Archeologia e Calcolatori
36.2, 2025, 39-54
doi 10.19282/ac.36.2.2025.05

THE SEMANTIC CENSUS: A NEW EXPRESSION OF THE CENSUS OF ANTIQUE WORKS OF ART AND ARCHITECTURE KNOWN IN THE RENAISSANCE AS OPEN DATA

1. Introduction

The Census of Antique Works of Art and Architecture Known in the Renaissance is a research project that has developed continuously since 1946. For over 75 years, it has attempted to answer a specific question: which antiquities were known in the Renaissance? Its objective has remained that of matching ancient artifacts with Renaissance visual representations and texts that depict or reference them. The Census project initially took shape as an analog system of index cards and photographs. Beginning in the early 1980s, it was digitized with the support of the Getty's Art History Information Program. It is among the first digital art history projects and possibly the oldest still in active use (Bartsch 2008). The Census database has undergone numerous technological advancements – from UNIX, to the Dyabola MS-DOS system, to CD-ROM, to an open-access database on EasyDB – and, since 2023, has been accessible on fylr, the latest iteration of EasyDB, at https://database.census.de.

Recently, between 2021 and 2023, the Census has taken further steps: its dataset was modeled according to the CIDOC-CRM ontology, creating a set of Semantic Census models that explicitly represent the knowledge and data contained within it. It was transformed into RDF following these models and made available first on Zenodo (Nenova, Bruseker 2023c) and subsequently on the eDoc server of the Humboldt-Universität (most recently, Christian 2024). With this latest shift, the Census has progressed toward the goal of FAIR data representation, delivering a corpus of rigorously researched, curated art historical data for new investigative programs beyond its original scope[1].

When it began, the Census was focused on figural antiquities and was guided by an interest in the origins of the Renaissance (1400-1527), when classical antiquity was once again 'known'. In the 1980s, the project expanded to include architecture and to encompass the whole of the sixteenth century. Now, the Census continues to evolve both methodologically and technically. At a time when born-analog research projects are being integrated into large-scale national and international research infrastructures and knowledge

[1] The semantic modeling of the Census data took place between 2021 and 2023 as a collaborative effort among the authors and was supported by generous funding from the Berlin University Alliance.

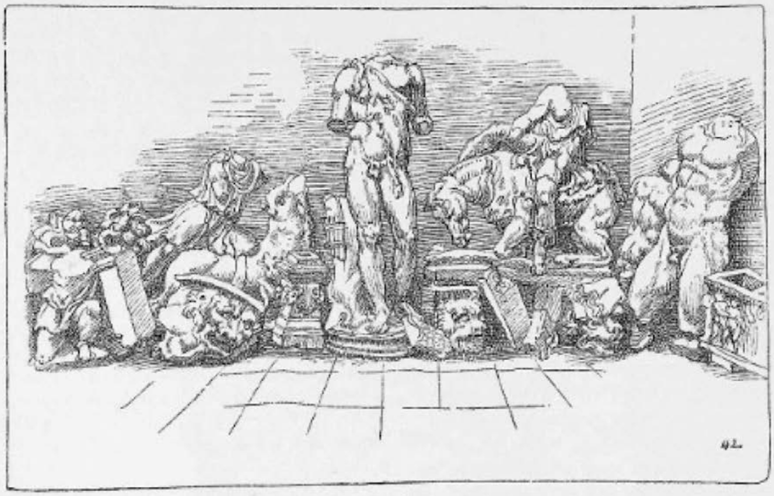
graphs, what opportunities does linked data offer for utilizing, challenging, or expanding this historic dataset? This article provides background to the Census project and its development over time, then describes the rationale and method of Semantic Census, which aims to meet the needs of the present digital landscape while laying the groundwork for future developments. It outlines how the Semantic Census builds upon the scholarly tradition of the analog Census, opening it to broader contexts, and concludes by addressing structural challenges.

2. Census history

The origins of the Census can be traced to a letter of September 1945 by the art historian Richard Krautheimer, who with his wife, Trude Krautheimer-Hess, was writing a monograph on Lorenzo Ghiberti (1378-1455). In correspondence with Fritz Saxl, director of the Warburg Institute, Krautheimer complained about a lack of basic research on the antique objects that might have inspired Ghiberti. He asked if they should organize «a corpus of antiquities known to the 15th century». Saxl responded enthusiastically, agreeing that «it is time that somebody, either at New York University or with us, tackled the subject» (Trapp 1999; *75 Years*). In the spring of 1946, Krautheimer and Saxl formulated their plans for a project that would correct a vague and inexact sense of the classical influences absorbed in the Renaissance, replacing it with hard facts about which antiquities were known, when, and where.

From its inception, the Census was not concerned with Renaissance adaptations of the antique, but with a corpus of antique artifacts that could be matched with Renaissance artistic or textual representations. Krautheimer and Saxl, with the support of Karl Lehmann at NYU, appointed the American archaeologist Phyllis Bober to develop the Census, which would occupy her from the 1940s to the 1980s. In devising a methodology, Krautheimer and Saxl followed a project developed in the 1930s by another exiled German art historian, Ludwig Burchard, who had compiled index cards at the Warburg Institute about the antiquities known to 17th-century artists (Lu 2023). The approach taken by the Census was, moreover, fundamentally shaped by a type of archaeological cataloging of Renaissance drawings first pioneered by Otto Jahn and developed by Adolf Michaelis and Christian Hülsen.

