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Comparing Art Event Databases in Austria
Standards for Exhibition Data

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Abstract

This master's thesis compares three Austrian event databases: basis wien, Database of Modern Exhibitions (DoME), and eSeL, which maintain exhibition-related data. It demonstrates that data on exhibitions offers a fruitful ground for exploring temporal and geographical patterns as well as social relationships in the field of art history and curatorial studies. With the digitization of documents and the rise of data collection initiatives, the volume of available data on exhibitions is increasing, and there is a growing need for common standards. For this reason, metadata schemata and thesauri that describe exhibitions are discussed, and examples for ontologies and Linked Data initiatives to model events are compared. This is followed by the analysis of the three Vienna-based databases regarding subsequent criteria: data structure, metadata categories, user interface, and FAIR principles. These databases were founded for different purposes, such as an archive, an event calendar, and a scholarly project. Consequently, the influences of the domain and the data entry sources on their structure and metadata categories are investigated. In three case studies, database-specific research questions are answered by explorative data analysis methods through various visualization types to demonstrate the usability of the databases. This comparative analysis aims to provide aids for cultural heritage institutions by describing relevant standards as well as identifying gaps in the interoperability of exhibition databases, and to underline the need for common guidelines.

Abstract

In dieser Masterarbeit werden drei österreichische Veranstaltungsdatenbanken verglichen, die ausstellungsbezogene Daten verwalten: basis wien, Database of Modern Exhibitions (DoME) und eSeL. Es soll gezeigt werden, dass Daten zu Ausstellungen einen fruchtbaren Boden für die Forschung zeitlicher und geografischer Muster sowie sozialer Beziehungen im Bereich der Kunstgeschichte und Curatorial Studies bieten. Mit der Digitalisierung von Dokumenten und dem Aufkommen von Datenerfassungsinitiativen nimmt die Menge der verfügbaren Daten zu Ausstellungen stetig zu, deshalb besteht ein wachsender Bedarf an gemeinsamen Standards. Daher werden Metadatenschemata und Thesauri zur Beschreibung von Ausstellungen diskutiert und Beispiele für Ontologien und Linked-Data-Initiativen zur Erstellung von Eventmodellen verglichen. Es folgt die Analyse der drei in Wien ansässigen Datenbanken hinsichtlich der nachstehenden Kriterien: Datenstruktur, Metadatenkategorien, Benutzeroberfläche und FAIR-Prinzipien. Diese Datenbanken wurden für verschiedene Zwecke gegründet (Archiv, Veranstaltungskalender und wissenschaftliches Projekt). Aus diesem Grund wird der Einfluss der Bereiche sowie der Datenquellen auf ihre Struktur und Metadatenkategorien untersucht. In drei Fallstudien werden datenbankspezifische Forschungsfragen durch explorative Datenanalysemethoden anhand verschiedener Visualisierungstypen beantwortet, um die Nutzung der Datenbanken zu demonstrieren. Diese vergleichende Analyse soll Kulturinstitutionen Hilfestellung bieten, indem sie relevante Standards beschreibt und Lücken in der Interoperabilität von Ausstellungsdatenbanken aufzeigt sowie die Notwendigkeit gemeinsamer Richtlinien unterstreicht.

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1. Introduction

In art historical research, exhibitions play a significant role in exploring temporal and geographical patterns as well as social relationships. In the 1980s, curatorial studies began to emerge as a new scholarly field. Exhibitions, the presentation of art objects, and the evolving concepts of artist canonization became central to investigations. With the digitization of printed publications (such as catalogs) and the rise of data collection and information extraction initiatives, the volume of available data on exhibitions has been steadily increasing. However, to provide a quantitative basis for qualitative close-reading methods, it is essential to develop high-quality data on art events. Nonetheless, it remains challenging to identify one dominant standard description model, ontology, or thesaurus to ensure the interoperability of published data. Karly Wildenhaus had already emphasized the necessity of Linked Data for art exhibitions in art historical research¹, while the initiators of the Expofinder project, Nuria Rodríguez-Ortega and Antonio Cruces Rodríguez², focus on the challenges of linking heterogeneous exhibition data collected from different web resources.

To address these challenges, I will examine common ontologies and standard description models to show different approaches to modeling complex data on exhibitions. I introduce the concepts of metadata standards, thesauri, ontologies, and the Linked Data model, and distinguish them from each other, providing exhibition-related examples with the intention to suggest solutions for data selection and preparation. The concept, organization, and participants of exhibition projects have changed over time, with art exhibitions evolving into mega-events featuring numerous sub-events. This raises the question: Is it possible to develop a single solution to describe and model both early 20th-century exhibitions and contemporary mega-events like Documenta?

Meanwhile, several event-specific ontologies have been developed, including the ABC Ontology (2000), Event Ontology (2007), DOLCE+DnS Ultralite (2007),

¹ Karly Wildenhaus, "The Possibilities of Constructing Linked Data for Art Exhibition Histories", *Art Documentation: Journal of the Art Libraries Society of North America* 38, no. 1 (2019): 22–34. <https://doi.org/10.1086/702890>.

² Nuria Rodríguez-Ortega and Antonio Cruces Rodríguez, "Development of Technological Ecosystems for Cultural Analysis: The Case of Expofinder System and Art Exhibitions", *Digital Scholarship in the Humanities* 34, no. 2 (2019): 423–48. <https://doi.org/10.1093/llc/fqy018>.

