SuALT: Collaborative Research Infrastructure for Archaeological Finds and Public Engagement through Linked Open Data

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The Finnish Archaeological Finds Recording Linked Database (*Suomen arkeologisten löytöjen linkitetty tietokanta* – SuALT) is a concept for a digital web service catering for discoveries of archaeological material made by the public; especially, but not exclusively, metal detectorists. SuALT, a consortium project funded by the Academy of Finland and commenced in September 2017, has key outputs at every stage of its development. Ultimately it provides a sustainable output in the form of Linked Data, continuing to facilitate new public engagements with cultural heritage, and research opportunities, long after the project has ended.

While prohibited in some countries, metal detecting is legal in Finland, provided certain rules are followed, such as prompt reporting of finds to the appropriate authorities and avoidance of legally-protected sites. Despite misgivings by some about the value of researching metal-detected finds, others have demonstrated the potential of researching such finds, for example uncovering previously unknown artefact typologies. Engaging non-professionals with cultural heritage also contributes to the democratization of archaeology, and empowers citizens. In Finland metal detecting has grown rapidly in recent years. In 2011 the Archaeological Collections registered 31 single or assemblages of stray finds. In 2014, over 2700 objects were registered, in 2015, near 3000. In 2016 over 2500 finds were registered. When the finds are reported correctly, their research value is significant. The Finnish Antiquities Act §16 obligates the finder of an object for which the owner is not known, and which can be expected to be at least 100 years old, to submit or report the object and associated information to the National Board of Antiquities (*Museovirasto* – NBA); the agency responsible for cultural heritage management in Finland. There is also a risk, as finders get older and even pass away, that their discoveries and collections will remain unrecorded and that all associated information is lost permanently.

In the current state of the art, while archaeologists increasingly use finds information and other data, utilization is still limited. Data can be hard to find, and available open data remains fragmented. SuALT will speed up the process of recording finds data. Because much of this data will be from outside of formal archaeological excavations, it may shed light on sites and features not usually picked up through 'traditional' fieldwork approaches, such as previously unknown conflict sites. The interdisciplinary approach and inclusion of user research promotes collaboration among the infrastructure's producers, processors and consumers. By linking in with European projects, SuALT enables not only national and regional studies, but also contributes to international and transnational studies. This is significant for studies of different archaeological periods, for which the material culture usually transcends contemporary national boundaries. Ethical aspects are challenged due to the debates around engagement with metal detectorists and other artefact hunters by cultural heritage professionals and researchers, and we address head-on the wider questions around data sharing and knowledge ownership, and of working with human subjects. This includes the issues, as identified by colleagues working similar projects elsewhere, around the concerns of metal detectorists and other finders about sharing findspot information. Finally, the usability of datasets has to be addressed, considering for example controlled vocabulary to ease object type categorization, interoperability with other datasets, and the mechanics of verification and publication processes.

The project is unique in responding to the archaeological conditions in Finland, and in providing solutions to its users' needs within the context of Finnish society and cultural heritage legislation. While it focuses primarily on the metal detecting community, its results and the software tools developed are applicable more generally to other fields of *citizen science in cultural heritage*, and

even beyond. For example, in many areas of collecting (e.g. coins, stamps, guns, or art), much cultural heritage knowledge as well as collections are accumulated and maintained by skilful amateurs and private collectors. Fostering collaboration, and integrating and linking these resources with those in national memory organizations would be beneficial to all parties involved, and points to future applications of the model developed by SuALT. Furthermore, there is scope to integrate SuALT into wider digital humanities networks such as DARIAH (http://www.dariah.eu).

Framing SuALT's development as a consortium enables us to ask important questions even at development stages, with the benefit of expertise from diverse disciplines and research environments. The benefits of SuALT, aside from the huge potential for regional, national, and transnational research projects and international collaboration, are that it offers long term savings on costs, shares expertise and provides greater sustainability than already possible. We will explore the feasibility of publishing the finds data through international aggregation portals, such as Europeana (http://www.europeana.eu) for cultural heritage content, as well as working closely with colleagues in countries that already have established national finds databases. The technical implementation also respects the enterprise architecture of Finnish public government. Existing Open Source solutions are further developed and integrated, for example the GIS platform Oskari.org (http://oskari.org) for geodata developed by the National Land Survey with the Linked Data based Finnish Ontology Service of Historical Places and Maps (http://hipla.fi). SuALT's data is also disseminated through Finna (http://www.finna.fi), a leading service for searching cultural information in Finland.

SuALT consists of three subprojects: subproject I "**User Needs and Public Cultural Heritage Interactions**" hosted by University of Helsinki; subproject II "**National Linked Open Data Service of Archaeological Finds in Finland**" hosted by Aalto University, and subproject III "**Ensuring Sustainability of SuALT**" hosted by the NBA.