Whereas studies like Michaelis's catalog of the drawings of Maarten van Heemskerck (Michaelis 1891; Fig. 1) began with Renaissance works of art and compiled lists of the antiquities they depicted, the Census would reverse this approach by starting with specific antiquities and listing the Renaissance visual and textual descriptions that documented 'knowledge' of them. The



142 Michaelis, Römische Skizzenbücher nordischer Künstler.

Fig. 3. In Casa Santacroce.

f) Kleiner Sarkophag, nur z. Th. sichtbar; vorne links eine Sonnenuhr(?), zwei stehende Knaben oder Jünglinge ringend(?), Andeutung einer weiteren Figur.

g) Links von *a* Mithras auf dem Stier knieend, an dem vorne der Hund sichtbar wird.

h) Kleine viereckige Basis mit Widderköpfen und Guirlanden.

i) Stück eines ovalen Sarkophags mit grofsem Löwenkopf, anscheinend Stück eines ganzen Löwen (vgl. I, 26 v, *b*).

k) Löwenkopf, ähnlich.

l) Kleine auf dem r. Knie kniende Figur, in Motiv und Gewandung nicht unähnlich der Amazone bei Cavall. III. IV, 43, doch scheint sie nicht identisch (vgl. zu I, 47, *a*) und ist vielleicht eher männlich. Von den attalischen Weihgeschenken?

Fig. 1 – Page from Michaelis 1891, 142.

Census method was to create index cards, each labeled at the top with the name of an antique monument. Information about the object's excavation, restoration, and Renaissance documentation (such as drawings, statuettes, prints, or texts) followed, along with relevant bibliography. The index cards were matched in the Warburg Institute's Photographic Collection with images (Fig. 2) and, through transatlantic cooperation, two analog Censuses of index cards and photographs grew in parallel: one in NYU and one at the Warburg Institute (Trapp 1999; *75 Years*). Those familiar with the handbook *Renaissance Artists and Antique Sculpture* by Bober and Ruth Rubinstein (Bober, Rubinstein 1986) will recognize the origins of this reference guide in the working methods of the analog Census.

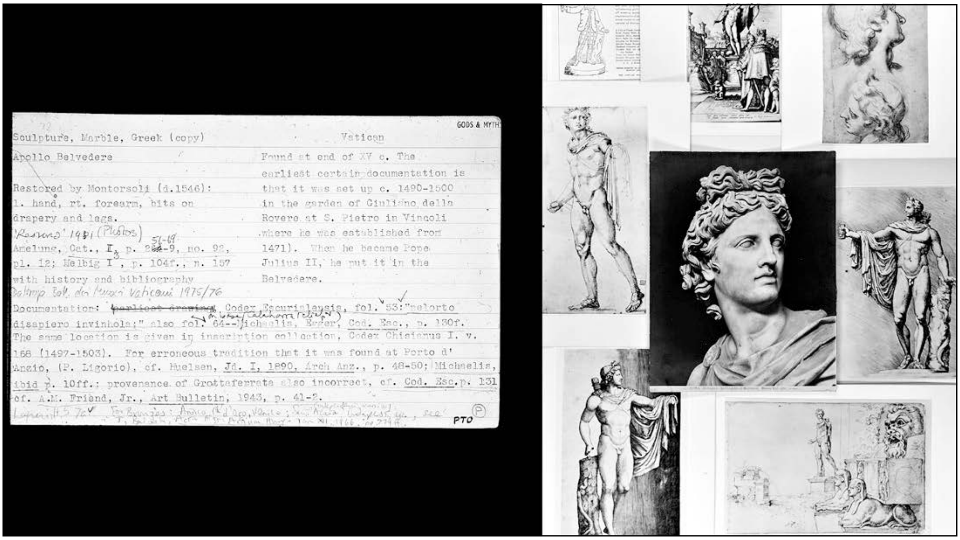


Fig. 2 – Warburg Institute, Photographic Collection, the Analog Census: Census card and photographs related to the Apollo Belvedere.

