/31 or form 15/17, which have partly identical rims and/or identical footings. This results in the following numeric values: 15/17 to 18/31 (same rim: p=0%; same footring: p=100%), 18/31 to 18 (same rim: p=100%; same footring: p=50%). Using this information, an AMT ontology (Thiery, Mees 2022b) can be created and applied (https://leiza-rse.github.io/amt-ceratyont/). This ontology allows the create Role-Chain-Axoims between forms A, B and C, such as:

Fig. 4 – Excerpt of the NAVISone Maritime Thesaurus and features of Ravenna, Sant'Apollinare Nuovo; in the middle, mosaic of the Civitas Classis (left: F. Thiery, created with SKOS Play!; middle: F. Thiery; right: RGZM/LEIZA/NAVIS3).

- Axiom 01: (A)-[exactMatch]→(B)-[exactMatch]→(C)
  - ➢ (A)-[exactMatch;ProductLogic]→(C)
- Axiom 02: (A)-[hasSameFootring]→(B)-[hasSameFootring]→(C)
  - ➢ (A)-[partiallyCoincidentWith;ProductLogic]→(C)
- Axiom 03: (A)-[hasSameRim]→(B)-[hasSameRim]→(C)
  - ➢ (A)-[partiallyCoincidentWith;ProductLogic]→(C)
- Axiom 04: (A)-[hasSameFootring]→(B)-[hasSameRim]→(C)
  - ➢ (A)-[partiallyNotCoincidentWith;ProductLogic]→(C)

With this information, the semantic reasoning of Axiom 04 shows that the semantic relationship between Dragendorff 15/17 to 18, via 18/31 (using the footing and rim information), is: (15/17) → (18) ➔ partiallyNotCoincidentWith 100%; (18) → (15/17) ➔ partiallyNotCoincidentWith 0%.

4. Community-driven vocabularies provided by 'archaeology.link'

The data hub 'archaeology.link' comprises community-driven vocabularies, e.g., the Maritime Thesaurus (derived from NAVISone), a Ceramics Typology and a Thesaurus of Figure Types (derived from the ARS3D and the Samian Research projects). The Maritime Thesaurus (Thiery 2023b) stems from the NAVIS I-III databases (https://www.leiza.de/navis) and comprises 16 top concept categories in 10 languages, e.g., ship function, internal construction, decks and ceilings, constructional features, sailing/steering gear, and warfare. An example from the NAVISone repository is ID: 200651 (https://www2.leiza.de/navis/object.html?id=200651), 'Ravenna, Mosaico della civitas Classis' (Fig. 4, middle, yellow box).

This mosaic is located in Ravenna (Italy), inside the Basilica of Sant'Apollinare Nuovo (Fig. 4, left-middle), made from glass during the Byzantine culture and displays three ship features (https://archaeolink-lod.github.io/navisone/obj_200651/). Feature 2 (ID: 201048, Fig. 4, middle green box) as well as several sailing gears such as ‘Mast (Main)’, ‘Rigging (Standing)’ and ‘Sail (Fore)’ (cf. green boxes in Fig. 4, left and right). These three keywords are part of the Maritime Thesaurus: ‘Mast (Main)’ (it.: *Albero (Maestro)*, ID: FE0706), ‘Rigging (Standing)’ (it.: *Manovre dormienti*, ID: 074F8A) and ‘Sail (Fore)’ (it.: *Vela (Di prua)*, ID: 71CB9C). The ‘Sail (Fore)’ (de.: *Vorsegel*) can be interlinked to, e.g., Wikidata Q538850 ‘foresail’, which translates to German *Fock (Segel)* and not *Vorsegel* as mentioned in the Maritime Thesaurus. The Wikidata item Q1885401 *Vorsegel* translates inside Wikidata to ‘headsail’ and is marked explicitly different from (P1889) Q538850 ‘foresail’. Moreover, the Getty AAT describes ‘foresail’ in ID:300425931 without any scope note, just as narrower than «temporary alphabetical list: water transportation equipment» and «water transportation equipment» (https://vocab.getty.edu/aat/300435696).