The primary aim of SuALT is to produce an open Linked Data service which is used by data producers (namely the metal detectorists and other finders of archaeological material), by data researchers (such as archaeologists, museum curators and the wider public), and by cultural heritage managers (NBA). More specifically, the aims are:

a. To discover and analyse the needs of potential users of the resource, and to factor these findings into its development;
b. To develop metadata models and related ontologies for the data that take into account the specific needs of this particular infrastructure, informed by existing models;
c. To develop the Linked Data model in a way that makes it semantically interoperable with existing cultural heritage databases within Finland;
d. To develop the Linked Data model in a way that makes it semantically interoperable with comparable 'finds databases' elsewhere in Europe, and
e. To test the data resulting from SuALT through exploratory research of the datasets for archaeological research purposes for cultural heritage and collection management work.

The project corresponds closely with the strategic plans of the NBA and responds to the growth of metal detecting in Finland. Internationally, it corresponds with the development of comparable schemes in other European countries and regions, such as Flanders (*MetaaldEtectie en Archeologie* – MEDEA initiated in 2014), and Denmark and the Netherlands (*Digitale Metaldetektorfund* or DIgital MEtal detector finds – DIME, and Portable Antiquities in the Netherlands – PAN, both initiated in 2016). It takes inspiration from the Portable Antiquities Scheme (PAS) Finds Database (https://finds.org.uk/database) in England and Wales. These all aspire to an ultimate goal of a pan-European research infrastructure, and will work together to seek a larger international collaborative research grant in the future. A contribution of our work in relation to the other European projects is to employ the Linked Data paradigm, which facilitates better interoperability with related datasets, additional data enrichment based on well-defined semantics and reasoning, and therefore better means for analysing and using the finds data in research and applications.

The **expected scientific impacts** are that the process of developing SuALT, including critically analysing comparable resources, user group research, and creating innovative solutions, will in themselves produce a rich body of interdisciplinary academic output. This will be disseminated in peer reviewed journals and at selected conferences across several disciplinary boundaries including Computer Science, Archaeology, and Cultural Heritage Studies. It also links in, at a crucial moment in the development of digital heritage management, with parallel resources elsewhere in Europe. This means that not only can a coordinated and international approach be taken in development, but that it is extremely timely, taking advantage of the opportunity to benefit from the experiences and perspectives of colleagues pursuing similar resources. SuALT ensures that Finnish cultural heritage management is at the forefront of digital heritage. The project also carries out a small-scale 'test' project using the database as it forms, and in this way contributes to the field of artefact studies. The contribution to future knowledge sits at a number of levels. There are technical challenges to create the linked database in a way that complements and is interoperable with existing national and international infrastructures. Solving these challenges generates contributions to understanding digital data management and service. The process of consulting users represents an important case study in formative evaluation of particular interest groups with regard to digital heritage and citizen science, as well as shedding further light on different perceptions and uses of cultural heritage. SuALT relates to the emerging trend of publishing open science data, facilitating the analysis and reuse of the data, exemplified by e.g. DataONE (http://www.dataone.org) and Open Science Data Cloud (http://www.opensciencedatacloud.org).

We hypothesise that SuALT will result in a sustainable digital data resource that responds to the different user needs, and which provides high quality archaeological research which draws on data from Finland. SuALT also enables integration with comparative data from abroad. Outputs throughout the development process represent important contributions to research into digital heritage applications and semantic computing, going the needs of the scientific community. The selected Linked Data methodology is suitable for archaeology and cultural heritage management due to the need to combine and connect heterogeneous data collections in the field (e.g. museum collections, finds databases abroad) and other datasets, such as vocabularies of places, persons, and time periods, benefiting cultural heritage professionals. Publishing the finds database as open data using standardised metadata formats facilitates the data's re-use, fostering new research by the scientific community but also the development of novel applications for professionals and citizens. Taking a strategic approach to the challenge of creating this resource, and treating it as a research project, rather than developing an ad hoc resource, ensures that the project's legacy is a significant and long term contribution to digital curation of public-generated archaeological data.

As its key societal impact, SuALT provides a vital interface for non-professionals to contribute to and benefit from Finland's archaeological record, and to integrate this with comparable datasets from abroad. The project enhances cooperation between non-professionals and cultural heritage managers. Careful user research ensures that SuALT offers means of engagement and access to data and other information that is usable and meaningful to a wide range of users, from metal detectorists and amateur historians, through to professional curators, cultural heritage managers, and academic researchers, domestically and abroad. SuALT's results are not limited to metal detection but have a wider impact: the same key challenges of engaging amateur collectors to collaborate with memory organization experts in citizen science are encountered in virtually all fields of collecting and maintaining tangible and intangible cultural heritage.

The process of developing SuALT provides an unprecedented opportunity to research the use of digital platforms to engage the public with archaeological heritage in Finland. Inspired by successful initiatives such as PAS and MEDEA, the potential for individuals to self-record their finds also echoes the emerging use of crowdsourcing for public archaeology initiatives. Thus SuALT offers a significant opportunity to contribute to further understanding digital cultural heritage and its uses, including its role within society. It is likely that the coordination of SuALT with digital finds recording initiatives in other countries will lead to a transnational platform for finds recording, giving Finland an opportunity to be at the forefront of digital heritage-based citizen science research and development.