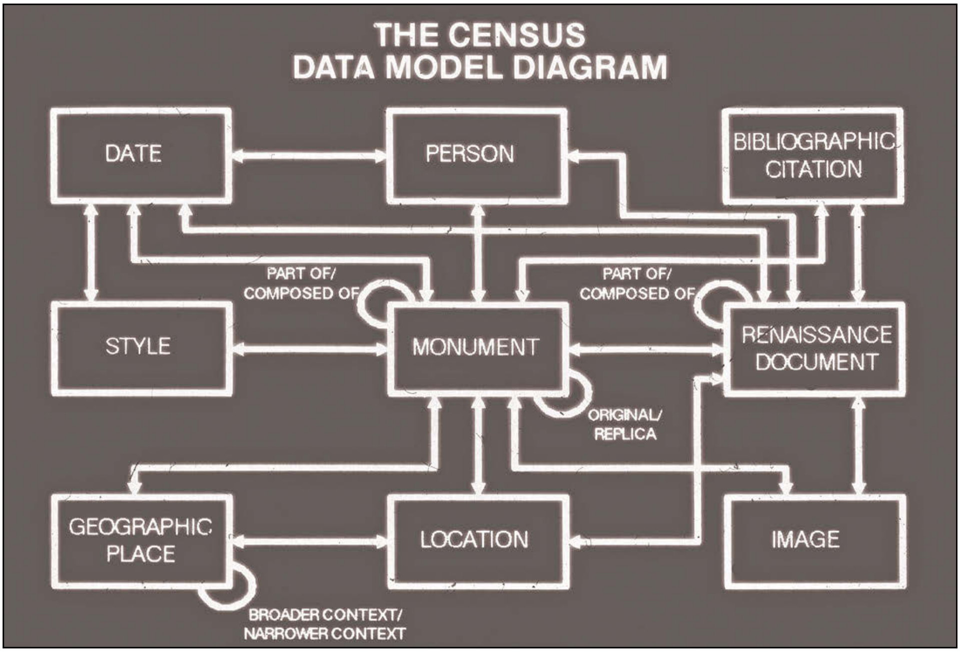


Fig. 3 – Original Census data model.

In the early 1980s, the Bibliotheca Hertziana joined the Census as a supporting partner, and the project was expanded to encompass architecture and the entirety of the sixteenth century. Starting in 1982, the Getty's Art History Information Program sponsored the development of a database system to access and search materials both in the Census and in the Witt photo archive of the Courtauld Institute. Arnold Nesselrath and the computer scientist Rick Holt developed a data model for the Census that linked two primary files: monuments (antiquities) and documents (the Renaissance texts and images that demonstrate knowledge of these antiquities). An additional set of 'authority files' (places, persons, bibliography, dates, and styles) was linked to these primary files (Nesselrath 1993; Bartsch 2009) (Fig. 3).

The digital representation of the Census put it on the cutting edge and gave it a more prominent profile at a time when art-historical interest in the reception of the antique was broadening (e.g. Settis 1984-1986). Its ordered data model provided the project with a systematic organization, which was preserved and adapted to new formats. The project moved to Berlin in the 1990s with Nesselrath's appointment as a Professor at the Humboldt-Universität, and further expansion of the content of the database was achieved through the addition of the Corpus Winckelmann and through collaboration with focused projects (*Linked Projects - Census,* https://www.census.de/en/linked-projects/).

As the Census database grew in content and became increasingly accessible, it served as a roadmap of antiquities and their Early Modern representations, filling a significant gap in research caused by the fact that antiquities in the Early Modern period were traditionally not a core concern of either archaeology or art history. At the same time, the early adoption of a fixed data model and a hierarchical, relational database format locked in a structure that could not be easily changed. Reservations about dryness and rigidity had followed the Census project since its origins (Bober 1989; Trapp 1999) and in 1982, at the earliest stages of digitization, Bober expressed hope that a computerized Census could retain a sense of flexibility and openness suited to individual use. The Census should be programmed in Pascal, she proposed, or another language likely to be taught in free evening courses, so that researchers could «make up their own program to use the data base in new searches we might not have anticipated» (*75 Years*, room 3).

The Census data model developed during an era of significant technical restrictions, when the digitization of images (originally stored on laserdisc) was highly resource-intensive. The structural and technical limitations of the systems available in the 1980s guided the database's rules of admission as well as its strict focus on its principal aim, which was to connect genuine antique monuments with Renaissance images or texts that documented them. Defining one-to-one links between antique monuments and Renaissance documents has remained over decades the core work of the Census database, yet by today's standards, such a data model seems rigid and restrictive, prohibiting the type of flexibility that Bober hoped to achieve. Over the years, proposals have been made to expand its functionality, specifically to transform the Census into a graph database to allow it to function as a complex network (Schich 2009).

The use of databases in the humanities generally has, in numerous ways, been called into question, and much research has been invested in more nuanced, more adaptable alternatives (Oldman 2021). Although a new representation of the Census data in an entirely different format has so far remained out of reach, since 2020 the first steps have been taken to make the dataset more dynamic and more open. For example, with the relaunch of the Census in fylr (in April 2023) the categories 'Monument' and 'Document' were renamed 'Antique Monument' and 'Postclassical Work'. This change acknowledges the integrity of drawings, sculptures, and texts as creative works in their own right, while complicating their status as straightforward 'documents' proving Renaissance knowledge of antiquities (Sawatzki 2023). 'Antique Monument' is now also redefined as a more ambiguous category, which «may also include deliberate falsifications of antiquities, or objects which were judged incorrectly in the Early Modern period to be antique» (*Census Data Model Documentation*: https://census-antiquity-renaissance.github.io/census_csdm/; Mantilla 2023; Miller 2024). Another key focus, as is detailed below, has been the transformation of Census data into semantic data in order to expand the project's reach, enable its data to be utilized beyond its original framework, and open it up to broader scholarly engagement.