LODE (2009), SEM (2009), and Event-Model-F (2009). However, none of these have become standard in the art field. Probably because the art historical research has been primarily engaged with objects, and there hasn't been enough data available on events. The commonly used CIDOC CRM is an event-based ontology, with the main focus on objects, and is highly complex for modelling events in detail. Common metadata description models, such as LIDO, EDM, Linked Art, and Dublin Core, were initially developed for recording cultural heritage objects and only provide basic descriptions for events, leaving room for varied interpretation. This situation complicates the selection of appropriate models and metadata standards for researchers, hinders the usability of the data for diverse research purposes, and contributes to the heterogeneity of open-access data.

In Austria, few art databases manage exhibition data, and of those that do, there are differences in how this data is modeled and published. In this thesis, I will examine the approaches used by three Austrian art databases: the basis wien archive, the Database of Modern Exhibitions (DoME), and eSeL calendar. The basis wien publishes data on exhibitions after 1945, along with other non-event-specific data (such as artist biographies and publications), by extracting information from invitations, catalogs, and artist CVs, and automatically linking it to other entities. The DoME project is an academic collection of data on European modern art exhibitions held between 1905 and 1915, based on digitized catalogs. The eSeL platform is an online calendar for contemporary programs in Vienna and the surrounding areas, publishing various pre-selected art events (not limited to exhibitions) and has been recently integrated into Kulturpool, the platform of the Austrian aggregator of the cultural heritage database Europeana. To better understand the challenges and potentials of these databases, I contacted employees at each institution for one-on-one meetings, and analyzed their use of standards, their structure, usability, accessibility, and how they fulfill the FAIR principles.

Ultimately, I aim to present different possibilities for data models of exhibitions and their significance for art historical research. In the chapter "Background", I introduce some definitions of exhibitions, describe their history, and provide examples for international platforms as well as research projects. In the "Literature Review", I introduce standards to model and describe exhibitions. And in the "Analysis", I investigate the three aforementioned Austrian databases. Key questions include: Does the source of event data – whether catalogs, invitation cards, or newsletters –

influence the description of events? Is it possible to develop a common solution for diverse domains such as archives, event calendars, and academia?

My second focus is on the research opportunities that event databases provide for digital humanities scholars and art historians. I pose exemplary research questions derived from these databases and explore them using various visualization methods, including network diagrams, charts of gender and nationality distributions, scatter plots of correlation, and maps using Tableau and Google My Maps. These visualizations aim to demonstrate the importance of open-access data on art exhibitions and highlight the potential of existing databases, despite their varying levels of accessibility.

2. Background: Exhibitions

Exhibitions are of particular importance for art historical research. Florence Derieux even claimed that “[...] the art history of the second half of the 20th century is no longer a history of artworks, but a history of exhibitions. However, this critical history still largely remains to be written”.³ There are different approaches to documenting exhibitions and collecting data on them. In this chapter, I introduce some definitions of exhibitions and give insights into their history. Then, I investigate which role they play in the art historical research and demonstrate it by examples, such as documentations, research platforms, and quantitative research projects.

Throughout history, exhibitions have played an important role in promoting artists, increasing the art market value of artworks, introducing new research results by art historians, educating, influencing acquisition policies, and promoting political ideas. Weber-Felver and Heinisch discuss exhibitions as a medium with actuality, ephemerality, discursiveness, and expressiveness compared to other core functions of a museum, such as collecting and preserving artworks.⁴ Contemporary shows reflect the current “Zeitgeist” and research into historical exhibitions can provide a number of insights into the social, political, and economic context of artworks and how the art historical canon was written in the past. It gives art professionals the opportunity to correct the mistakes of the past by rediscovering forgotten artists, underrepresented genders, regions, and artistic styles. A prominent example of this practice is the case of the Museum of Modern Art (MoMA) in New York.⁵ In 2019, after an overhaul, it closed its doors for four months to rehang its collection and address the lack of diversity of the artists featured in its permanent exhibition in terms of geographical origin, gender, and race. They changed the duration of the permanent exhibitions to be able to present more artists and shifted from a purely chronological presentation to a discursive approach.

³ Florence Derieux, “Introduction”, in *Harald Szeemann: Individual Methodology*, ed. Derieux, Florence, 8. JRP Ringier, 2007.

⁴ Ulrike Weber-Felber, and Severin Heinisch, „Ausstellungen: Zur Geschichte eines Mediums“. *Österreichische Zeitschrift für Geschichtswissenschaften* 2/4 (1991): 7–8.
<https://doi.org/10.25365/oezg-1991-2-4-2>.

⁵ Alex Greenberger, “In Collection Hangs, Major Museum Remix the Classics”, *artnews*, May 2, 2024, accessed February 23, 2025, <https://www.artnews.com/art-in-america/features/museum-collection-hangs-remix-classics-1234704248/>.

Joyeux-Prunel and Marcel highlight several factors, that hinder the use of quantitative analysis on exhibitions: art historians tend to be resistant to numbers because they simplify the complexity of the information given; it is difficult to find a large number of comparable historical sources from which to extract data; the digitization in art history has mainly concentrated on magazines rather than catalogs; and copyright issues make it difficult to publish a richly illustrated catalog online.⁶ Nevertheless, there are several research initiatives analyzing data on exhibitions to obtain new knowledge on artist networks, institutions, and developments in art, which I will describe in section 2.5.