This small example shows challenges in mapping *thesauri* terms, which requires new solutions using semantic alignment techniques (Thiery, Mees 2023a). This can be done by using variations of Simple Knowledge Organization System (SKOS) mapping properties (https://www.w3.org/TR/2009/REC-skos-reference-20090818/#mapping) skos:relatedMatch, skos:closeMatch and skos:exactMatch properties (Nation 2017), e.g., almost certainly (skos:exactMatch), very good chance (skos:closeMatch), little chance (skos:relatedMatch) or highly unlikely (skos:relatedMatch), or using quantitative descriptions of the edge properties, such as a weight attribute (degree of connection between 0 and 1) in the Academic Meta Tool (Unold *et al.* 2019). The perceptions of probability and numbers can lead to weights (as median values of Nation 2017, probly.csv), e.g., almost certainly (95%), very good chance (80%), little chance (15%) or highly unlikely (5%).

5. Research and FAIRification tools provided by ‘archaeology.link’

One of the main aims of ‘archaeology.link’ is to provide research software for domain-specific purposes. This includes FAIRification tools such as the re3dragon (Thiery, Mees 2024) or AMT (Unold *et al.* 2019; Thiery, Mees 2023a) or research tools which can handle LOD and relative chronologies such as Alligator (https://github.com/leiza-rse/alligator/) or TiGeR (https://github.com/leiza-rse/tiger/). Both tools allow for handling so called ‘Dated Sites’ using correspondence analysis to treat chronologies as graphs (Thiery, Mees 2023c). One example to demonstrate the possibilities of the TiGeR (Time Geospatial RDF) and Alligator (Allen Transformer) research tools can be seen in Fig. 5. Following the horseshoe paradigm (Madsen 1988, 25), a correspondence analysis (CA), when applied to datasets with a possible chronological sensitive meaningfulness,

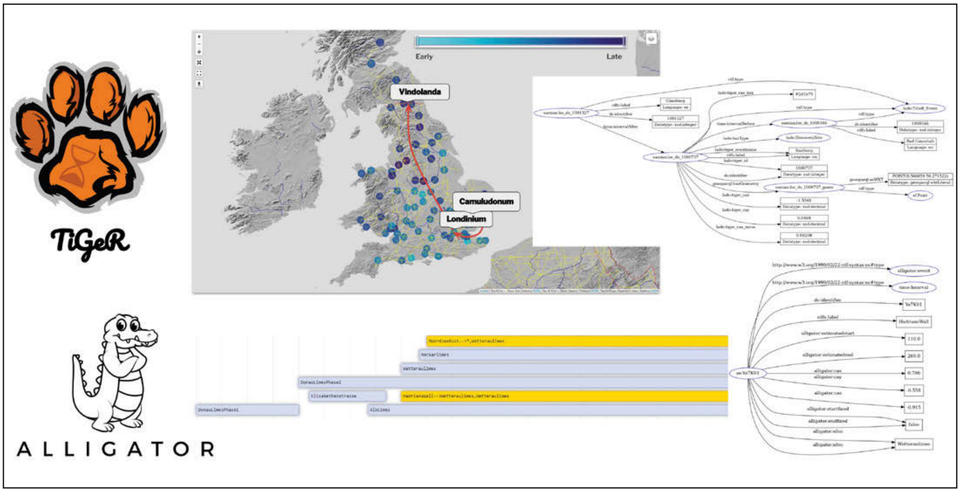

Fig. 5 – Samples from the Research Tools TiGeR and Alligator show visualisations of relative time periods on a map and virtual timeline and as schematic RDF/LOD calculated by correspondence analysis results (F. Thiery, A.W. Mees).

displays the inertia within a dataset based on computing the Chi-square statistic for two-way tables. The results may provide a measure of (possible chronological) overlap between e.g. different Roman 'Dated Sites' comprising identical materials such as a Roman *terra sigillata* having identical features, specifically vessels having name stamps of the same potter. It is important to note that a CA of assumed 'Dated Sites' does not comprise any pre-known dating information of these 'Dated Sites', but solely calculates with the partially overlapping incidences of specific objects between these 'Dated Sites'.