3. From digital resource to Linked Data

As a long-lived and successful project, the Census has spanned multiple technological shifts during the course of its existence. Moving through several analog stages and embracing the digital shift early on, it has had to evolve in dialogue with the advancement of information management technologies. Doing so, as has been detailed above, has meant both reaping the benefits and experiencing the limitations of those technologies as they arose. One approach to information management that has emerged over the later period of the Census's history is the proposal of the semantic web and Linked Open Data (Berners-Lee *et al.* 2001; Bizer *et al.* 2023). This method offers an opportunity to create an additional representation of the Census data that would not only preserve its original value but would also simultaneously free it from the particular research perspective of its origin, to act as raw data for new research questions and methods, in art history, in archaeology, and also potentially outside of these disciplines entirely.

The idea of the semantic web proposes that data be encoded in a way that is not only human-readable but also machine-processable (Antoniou, Van Harmelen 2004). By adopting agreed common data structuring methods – formal ontologies – it proposes expressing data through a lingua franca for data encoding that is both recognizable and usable for members of a common domain, such as art history, while also being logically processable by algorithms and queries (Guarino 1997). The notion of Linked Open Data builds on this by ensuring that data is assigned unique resource identifiers, making unique items in the common data web referenceable and potentially discoverable. Linking the data by semantically meaningful predicates aims to make it fully accessible without the barrier of an idiosyncratic data structure. Together, these proposals form a key part of the concept of FAIR data (Carballo-Garcia, Boté-Vericad 2022), which has become a primary objective of the collaborative research community and, increasingly, a requirement for publicly funded research. FAIR data ensures that publicly funded data is accessible and reusable, while enabling research results to be integrated across projects over time.

Curated over several generations of scholarship, the Census dataset offers a rich seam of research data for representation in the semantic web. Moreover, its evolution as a project and dataset parallels many of the core aims of such a diachronic research effort. While the Census, as outlined above, began with targeted scholarly goals, shifts in methodology and changing interactions of scholars stretched its capacities, expanding the scope of the original data structure and of the data collected. The demands of the research, moreover, made interinstitutional data gathering and sharing a necessity. Its early digitization program, supported by the Getty, provided the Census with its first data model and engaged it in the question of how to explicitly document and share data over time. Thus, while the Census could be caricatured as a so-called data silo, its evolution shows how, in pursuing its aims, it has naturally transitioned from rigid curation criteria – dictated in no small part by the recording methods then available (index cards, early database systems) – to an international effort advancing scholarship on the reception of antiquity and on Early Modern visual culture more broadly. Thus the creation of a Semantic Census – an expression of the Census data that provides an open and reusable version of the dataset for scholars – continues the project's broadening over time and constitutes an important adaptation to the changing digital scholarly landscape. The Linked Open Data approach offers an alternate representation that removes the limitation of the record boundary, aiming to create an open network of knowledge.

4. Analysis and semantic data modeling

The first step in creating a Semantic Census was to initiate an analysis of the Census database in the first place. The case of the Census data model was particularly interesting for this process. While many data structures grow organically from the needs of research projects or are imposed top-down from the adoption of softwares which dictate an extant data structure with little or no ability to alter it, the Census data model was deliberately devised with the scholarly intent of the data recording in mind. The Census data model, devised already in the 1980s by Nesselrath and Holt, had features anticipating a semantic database already, without the formalized semantic encoding. At the heart of the data structure lay the division between Monument and Document and the relation between them. The primary focus of cataloging in the information system was monuments in antiquity. Criteria for inclusion as instances of this class were their being (a) genuinely antique and (b) referenced in a Renaissance document. The other most important class of the original data structure was the document. A document was defined as a Renaissance work, such as a drawing, print, text, or sculpture, which provided a response to the antique monument. The key relationship mapped in the Census is one of witnessing or giving evidence of an awareness, knowledge, or perception of antique monuments in the Renaissance era. Supporting these were a series of models recording persons, images, bibliography, dates, and locations.

The initial work of understanding the model for its semantic representation involved reviewing the extant documentation in sessions between Census staff and the semantic modeling team. These sessions aimed to clarify both the original intent of the models and their actual use over time. To generate a semantic dataset, a formal ontology – a high-level semantic language suitable for the dataset – must be chosen, and the original data must be translated from regular tabular format into a semantically encoded and meaningful information structure. To approach the modeling of this data, the CIDOC CRM (Bekiari *et al.* 2021) was selected as the base formal ontology for semantic representation. This decision was grounded in considerations of both adequacy and practicality. In terms of adequacy, the scope and range of the CRM ontology – which models cultural heritage and historical facts over time – aligned with that of the Census data. In terms of practicality, the CRM is a widely adopted standard in cultural heritage data projects, facilitating broader uptake and reuse.