When archiving exhibitions, one should focus not only on what, but also on how the data should be preserved and published to be useful for researchers to work with. For this reason, I delve into some fundamental questions about exhibitions with the intention of detecting relevant information for quantitative research. I ask for the answers to the following questions: What is an exhibition? How have they changed over time? What kind of insights can exhibitions give art historians about art?

2.1. Meaning of “exhibition”

In my dissertation, I focus on exhibition-related data; accordingly, it is important to give a definition of exhibitions to find out which components are essential parts of them. I discuss different approaches for describing the word “exhibition” to prove that the term is complex and that there is no consensus on what constitutes an exhibition or what is inherent in its definition. This is all the more surprising given that exhibitions have a long history (at least 250 years) and that, in the last decades, exhibition history became an independent field of art history research, alongside the establishment of curatorial studies in the 1990s.⁷ There was even a journal for curators, “The Exhibitionist” (2010-2016), which was the first magazine for curators to promote discourse on the theory of exhibition making and the history of exhibitions;

⁶ Béatrice Joyeux-Prunel, and Olivier Marcel, “Exhibition Catalogues in the Globalization of Art. A Source for Social and Spatial Art History” *Artl@S Bulletin* 4, no. 2 (January 1, 2015): 91-92. <https://docs.lib.purdue.edu/artlas/vol4/iss2/8/>.

⁷ Felix Vogel, “Resistance to Theory. The Ideology of “the Curatorial”, *Revisita de História da Arte - The Exhibition: Histories, Practices and Politics* no. 14 (2019): 66. https://institutodehistoriadaarte.com/wp-content/uploads/2019/12/rha_14.pdf.

furthermore, several publications investigate past exhibitions.⁸ But what defines and constitutes them?

The etymology of the English word “exhibition” can be derived from the French word “exposer”, “act of putting something on public view”, originating from the Latin “exhibere”, to “hold out”.⁹ This means that, from a linguistic point of view, the public presentation of something is an inherent criterion of an exhibition, and they are the result of actions. Exhibitions are intended to be seen in the present and in “a distinct space and time”.¹⁰ Chad Dawkins, a curator, critic, and educator specializing in exhibitionary practices as a professor at Spelman College, Atlanta, defines exhibitions at different levels of precision. His simplest definition is “a display of an object or image”.¹¹ He also quotes the Oxford English Dictionary, which adds the location of the presentation as a further criterion: “a public display of works of art or other items of interest, held in an art gallery or museum or at a trade fair”.¹² Although this definition is more detailed, it still misses important aspects of exhibitions such as their temporality and purposeful, organized character, and it excludes several possible venues for them, such as open-air venues, churches, universities, and online exhibitions. The Grove Art Dictionary takes another approach and defines art exhibitions as temporary displays with a specific presentation purpose: “The temporary display of works of art for pleasure, instruction, the enhancement of scholarship, or for sale.”¹³

Some art-specific standards describe exhibitions more in relation to art objects and for their own data management purposes. The metadata description framework Categories for the Description of Works of Art (CDWA) gives the following definition of exhibition/loan history: “A historical record of the public display of a work, including its installation in a gallery, inclusion in a special or online exhibition, and any loan during which the work was on public view, even if not a part of a formal exhibition.”¹⁴ The

⁸ Ibid, 66.

⁹ Chad Dawkins, “The Definition of Exhibition in Art Historical Inquiry”, *Academia Letters*, Academia.edu, October 26, 2021, 2. <https://doi.org/10.20935/al3779>.

¹⁰ Ibid, 3.

¹¹ Ibid, 1.

¹² Ibid, 1.

¹³ Christopher Rowell, “Exhibition”, *Grove Art Dictionary*, 2003, accessed February 25, 2025, <https://doi-org.uaccess.univie.ac.at/10.1093/gao/9781884446054.article.T027139>.

¹⁴ “CDWA List of Categories and Definitions”, J. Paul Getty Trust & College Art Association, Inc., accessed July 20, 2025, https://www.getty.edu/research/publications/electronic_publications/cdwa/definitions.pdf.

focus here is on the loan history of an object that may be exhibited in a variety of settings. In the Art and Architecture Thesaurus (AAT) exhibitions are hierarchically subordinate to events and superior to art exhibitions: “Organized, usually named, temporary public displays of works of art, crafts, natural history, science, or other items of cultural interest.”¹⁵ Here three other aspects enrich the definition: that an exhibition is organized, has a title, and that the objects displayed are of cultural interest. The Linked Art data schema is based on the event-centric ontology CIDOC CRM and interpret exhibition as follows: “Exhibitions are a very common activity that involves artwork owned by different organizations being displayed together, often with additional contextual information linking the pieces together. The exhibition is often presented at different venues over time and might be part of a series such as the World Fairs or annual exhibitions.”¹⁶ This refers in addition to owners, contextual information (curatorial concept), exhibitions with several venues (such as traveling exhibitions or a biennial), and recurring exhibition series (Biennial, Documenta, Manifesta).