In the examples of Fig. 5, incidences of sites, potters and their occurrences are used. The TiGeR map shows assumed 'Dated Sites' in Britannia coloured by normalising the 1st Dimension values of the CA output and converting them into gradient colours using rainbow.js. This creates a result which can be interpreted as a gradient chronology of Britannia, displaying the enrolling occupation of Britain from *Camulodunum* via *Londinium* to *Vindolanda* on a map, resulting in an Linked Open Data (LOD) representation in a Resource Description Framework (RDF) format following the TiGeR ontology (Fig. 5, top). Using the Alligator Method based on the Alligator Algorithm (Thiery, Mees 2023b), the calculation starts with calculating the 3D distances by using the coordinates of the first 3 CA dimensions, establishing undated wobbly floating periods by finding the next 3D CA neighbour.

Within the next step, the new virtual time intervals are calculated, and the resulting virtual fuzzy years are generated based on Allen's Interval Algebra (Allen 1983; Freksa 1991). Fig. 5 (bottom) displays the virtual timeline (and its LOD representation) of vague floating intervals for two *limes* sections: Hadrian's Wall and the North Sea Coast. The process of nearest neighbour findings suggests a starting date of Hadrian's Wall similar to that of the Wetterau Limes. The calculated virtual fuzzy years seem to confirm the widespread assumption that Hadrian's Wall, the North Sea Coast foundations and the Wetterau Limes were founded in the same decades.

6. Conclusion

This paper has demonstrated three elements of the 'archaeology.link' resource: the semantic modelled Linked Open Data and ontologies, community-driven vocabularies such as research domain-specific *thesauri*, and the provision of research and FAIRification tools. Data hubs like 'archaeology.link', providing a common ontology, derived research data and *thesauri*, sub-ontologies and research tools which are enabling the implementation of Semantic Web technologies (serving themselves as FAIRification tools as well) are offering good opportunities to implement the FAIR data principles and to realise the idea of Open Science.

The research results stemming from the usage of the platform 'archaeology.link' have thrown entirely new light on the dating qualities of archaeological finds, such as Roman *terra sigillata,* which is found in Italy, Spain, North Africa and the Northwestern Roman Empire. The developed ontology of CeraTyOnt enables new ways of interconnecting different European research traditions, which are rooted in their own national typologies. This typologies ontology enables the interconnection of European typologies instead of creating a single new dominating typology, which acceptance in individual European research traditions would remain to be seen. The handling of time intervals with the Alligator tool enabled the chronological classification of e.g. continental Limes sections together with Hadrian's Wall. This provides a new dating fundament for British, Dutch and German archaeologies. The same is valid for the Maritime Thesaurus, comprising SKOS based terms which are in use in different European maritime archaeologies, ranging from Italian shipwrecks, Scandinavian Viking ships to Phoenician maritime finds.

Institutions which are offering similar resources like 'archaeology.link' are paving their way into (inter)national initiatives such as NFDI consortia or EOSC. However, the hurdles are high for researchers within the Humanities to transform and provide their data structured in the required way. Platforms and hubs like 'archaeology.link' are a great way to establish interdisciplinary, international and cross-institutional communities around specific scientific subjects. Due to the common LADO ontology, these initiatives all have a common and scalable fundament. However, the challenges of maintenance, continuity and sustainability for both data and research software must be matched with the available financial and human resources, suggesting that there is only a very limited group of research institutions which can guarantee the sustainability of such platforms and hubs.

Florian Thiery, Allard W. Mees
Leibniz-Zentrum für Archäologie (LEIZA), Mainz
florian.thiery@leiza.de, allard.mees@leiza.de

REFERENCES

Allen J.F. 1983, *Maintaining knowledge about temporal intervals*, «Communications of the ACM», 26, 11, 832-843 (https://doi.org/10.1145/182.358434).

Berners-Lee T. 2006, *Linked Data* (https://www.w3.org/DesignIssues/LinkedData.html).