Beyond adopting the CIDOC CRM as the semantic framework, the project aimed to create semantic translations of the original data according to commonly used patterns to ensure maximum compatibility with potential overlapping datasets. It anticipated future collaborations with like-minded

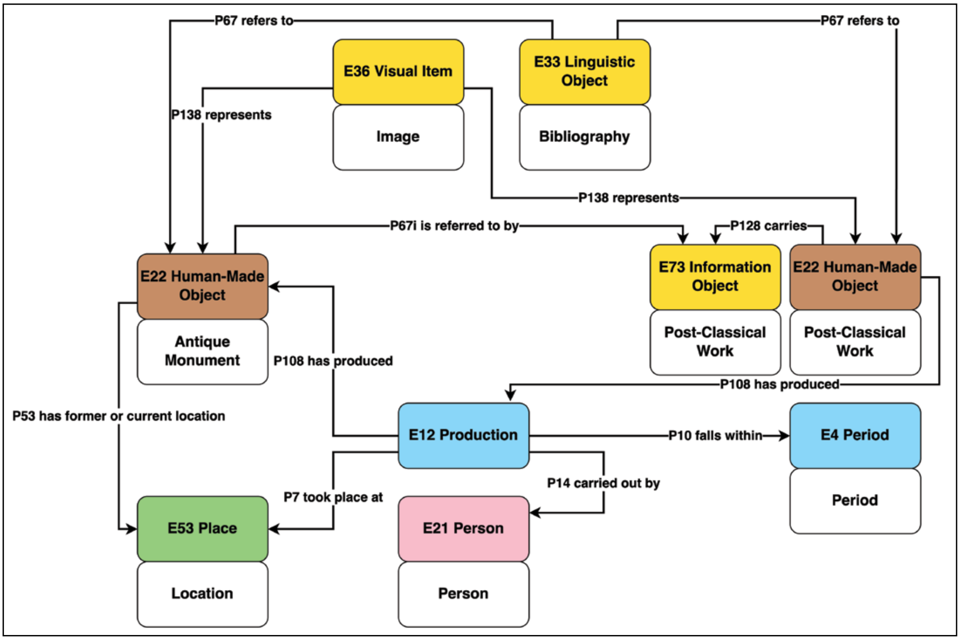


Fig. 4 – Overview of the Census ontology.

research initiatives such as those represented in the CORDH network (https://www.cordh.net/) of which the Census is a member. The Swiss Art Research Infrastructure's Semantic Reference Data Models (SARI Documentation, https://docs.swissartresearch.net/), offered within this network, serve as guidelines for basic modeling decisions in art and architectural semantic modeling using CIDOC CRM, which made them an ideal starting point. These models offer common semantic modeling patterns for basic entities in the cultural heritage sector, as well as common patterns for translating atomic elements of information, such as names or identifiers. Adopting such patterns streamlined the modeling process by providing ready-made solutions to potential problems, so that modeling efforts could concentrate on difficult areas of documentation where the ontology or the patterns did not have a predefined solution.

This process resulted in the development of eight Semantic Census models. These models provide an expression of the data captured by the original Census data structure, now aligned with the CIDOC CRM ontology. Fig. 4 provides an overview of the top-level modeling and the main connections between the models. The semantic modeling process was not unidirectional, but resulted in a reconsideration of the original models themselves. Thus with the relaunch of the Census database in fylr in April 2023, 'Monument' and 'Document' were renamed 'Antique Monument' and 'Postclassical Work', respectively, to better describe the contents of the Census. These categories are represented neutrally as instances of E22 Human-Made Object in the CIDOC CRM ontology. Additionally, to reflect research taking place in the field of classical reception, the category of 'Antique Monument' was expanded to include not only works dated by archaeology to antiquity, but also works that were perceived as being antique during the postclassical era. Individual time spans previously documented in the 'date' model were reassigned to the relevant items and events which they temporally delineate. Periods and styles were recognized as reference data in their own right, requiring their own documentation, and were matched to the class E4 Period.

Each of the models is based on the data contained in Census records. But these models also allow the data to transcend the confines of the Census data model, aligning it with the CIDOC CRM framework. Integrating the data into an open semantic web enables reanalysis and reuse according to questions and concerns that extend beyond the original cataloging function. It allows the thoroughly-researched data of the Census to serve as authoritative reference data for other projects, facilitating both appropriation and critique.

5. Semantic data model documentation

The adoption of the semantic reference data model technique (Bruseker *et al.* 2025) offered a significant advantage to the Semantic Census project. It provided not only for a semantic translation of the data, but also for a standardized documentation of that model accessible to scholars, who may not be well-versed in semantic data, thereby supporting the potential reuse of Semantic Census data. The uptake in digital skills which Bober imagined in 1982 is still not realized in the fields of archaeology and art history in 2025. Bridging this technological gap requires the development of accessible pathways that enable individuals to understand and manipulate data. This goal motivated the adoption of an intensive work plan to document the Semantic Census data models in a way that is understandable to both scholars and engineers.