To summarize the information given: Exhibitions are temporary, organized activities with distinct titles, display culturally relevant objects in a context, serve different purposes (such as pleasure, education, financial profit), and can take place in different locations at the same time or travel to different host institutions. What’s common to all these definitions is that they provide a more general description of exhibitions, and except for Linked Art, don’t give examples for exhibition types. Although most of the definitions discuss exhibitions in an art context, they don’t mention the artist in connection with the object; only the owners are included as “different organizations,” but not private persons. If artists are not mentioned, certain aspects of exhibitions are neglected, such as contributing to the popularity of artists, including artists in the art historical canon, and selling the artworks of artists to secure their living.

The role of curator is also omitted. The curator often acts like a theatre director or artist, creating experiences for the visitor, providing new contexts for artworks, and producing meaning. In some cases, the curator doesn’t serve the art but shapes it,¹⁷

¹⁵ “Exhibitions (Events)”, in *Art and Architecture Thesaurus Online Full Record Display*, J. Paul Getty Trust, 2004, accessed July 20, 2025, <https://www.getty.edu/vow/AATFullDisplay?find=exhibition&logic=AND¬e=&page=1&subjectid=300054766>.

¹⁶ “Exhibitions”, Linked Art, accessed July 20, 2025, <https://linked.art/model/exhibition/>.

¹⁷ Vogel, “Resistance to Theory,” 70.

and the message of the exhibition becomes more significant than its exhibits. The historical role of exhibitions has changed over time, and the 20th century gave rise to several different interpretations of exhibitions by artists and curators. In the following section, I am focusing on these developments.

2.2. History of exhibitions

Exhibitions have their origins in the ritual presentation of objects. As early as the 5th century BC, works of artists were presented in Greece for religious purposes.¹⁸ In the Roman Empire, the display of works of art was related to the art market and the triumphal processions of plunder (2nd century BC).¹⁹ In the 17th century, a display culture emerged in several countries. In Rome, from 29 August 1620, collectors presented their favorite artists in annual exhibitions, and between 1678 and 1719, Giuseppe Ghezzi, the Permanent Secretary of the Accademia di S. Luca, organized exhibitions, mainly of old masters by arranging transport, lighting, and security for the masterpieces.²⁰

In France, the first exhibition was organized in 1667 at the court of Leopold XIV by his chief minister, Jean-Baptiste Colbert, for the members of the Académie Royale de Peinture et de Sculpture to demonstrate the achievements of the artists' associations.²¹ In the 18th century, the tradition of "Salon" exhibitions was established, named after the venue of the regular Academy exhibitions, the "Salon Carré". The artworks were arranged by a décorateur following hierarchical principles.²² They were documented in catalogs and were open to a wide public, also giving rise to art criticism. In 1798, the first industrial exposition was organized by the government, which inspired the art and industry exhibitions in Germany.²³

In London, one of the earliest exhibitions was initiated by artists in 1740, which became publicly recognized in the 1760s.²⁴ In the same decade, the Society of Arts organized the first public exhibition, followed by the annual exhibitions of the Royal Academy from 1769. The first public museum, the British Tate Museum, was founded

¹⁸ Rowell, "Exhibition".

¹⁹ Ibid.

²⁰ Ibid.

²¹ Ibid.

²² Ibid.

²³ Ibid.

²⁴ Ibid.

in 1753,²⁵ and the first commercial exhibition space, the Christie's Auction rooms, in 1767.²⁶ In the 18th and 19th centuries, exhibitions were seen as a reflection of history, inspired by the philosophy of Hegel and his concept of the "Zeitgeist".²⁷ This motivated the presentation of contemporary artworks alongside historical ones. The need to present Old Masters led to the creation of the British Institution in 1805, which presented private collections.²⁸ At the same time, international world exhibitions were established to document the development of society. Birmingham hosted the first international exhibition, the Great Exhibition of 1851, which displayed industrial and decorative arts but excluded paintings.²⁹ The 1781 exhibition of the Wiener Kaiserliche Galerie (Vienna Imperial Gallery) at the Belvedere was an early example of the thematic presentation of artworks based on iconography.³⁰

In these early academic and salon exhibitions, the artworks covered the entire wall, and until the 19th century, the quantity of artworks continued to distract the viewer. Some artists and art critics claimed that the installation of artworks made them look like commodities, and their artistic value could not be recognized.³¹ In protest, Gustav Courbet organized an independent exhibition in 1855, breaking with the tradition of the Salon. It took some 30 years for Courbet's idea to be institutionalized with the foundation of the Salon des Indépendants (1884), initiated by Paul Signac, where artists could exhibit for free and without the approval of a selection committee.³² Similarly, the artists of the Secession movement in Vienna initiated a split from the traditional artists' association, exhibiting in independent exhibition venues and reclaiming the "aura" of the artwork.³³ They designed the spaces individually for each exhibition, establishing the idea of the "Gesamtkunstwerk" to deconstruct the boundary between artwork and environment. These independent practices continued until the First World War and influenced the development of several modern art movements.

²⁵ Katharina de Andrade Ruiz, „Die Entwicklung der Ausstellung als Medium der Kunstpräsentation“, in *Wie kommt Tanz ins Museum?*, 67:50. transcript Verlag, 2023. <https://doi.org/10.1515/9783839468234-006>.

²⁶ Rowell, "Exhibition."