Bibby D., Bruhn K.-C., Busch A., Dührkohp F. *et al.* 2023, *NFDI4Objects. Proposal*, «NFDI4Objects Zenodo Community» (https://doi.org/10.5281/zenodo.10409227).

Dragendorff H. 1895, *Terra sigillata. Ein Beitrag zur Geschichte der griechischen und römischen Keramik*, «Bonner Jahrbücher», 96-97, 18-155.

Fless F., Baumeister P., Boyxen B. *et al.* 2021, *Die iDAI.world vor dem Hintergrund der neuen Digitalgesetze*, «Forum for Digital Archaeology and Infrastructure», 1, 1-51 (https://doi.org/10.34780/s2ne-t268).

Freksa C. 1991, *Conceptual neighborhood and its role in temporal and spatial reasoning*, in M.G. Singh, L. Travé-Massuyés (eds.), *Proceedings of the IMACS Workshop on Decision Support Systems and Qualitative Reasoning*, Amsterdam, North-Holland, 181-187.

Hartl N., Wössner E., Sure-Vetter Y. 2021, *Nationale Forschungsdateninfrastruktur (NFDI)*, «Informatik Spektrum», 44, 5, 370-373 (https://doi.org/10.1007/s00287-021-01392-6).

Hayes J.W. 1972, *Late Roman Pottery*, London, British School at Rome.

Helms T. 2018, *DANTE-DAtendrehscheibe für Normdaten und TErminologien*, «AKMB-News», 24, 1 (https://doi.org/10.11588/akmb.2018.1.63475).

Homburg T., Thiery F. 2024, *SPARQL Unicorn ontology documentation, v0.17*, «Squirrel Papers», 6, 2 (https://doi.org/10.5281/zenodo.10780476).

Isaksen L., Earl G., Martinez K., Keay S., Gibbins N. 2010, *Linking archaeological data*, in B. Frischer, L. Fischer, D. Koller (eds.), *Making History Interactive. Computer Applications and Quantitative Methods in Archaeology (CAA): Proceedings of the 37th International Conference*, Williamsburg, Archaeopress, 2-8 (https://eprints.soton.ac.uk/204529/).

Klyne G., Carroll J.J., McBride B. 2014, *RDF 1.1 Concepts and Abstract Syntax; W3C Recommendation 25 February 2014* (https://www.w3.org/TR/rdf11-concepts/).

zu Löwenstein S. 2015, *Mythologische Darstellungen auf Gebrauchsgegenständen der Spätantike: die appliken- und reliefverzierte Sigillata C3/C4*, «Kölner Jahrbuch», 48, 397-823.

Madsen T. (ed.) 1988, *Multivariate Archaeology: Numerical Approaches in Scandinavian Archaeology*, Århus, Jutland Archaeological Society.

Mees A., Thiery F. 2021, *Une visualiseur et éditeur numérique sur Internet pour une ontologie des typologies de terre sigillée,* in *Actes des Congrès de la Société française d'étude de la céramique antique en Gaule*, Marseille, SFÉCAG, 585-589.

Nation Z. 2017, *Perceptions of Probability and Numbers* (https://github.com/zonination/perceptions).

Raemy J.A., Sanderson R. 2023, *Analysis of the usability of automatically enriched cultural heritage data*, «arXiv», 2309.16635 (https://doi.org/10.48550/arXiv.2309.16635).

Sanderson R. 2018, *LOUD: Linked Open Usable Data* (https://linked.art/loud/).

Schmidt S.C., Thiery F., Trognitz M. 2022, *Practices of Linked Open Data in archaeology and their realisation in Wikidata*, «Digital», 2, 3, 333-364 (https://doi.org/10.3390/digital2030019).

Thiery F. 2022, *Linked Archaeological Data Ontology*, *v1.0*, «Squirrel Papers», 4, 2 (https://doi.org/10.5281/zenodo.7377740).

Thiery F. 2023a, *Archaeolink-lod/ars*, *GitHub-Repository*, «Squirrel Papers», 5, 6 (https://github.com/archaeolink-lod/ars).