The semantic reference data model methodology suggests documenting semantic data projects in units of models, collections, and fields. Each unit corresponds to familiar data patterns, such as forms and tables, with which scholars are acquainted. They are defined using terminology oriented to the scholar but linked to explicit formal representations in the target ontology. The outcome of adopting this methodology was the elaboration of a rich documentation detailing the meaning of the semantic models for their long term reuse (Nenova, Bruseker 2023a), which can be accessed here:

Model Name	CRM Class	Documentation Link
Antique Monument	E22 Human-Made Object	https://tinyurl.com/46hpxs3e
Post Classical Work	E22 Human-Made Object	https://tinyurl.com/bdhud3nh
Person	E21 Person	https://tinyurl.com/9xp4ckm7
Location	E53 Place	https://tinyurl.com/3kwbu8d7
Image	E36/D9 Visual Image	https://tinyurl.com/3n4sp9ke
Period / Style	E4 Period	https://tinyurl.com/d5cmh5yp
Bibliography	E33 Linguistic Object	https://tinyurl.com/ahfe64wk

Moreover, by adopting the Semantic Reference Data Model methodology, we were able to reuse many patterns from the SARI SRDM while explicitly documenting the new fields, collections, and models proposed by the Semantic Census. In total, the Semantic Census added 95 fields and three collections, and it built eight new models. This documentation provides a guide to understanding the Semantic Census data, creating data from scratch that would integrate with it, and transforming existing data into a compatible form.

6. Mapping and transformation

After developing an ideal set of documented SRDMs, the target model for a semantic data transformation was set. In keeping with the goal of making the Semantic Census data FAIR, an explicit and reusable process to transform the extant data to a semantic format was created. For this process we used the X3ML mapping language and the 3M (Mapping Memory Manager) tool (Marketakis *et al.* 2017). This technology was chosen because X3ML is a declarative mapping language that enables explicit mapping instructions to transform data from a source to a target semantic

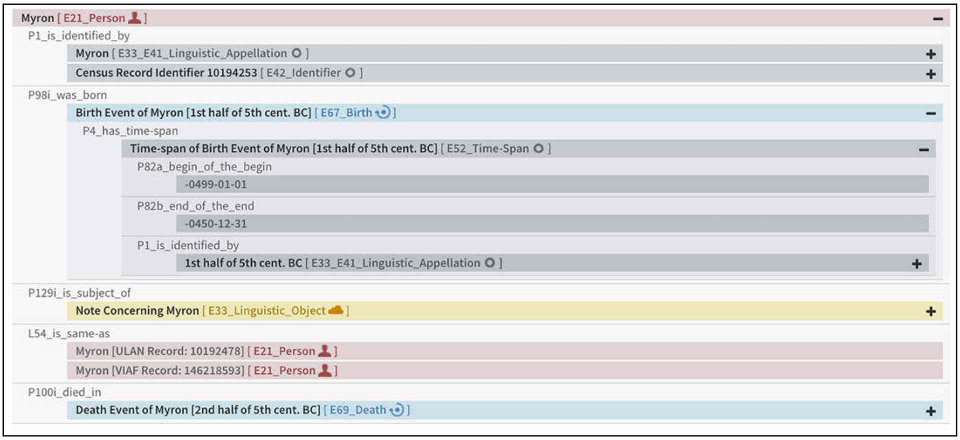


Fig. 5 – Semantic mapping.

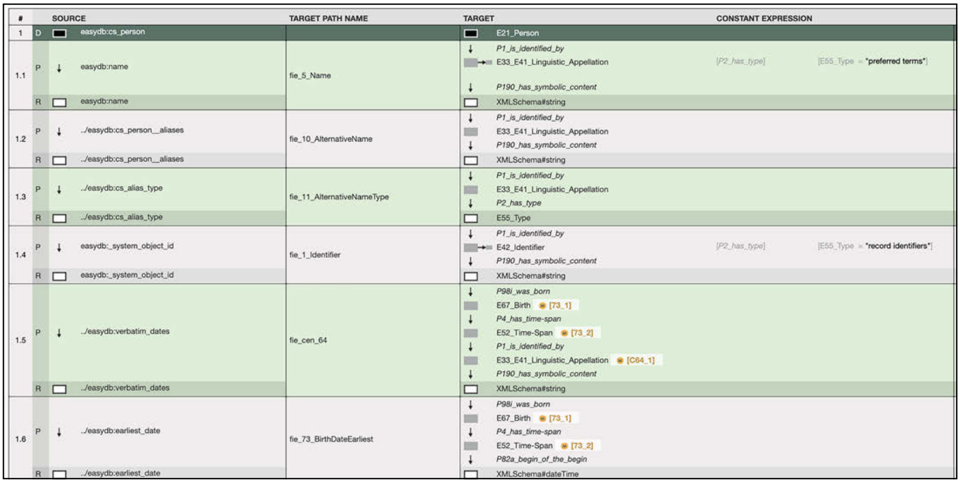


Fig. 6 – RDF visualizer.

data model. In this way, we were able to generate a mapping for each model from the original source data, expressed in relation to the semantic reference data patterns, which directly shows how each source field is translated into its corresponding target field (Fig. 5). An additional advantage of the 3M mapping tool was its integration of an RDF Visualizer (https://www.ics.forth.gr/isl/rdf-visualiser?lang=en) (Fig. 6).