²⁷ Ibid.

²⁸ Ibid.

²⁹ Ibid.

³⁰ Weber-Felber and Heinisch, „Ausstellungen: Zur Geschichte eines Mediums“, 16.

³¹ Ibid, 10.

³² Rowell, "Exhibition."

³³ Weber-Felber and Heinisch, „Ausstellungen: Zur Geschichte eines Mediums“, 21.

At the same time, commercial galleries organized one-man shows to promote their artists and obtain higher prices for their artworks.

In the 20th century, art exhibitions became a guarantee of the artistic quality of the objects presented. Marcel Duchamp reflected on the strong connection between exhibition and artwork with his pissoir „The Fountain” (1917), an ordinary industrial object signed by the artist and exhibited in an exhibition space to verify it as an artwork.³⁴ Several exhibitions criticized current practices, such as Yves Klein in 1958, who exhibited the gallery space itself.³⁵ From the 1960s the institutional criticism gave rise to temporary art products (performances, land art) and public art outside of the sterile exhibition space. The exhibitions of Minimal Art and Art Povera showcased objects that extended into the exhibition space, creating situations.³⁶ In the exhibition “9”, organized by Robert Morrison at the Leo Castelli Gallery, the artworks of Eva Hesse, Bruce Nauman, and Richard Serra changed constantly throughout the exhibition (1968), offering a new exhibition experience every day.³⁷ In 1969, Robert Barry organized the first closed exhibition with the title “Closed Gallery”.³⁸ All these new forms of exhibition questioned various aspects of exhibition making by ignoring one of its constitutive parameters: the artworks exhibited, the opening time, and the persistency during the show. Exhibitions became an experience, not a mere presentation of art objects, and could be perceived in multiple ways.³⁹ For this reason, the meanings created through the arrangements by artists, curators, and art experts should be acknowledged as subjective concepts, and the proper documentation of the idea behind them is all the more important. But how is it possible then to preserve exhibitions in their entirety for the future?

2.3. Documenting exhibitions

The proper documentation of exhibitions with primary sources and their reception is essential for the research field of exhibition studies.⁴⁰ Publication and

³⁴ Rowell, “Exhibition”.

³⁵ Ibid.

³⁶ Andrade Ruiz, „Museum und Ausstellung“, 67.

³⁷ Ibid, 69.

³⁸ Ibid, 70.

³⁹ Andrade Ruiz, “Die Ausstellung und das Ausstellen des 21. Jahrhunderts”, 71-77.

⁴⁰ Catalina Imizcoz, “The Publication as Evocation: Exhibition Histories’ Printed Matter”, *Revisita de História da Arte - The Exhibition: Histories, Practices and Politics* no. 14 (2019): 79, https://institutodehistoriadaarte.com/wp-content/uploads/2019/12/rha_14.pdf.

documentation preserve the exhibition for the future and have a permanent character compared to temporary shows. Catalina Imizcoz emphasizes that these “non-aligned temporalities affect the way exhibitions come down in history”⁴¹. The curators create a narrative that then evolves in the spectator’s mind. Books tend to provide linear narratives, but the narratives of exhibitions have a discursive character and unfold over the course of a visit. Imizcoz raises the question: “To what extent can the act of visiting an exhibition be depicted on the page, and what tools need to be employed in order to convey this experience editorially?”⁴² Exhibitions can be documented in various forms: printed catalogs, catalogue raisonnés, anthologies, institutional exhibition histories, and microsites – but it is difficult to capture them in their entirety or to reconstruct the experience they offer visitors in their temporal existence.

Catalogs are a common accompaniment to exhibitions, “supposed to show evidence of an historical event”.⁴³ A catalog consists of several reproductions of exhibits, documents (installation views, correspondences, essays, credits), a list of artists with biographical data (nationality, place of birth, gallery representing them, studio address, their master and place of study), and a list of artworks with their title, dimensions, technique, owner and price. Recent catalogs have also included critical texts on the theoretical/conceptual background underpinning the particular constellation of art pieces. Joyeux-Prunel and Marcel distinguish three types of information on the pages of a catalog: factual, discursive, and relational information.⁴⁴ The factual elements are the basic information about the exhibition (title, duration, location), the participants, and the artworks. Discursive elements communicate with the art world through critical views on public matters as history, sociology, economics, or theories. Relational elements are all the social information (galleries, curators, collectives, dealers, etc.) and the chosen vocabulary of toponyms, ethnonyms, and chrononyms. “Catalogs can therefore be seen as a strategic tool used by the actors of the art world to circulate ideas and names, develop a favorable discourse, build reputations, and ultimately exist beyond boundaries.”⁴⁵ They can include additional information on exhibitions that are not explicitly stated in the exhibition rooms themselves and can forge connections between concepts and artists, which may not

⁴¹ Ibid, 79.

⁴² Ibid, 81.

⁴³ Joyeux-Prunel and Marcel. "Exhibition Catalogues in the Globalization of Art.", 81.

⁴⁴ Ibid, 84.

⁴⁵ Ibid, 98.

be represented by objects in the physical space. This additional information could also be collected as data and analyzed by quantitative methods, drawing up a knowledge network.