Thiery F. 2023b, *Archaeolink-lod/maritimethesaurus*, *GitHub-Repository*, «Squirrel Papers», 5, 6 (https://github.com/archaeolink-lod/maritimethesaurus).

Thiery F. 2023c, *Archaeolink-lod/navisone*, *GitHub-Repository*, «Squirrel Papers», 5, 6 (https://github.com/archaeolink-lod/navisone).

Thiery F., Mees A. 2022a, *Ceramic Typologies Ontology (CeraTyOnt)*, *v0.2*, «Squirrel Papers», 4, 2 (https://doi.org/10.5281/zenodo.5767082).

Thiery F., Mees A. 2022b, *CeraTyOnt @ AMT*, *v1.0*, «Squirrel Papers», 4, 2 (https://doi.org/10.5281/zenodo.7143093).

Thiery F., Mees A. 2023a, *Taming Ambiguity. Dealing with doubts in archaeological datasets using LOD*, in *Proceedings of Computer Applications and Quantitative Methods in Archaeology Conference CAA 2018, Human History and Digital Future (Tübingen 2018)*, Tübingen, University Press (http://dx.doi.org/10.15496/publikation-87762).

Thiery F., Mees A.W. 2023b, *Alligator method*, «Squirrel Papers», 5, 1 (https://doi.org/10.5281/zenodo.7624870).

Thiery F., Mees A.W. 2023c, *Dating dated sites. Using Correspondence Analysis to handle chronologies as graphs*, «Squirrel Papers», 5, 4 (https://doi.org/10.32028/Groma-Issue-7-2022-2429).

Thiery F., Mees A. 2024, *Re3dragon. A research registry resource API for data dragons*, «GROMA: Documenting Archaeology», 7 (http://doi.org/10.32028/Groma-Issue-7-2022-2429).

Thiery F., Mees A.W., Gottwald D., Homburg T. 2023a, *Archaeolink-lod/samian*, *GitHub-repository*, «Squirrel Papers», 5, 6 (https://github.com/archaeolink-lod/samian).

Thiery F., Mees A.W., Weisser B., Schäfer F.F., Baars S., Nolte S., Senst H., Von Rummel P. 2023b, *Object-related research data workflows within NFDI4Objects and beyond*, in Y. Sure-Vetter, C. Goble (eds.), *1st Conference on Research Data Infrastructure (CoRDI) - Connecting Communities*, Hannover, TIB Open Publishing, CoRDI2023-46 (https://doi.org/10.52825/cordi.v1i.326).

Thiery F., Schmidt S.C. 2023, *Research-Squirrel-Engineers/bb-5kbc*, *GitHub-repository*, «Squirrel Papers», 5, 6 (https://github.com/Research-Squirrel-Engineers/bb-5kbc/).

Thiery F., Schmidt S.C., Homburg T., Trognitz M. 2020, *The SPARQL Unicorn: An introduction*, «Squirrel Papers», 2, 1 (https://doi.org/10.5281/zenodo.3742185).

Unold M., Thiery F., Mees A. 2019, *Academic Meta Tool. Ein Web-Tool zur Modellierung von Vagheit*, «ZfdG. Zeitschrift für digitale Geisteswissenschaften», Die Modellierung des Zweifels. Schlüsselideen und-konzepte zur graphbasierten Modellierung von Unsicherheiten. Sonderband 4 (https://doi.org/10.17175/SB004_004).

ABSTRACT

FAIRification and sharing of open data is an important aspect of the German National Research Data Infrastructure (NFDI) and its archaeology related consortium NFDI4Objects. NFDI4Objects offers domain-specific data-driven hubs to publish and share research data, Linked Open Data (LOD), ontologies, community-driven vocabularies and authority files, such as *thesauri*. This paper demonstrates the content, challenges and possibilities of the Data Hub 'archaeology.link'. It consists of five thematic parts: 1) Semantic Modelling using the Linked Archaeological Data Ontology (LADO), 2) publication of domain-specific Linked Open Data, 3) community-driven vocabularies such as *thesauri*, 4) ontologies and 5) research tools.