This particular software provides a compact representation of RDF data structures. In terms of creating mapping instructions, as well as testing and explaining the outcomes between the data engineer and the researcher, this tool was highly important for verifying that the data transformation successfully expressed the primary data in the new semantic format. The mapping files created to generate this transformation were published as a paradigm for further transformations of data which could align to the Semantic Census data (Nenova, Bruseker 2023d).

7. Querying and research questions

While the aim of the semantic representation of the Census data was to open it to a wider audience, a key challenge of using semantic data in humanities research is that, while it has been adapted in numerous projects, basic familiarity with its creation, maintenance, or querying is far from a core skill taught to students. It was therefore considered a priority to establish an access point for researchers to begin to understand how to query the data and to envision the kind of responses it could provide. The modeling and documentation structure of the semantic data models offered a foundation for systematically describing the types of queries that could be formulated using the semantic models. These queries were documented both as SPARQL query code and as English language questions corresponding to the types of inquiries researchers might pose of the data. Equivalences were made such as: ‘Show me the monuments with creator information’.

The complete set of queries for the models was documented and published (Nenova, Bruseker 2023b). Using the field system of the SRDM approach, these queries not only represent a way to access data for a particular topic in the Semantic Census dataset, but also serve as primary material for constructing richer, more complex questions that are the result of multiple cross-model queries to the knowledge base.

8. Conclusion

The Semantic Census project aimed to build upon the scholarly tradition of the Census project by providing it with a new data expression, opening it to the Linked Open Data world and new lines of inquiry. Achieving this goal required the creation of a fully documented set of semantic reference data models for the Census, a set of explicit mapping files that can be used in a pipeline to transform and update the semantic representation of the Census on a regular basis (Nenova, Bruseker 2023e), and a systematic set of SPARQL queries to explore this data in relation to real world questions that researchers might pose. The Semantic Census is a resource that expands the project’s scope, enabling its reuse across broader disciplinary contexts while adhering to the principles of FAIR content. This transformation is especially significant since the Census occupies a unique position as a bridge to the early history of art history and the early history of digital humanities. The Census is a distinctive case, moreover, given its long-standing position at the intersection of art history and archaeology, where it has been shaped by the diverse methodologies of these fields.

The Semantic Census project lays the groundwork for future research, while highlighting institutional and infrastructural challenges as well as fundamental research and pedagogical concerns. Regarding the former, a key issue is building infrastructure and identifying stable institutional homes for semantic data. Enabling partnerships and long-term collaborations – both at the software level and the institutional level – is essential to realizing FAIR principles and unlocking the potential of research across semantic datasets. In the case of the Census, while semantic data is generated regularly and stored for researcher access, it is not hosted as a live dataset, and the need for supporting software that enables interactive relationships with semantic data must be addressed. A broader issue of training is also relevant: while the promise of Linked Open Data is to provide explicit and openly available scholarly datasets for analysis and reuse, the dissemination of fundamental skills necessary to work with this data within the humanities remains limited. Much remains to be done, since historic databases such as the Census stand to gain considerably by connecting their resources in a way that empowers not only institutions, but also individual researchers and early career scholars, to leverage open research.

George Bruseker, Denitsa Nenova
Takin.solutions
mailus@takin.solutions

Kathleen Christian
Humboldt-Universität zu Berlin
kathleen.christian@hu-berlin.de

REFERENCES

Antoniou G., Van Harmelen F. 2004, *A Semantic Web Primer*, Cambridge (MA), The MIT Press.

Bartsch T. 2008, *"Distinctae per locos schedulae non agglutinatae" – Das Census-Datenmodell und seine Vorgänger*, «Pegasus», 10, 223-260.

Bekiari C., Bruseker G., Doerr M., Ore C.-E., Stead S., Velios A. (eds.) 2021, *Definition of the CIDOC Conceptual Reference Model*, CIDOC CRM Special Interest Group (https://doi.org/10.26225/FDZH-X261).

Berners-Lee T., Hendler J., Lassila O. 2001, *The Semantic Web*, «Scientific American», 284, 5, 34-43.

Bizer C., Heath T., Berners-Lee T. 2023, *Linked Data. The story so far*, in *Linking the World's Information: Essays on Tim Berners-Lee's Invention of the World Wide Web*, Association for Computing Machinery, 115-143 (https://doi.org/10.1145/3591366.3591378).

Bober P.P. 1989, *The Census of Antiquities known to the Renaissance: Retrospective and prospective*, in S.D. Squarzina (ed.), *Roma, centro ideale della cultura dell'Antico nei secoli XV e XVI*, Milano, Electa, 372-381.

Bober P.P., Rubinstein R. 1986, *Renaissance Artists & Antique Sculpture: A Handbook of Sources*, London-Oxford, Harvey Miller Publishers-Oxford University.

Bruseker G., Fielding M., Nenova D., Haensli T. 2025, *The semantic reference data modelling method: Creating understandable, reusable and sustainable semantic data models*, «Journal of Open Humanities Data», 11 (https://doi.org/10.5334/johd.282).