There have also been several attempts to revisit past exhibitions, using all recoverable primary sources (installation views, curatorial texts, press releases) and other materials (articles, reviews) and publishing their historical reconstruction with the integration of multiple voices. A prominent example is the catalog of *When Attitude Becomes Form*, an exhibition curated by Harald Szeeman and reconstructed by the Fondazione Prada in 2013. The accompanying publication offers a historical retrospective by enabling a virtual walk through the past exhibition.⁴⁶ Several installation views, photos of the opening event and the artworks, as well as floor plans of each room, invite the reader to reexperience the exhibition through the sequences. The differences between the old and the reconstructed show are also highlighted. Reesa Greenberg refers to another type of reenactment, which she calls a riff.⁴⁷ A riff builds on a historical exhibition and interprets it in relation to contemporary issues. For example, Jens Hoffmann's 2014 revisiting of *Primary Structures* (1966) from a global point of view, adding artworks by non-Western European artists to the original concept of the exhibition.⁴⁸

Another approach is to collect a large number of different exhibitions in a single volume according to some common criteria. The art historian Bruce Altshuler, for example, has written several exhibition histories: *The Avant-Garde in Exhibition* (1994), *Salon to Biennial* (2008), and *Biennials and Beyond* (2013). According to Imizcoz, these follow a linear method from a modernist point of view, claiming a continuous historical progress of Western exhibition making, but providing a plurality of voices concerning the exhibition via art critics with contradictory opinions.⁴⁹ The author quotes Madeleine Kennedy, who points out the danger of determining the

⁴⁶ Imizcoz, "The Publication as Evocation", 87.

⁴⁷ Reesa Greenberg, "Remembering Exhibitions: From Point to Line to Web: Landmark Exhibitions Issue", *Tate Papers* no.12, (2009), accessed July 20, 2025, <https://www.tate.org.uk/research/tate-papers/12/remembering-exhibitions-from-point-to-line-to-web>.

⁴⁸ Linda Boersma and Patrick Van Rossem, "Rewriting or Reaffirming the Canon? Critical Readings of Exhibition History", *Stedelijk Studies Journal* 2 (2015), <http://www.stedelijkstudies.com/journal/rewriting-or-reaffirming-the-canon-critical-readings-of-exhibition-history/>.

⁴⁹ Imizcoz, "The Publication as Evocation", 81-83.

historical relevance of an exhibition by the amount of material available about it, which could be tempting when writing the history of exhibitions.⁵⁰

2.4. Digital presentation of exhibitions

Museums have also begun to document their own exhibitions, such as the Centre Pompidou in Paris. From 2010, together with young researchers from various universities, they developed a linear history of their exhibitions between 1997 and 2017, a so-called catalogue raisonné, and published it digitally on a Wiki in French under the title *Histoire des Expositions: Carnet de Recherche du Catalogue Raisonné des Expositions du Centre Pompidou*.⁵¹ An important difference is that a catalogue raisonné is not a selection of the most notable shows and is not a tool of canonizing exhibitions, but aims to provide complete documentation based on editorial standards and is also relevant to the history of the institution. In most cases, it includes information such as the title, the date, the description, and images of the exhibition. Some more detailed collections aim to reproduce all the documents associated with the show. In digital form, it is also possible to include sounds and videos. However, the Centre Pompidou has designed its catalog based on an analog approach without incorporating digital content (such as microsites of previous exhibitions).⁵² In contrast, MoMA's exhibition history also includes multimedia content, and its exhibitions can be searched by exhibition title and location as well as filtered by year and location. In 2019, the Calouste Gulbenkian Foundation (FCG) in Portugal also made its exhibition history available.⁵³ They collected data on each event promoted by the FCG: title, venue, dates, description, artists represented, curator, museographer, organizational partnerships, graphic and photographic material, bibliography, press releases, critical articles or related documents, available in their own archive and art library.⁵⁴ The

⁵⁰ Ibid, 84.

⁵¹ "Catalogue raisonné des expositions du Centre Pompidou (1977-2017)", Centre Pompidou, last modified: 19 July 2025, accessed July 21, 2025, <https://cataloguedesexpositions.centrepompidou.fr/Bienvenue>.

⁵² Reesa Greenberg, "Remembering exhibitions online: microsites and catalogues raisonnés". *Revisita de História da Arte - The Exhibition: Histories, Practices and Politics* no. 14 (2019): 44, https://institutodehistoriadaarte.com/wp-content/uploads/2019/12/rha_14.pdf.

⁵³ "História das Exposições de Arte da Fundação Calouste Gulbenkian 1957 – 2023", Fundação Calouste Gulbenkian, accessed July 21, 2025, <https://gulbenkian.pt/historia-das-exposicoes/>.

⁵⁴ Leonor Nazaré and Isabel Falcão, "History of the Calouste Gulbenkian Foundation's Art Exhibitions – Online Catalogue", *Revisita de História da Arte - The Exhibition: Histories, Practices and Politics* no. 14 (2019): 218, https://institutodehistoriadaarte.com/wp-content/uploads/2019/12/rha_14.pdf.

database contains 1.396 exhibitions, 20.019 entities, 17.088 photographs, 2.293 publications, and 4.806 print items, categorized by main themes, such as retrospectives, decorative arts, architecture, ethnography, etc. All these approaches underline the historical interest in art exhibitions and represent different levels of documentation by the organizing institutions as the primary sources of information.

Not only do museums document their exhibition histories, but certain recurring major events, as institutions, seek to archive their past. The Art Cologne (formerly Kunstmarkt Köln) was established in 1967 and was the world's first art fair to focus on contemporary art.⁵⁵ The project ART|GALLERY GIS|COLOGNE was created to visualize the development of the art fair between 1967 and 1997 on an interactive online deep map, offering information about the participating galleries and the context of the events.⁵⁶ The project was based on the fair's catalogs and intended to answer key questions about the art market, such as how the composition of participating galleries changed over time and which countries they came from.

Alongside exhibitions, it is becoming increasingly common to publish microsites, which are digitally born, easily accessible websites that contain relevant information about ongoing exhibitions, such as the content, artists, design, curatorial and installation processes, and program calendar.⁵⁷ While their purpose is to inform future visitors and reach a wide audience, in retrospect, they offer an opportunity to contextualize exhibitions. In 2012, MoMA created a dedicated website for its exhibition *Inventing Abstraction 1910-1925*.⁵⁸ At the center of the site is an interactive network diagram, published alongside the standard list of artists and artworks and interviews with art professionals. There are also links to a blog, a calendar, and a digital radio with music related to abstraction. The website is still available and is linked from the museum's exhibition history page.

⁵⁵ ART | GALLERY GIS | COLOGNE, Department of History, University of Cologne, accessed July 21, 2025, <http://www.aggc.uni-koeln.de/#/home>.

⁵⁶ Nadine Oberste-Hetbleck, "Reflecting on the Development of a Digital Platform for the Analysis of Fairs for Modern and Contemporary Art—Approach, Challenges, and Future Perspectives Using the Project ART|GALLERY GIS|COLOGNE as an Example" *Arts* 8, no. 3, (2019): 88. <https://doi.org/10.3390/arts8030088>.

⁵⁷ Greenberg, "Remembering exhibitions online", 38.

⁵⁸ "Inventing Abstraction 1910-1923", Museum of Modern Art, accessed July 21, 2025, <https://www.moma.org/interactives/exhibitions/2012/inventingabstraction/>.

As Griselda Pollock states: “Archives matter. What is included shapes forever what we think we were and hence what we might become.”⁵⁹ As exhibition history is written, a canon is inevitably created.⁶⁰ One should aim to preserve as much contextual material about the exhibition as possible, corresponding to its discursivity and relativizing its position by including forgotten shows in the canon. Altshuler distinguished between the curatorial canon and the art historical canon.⁶¹ The former contains exhibitions that change the notion of exhibition and add new concepts to the presentation, such as the introduction of new forms of display, curatorial processes, and the expansion of exhibition sites. For art historians, on the other hand, exhibitions gain significance when noteworthy artworks and new kinds of artistic practices are presented. While curators focus on the concepts of the exhibition, art historians prioritize the significance of the artworks. In my opinion, it is not necessary to separate these canons, as there are several intersections between new curatorial approaches and artistic practices, such as the aforementioned exhibition of Yves Klein, and if the canons are united, further connections can be derived.

The canon can be expanded through collecting and analyzing big amount of data based on certain interests, such as institutional history, artistic or curatorial biography, geographical focus or epoch and through including exhibitions on the “peripheries” outside the art centers (widening the geographical scope) as well as giving a voice to more diverse artists instead of the privileged few. Joyeux-Prunel and Marcel call for a global relational database of exhibition catalogs that is carefully edited and encourages art historians to undertake geographical, serial, and statistical analysis.⁶² The authors argue that the structure of catalogs is sufficiently constant to allow for comparable data to be found, such as: the title, places, names, and suggest the following research perspectives: “to compare several internationalization schemes, highlight the role of a mediator, a specific network, or to locate the trajectory of an artwork within a more general economical, social or geopolitical context.”⁶³ It can reveal the circulation of artists and artworks, the dominant taste of an era and art marketing strategies that focus on both the local and global events. They also give

⁵⁹ Griselda Pollock: *Encounters in the Virtual Feminist Museum: Time, Space and the Archive*, Routledge, 2007, 12.

⁶⁰ Boersma and Rossem, “Rewriting or Reaffirming the Canon?”.

⁶¹ Bruce Altshuler, “A Canon of Exhibitions”, *Manifesta Journal* no. 11 (2010): 7-8.

⁶² Joyeux-Prunel and Marcel. “Exhibition Catalogues in the Globalization of Art.”, 92.

⁶³ *Ibid*, 93.

examples of how quantitative analysis can disprove common art historical beliefs and decentralize our narratives.

2.5. Exhibition databases

Besides institutional histories, several projects have collected exhibition data for research purposes. The goal here is not to document individual exhibitions and institutional history, but rather to filter out data from large amounts of existing documentation and discover patterns, forgotten actors, or past shows. The basart global exhibition database was developed in 2009 as part of the ARTL@S project.⁶⁴ The data have been extracted from exhibition catalogs dating from the invention of exhibition catalogs (1673) to the present day and have been published online. Geographical references and exact dates allow the researcher to trace certain actors over time, to follow the journey of artworks, and to study the landscape of exhibitions, artworks, owners, and artists. The search results are displayed as a list, a map, or temporal charts and can be exported in CSV format with detailed data, encouraging quantitative data analysis and comparative approaches. The database DoME represents a similar endeavor.