Carballo-Garcia A., Boté-Vericad J.-J. 2022, *Fair data: History and present context*, «Central European Journal of Educational Research», 4, 2 (https://doi.org/10.37441/cejer/2022/4/2/11379).

Christian K. 2024, *Semantic data of the Census of Antique Works of Art and Architecture Known in the Renaissance, 1946-05-13 to 2024-10-01* [dataset], Humboldt-Universität zu Berlin e-doc Server (https://doi.org/10.18452/29556).

Guarino N. 1997, *Understanding, building and using ontologies*, «International Journal of Human-Computer Studies», 46, 2, 293-310.

Lu C. 2023, *Tracing the Footsteps of Alfred Scharf: The Early History of the Census and the 'Republic of Pictures'*, Verso. A Discussion Forum of the Census (https://verso.hypotheses.org/3749).

Mantilla J.C.G. 2023, *Sacsayhuaman in Early Modernity: The Invention of New Ancient Edifices*, Verso. A Discussion Forum of the Census (https://verso.hypotheses.org/2911).

Marketakis Y., Minadakis N., Kondylakis H., Konsolaki K., Samaritakis G., Theodoridou M., Flouris G., Doerr M. 2017, *X3ML Mapping framework for information integration in Cultural Heritage and beyond*, «International Journal on Digital Libraries», 18, 301-319.

Michaelis A. 1891, *Römische Skizzenbücher Marten van Heemskercks und anderer nordischer Künstler des XVI. Jahrhunderts*, «Jahrbuch des Kaiserlich Deutschen Archäologischen Instituts», 6, 125-172.

Miller J.L. 2024, *Forgery, Imitation, Emulation: The Creation of Antiquity in the Renaissance*, Verso. A Discussion Forum of the Census (https://verso.hypotheses.org/5360).

Nenova D., Bruseker G. 2023a, *Deliverable 2-Documented Semantic Data Model* (https://doi.org/10.5281/zenodo.7684280).

Nenova D., Bruseker G. 2023b, *Deliverable 5-Research Questions Implementation (Version 1)* [Dataset], Zenodo (https://doi.org/10.5281/zenodo.7684331).

Nenova D., Bruseker G. 2023c, *Semantic Census RDF Data (Version 1)* [dataset], Zenodo (https://doi.org/10.5281/zenodo.7684301).

Nenova D., Bruseker G. 2023d, *Semantic Census X3ML Mappings (Version 1)* [dataset], Zenodo (https://doi.org/10.5281/zenodo.7684325).

Nenova D., Bruseker G. 2023e, *Sustainable Semantic Data Management Pipeline Documentation. Semantic Census Deliverable 4: An ETL Pipeline from easydb to RDF; Semantic Census Deliverable 6: Semantic Data Transformation and Testing* (https://doi.org/10.5281/zenodo.7684257).

Nesselrath A. 1993, *The Census of Antique Works of Art and Architecture Known to the Renaissance*, «Archeologia e Calcolatori», 4, 237-241.

Oldman D. 2021, *Digital research, the legacy of form and structure and the ResearchSpace system*, in K. Golub, Ying-Hsang Liu (eds.), *Information and Knowledge Organisation in Digital Humanities*, New York, Routledge, 131-153.

Sawatzki C. 2023, *Winged Horses and Snail-shaped Dolphins: A Broader Perspective on Drawings after the Antique in the Census Database*, Verso. A Discussion Forum of the Census (https://verso.hypotheses.org/1785).

Schich M. 2009, *Rezeption und Tradierung als komplexes Netzwerk. Der CENSUS und visuelle Dokumente zu den Thermen in Rom*, Munich, Biering & Brinkmann (PhD Diss. HU Berlin 2007).

Settis S. (ed.) 1984-1986, *Memoria dell'antico nell'arte italiana*, I-III, Torino, Einaudi.

Trapp J.B. 1999, *The Census: Its past, its present and its future*, «Pegasus. Berliner Beiträge zum Nachleben der Antike», 1, 11-21.

75 Years, 1946-2021. From Index Cards to Online Database [online exhibition] (https://www.census.de/en/exhibition/).

ABSTRACT

The Census of Antique Works of Art and Architecture Known in the Renaissance, established in 1946, is a research project that traces the knowledge and reception of antiquities known during the Renaissance by linking them with Early Modern visual and textual records. It has over its long history evolved from an analog system, to one of the earliest digital art history projects, to an online database (https://database.census.de). Recent innovations (2021–2023) have transformed the database into semantic data using the CIDOC-CRM ontology, aligning it with FAIR principles and encouraging broader engagement with the Census's rigorously-researched dataset. The modeling process involved creating eight Semantic Census models, supported by extensive documentation. The semantic transformation of Census data

used the X3ML language and 3M tool for mapping and verification, ensuring consistency and compatibility with other datasets, such as those in the CORDH network. Queries can now be performed using SPARQL, with documented query examples to guide researchers unfamiliar with semantic data. The Semantic Census models have the ability to facilitate new research purposes for Census data, not only in the fields of art history and archaeology, but also beyond the project's original scope.