Another cross-institutional approach is the Croatian Artists Networks Information System (ARTNET) of the Institute of Art History in Zagreb.⁶⁵ Their database represents networks and collaborations between artists in the 20th and 21st centuries and explores the characteristics of cross-cultural and transnational models of communication and organization, taking Croatian modern and contemporary art as a starting point. Their main focus is on local art that had a particularly lively exchange with other European artists.⁶⁶ In addition to using exhibition documentations, they also examine magazines, almanacs, other printed resources (mail art), and virtual social networks. Unfortunately, the data are not yet publicly available. The basis wien archive, also preserves heterogeneous materials on exhibitions. Besides primary sources, used for the data entry, they collect documents on the reception of exhibitions and unique pieces.

⁶⁴ basart, Université de Genève and Ecole normale supérieure Paris, accessed July 21, 2025, <https://artlas.huma-num.fr/map/#/>.

⁶⁵ "Croatian Artists Networks Information System", Institute of Art History Zagreb, accessed July 21, 2025, <http://artnet.s2.novenaweb.info/web/Login.aspx?ReturnUrl=%2f>.

⁶⁶ Wildenhaus, "The Possibilities of Constructing Linked Data for Art Exhibition Histories", 27.

A national initiative is the research portal of the Swiss Institute for Art Research (SIK-ISEA) that provides scientific information on art in Switzerland from the Middle Ages onwards and contains a digital catalogue raisonné and a digital lexicon with data on exhibitions.⁶⁷ A total of 65.550 exhibitions between 1862 and 2025 are recorded and are available in a table with basic information (title, institution, type, date, location). Clicking on an entry displays further details, such as participants, related institutions, works, publications, awards, documents, and themes. The exhibition records can also be viewed on an interactive timeline. Unfortunately, it is not possible to download structured data from the website.

The initiators of the ambitious Expofinder system project at the Art History Department of the University of Malaga (Spain) aimed to recombine heterogeneous exhibition data available online and structure it for reusability, such as network analysis and further quantitative methods.⁶⁸ The challenge wasn't just to select relevant and authorized sources, but also to develop a useful tool for accessing the results. Rodríguez-Ortega and Cruces Rodríguez claimed that the abundance of data available on the Web is encouraging a shift from the web of documents to the web of data, and that the new challenge is to combine this data for reuse.⁶⁹ According to the authors, exhibitions are particularly suitable for the technical experiment of combining heterogeneous data, not only because they are the focus of several fields, such as museums, art history, the art market and the leisure industry, but also because they are available in different formats, such as institutional websites and blogs, individual blogs, critics, digital magazines, and so on. However, this data is not structured, and in order to recombine and collect reasonable data from different sources, semi-automated text mining techniques are required.⁷⁰ The project constantly collects data from several URIs (in 2019: 16.000 URIs) and in the year of publication (2019) about 50.000 records on entities (institutions, organizations), people (artists, curators, collectors, critics), inscription devices (catalogs) and companies were collected with more than 450.000 metadata and 100.000 connections.⁷¹ After validation of the user,

⁶⁷ SIKART Lexicon, SIK-ISEA Research Portal, accessed July 21, 2025, <https://recherche.sik-isea.ch/en/everything/in/sikart/exhibition/list>.

⁶⁸ Rodríguez-Ortega and Cruces Rodríguez, "Development of technological ecosystems for cultural analysis", 423.

⁶⁹ *Ibid.*, 425.

⁷⁰ *Ibid.*, 429.

⁷¹ *Ibid.*, 439-440.

the data on exhibitions can be exported and used for own research purposes.⁷² However, the website also offers a data visualization function, a data query interface (currently unavailable) and an SQL query interface.⁷³ The eSeL database, an archived event calendar is a good example for a database including a big amount of data on exhibitions apart from museum websites and research projects and could be used for automatically collecting data on previous or upcoming shows.

In parallel with large collections of data for non-specific research purposes, there are several art historical projects based on particular research questions, using smaller sets of exhibition data. L. E. A. Braden used MoMA exhibition data to investigate artist networks among participants in the Armory Show initiated by the museum's curators. Using standard statistical calculations (centrality measures), he analyzed whether the curators' practice of exhibiting famous artists with lesser-known artists had an effect on the historical recognition of the latter.⁷⁴ He argues that the connections created by curators influence the extent to which an artist finds his/her way into the art historical canon.

In her network analysis project, independent researcher Tihana Puc used artist biographies of 61 Croatian artists with data on their exhibition activities to trace the influence of globalization processes on the field of contemporary art in Croatia.⁷⁵ Focusing on globalization from a non-Western perspective, she assesses the international position of local artists, distinguishing between domestic gatekeepers (institutions, curators, and artists) and international intermediaries. She concludes that the younger generation is internationally more integrated and that the place of residence is no longer exclusively relevant for international recognition. The artists still exhibit mainly in Western countries, but no specific institutional centers could be identified.

These examples show a growing interest in researching exhibition history, both within museums or organizing institutions, and as group or individual scholarly projects. The collected data are selected from exhibition catalogs and further primary

⁷² The author requested access to the data two times, but both attempts were unsuccessful.

⁷³ Ibid, 441.

⁷⁴ L. E. A. Braden, "Networks Created Within Exhibition: The Curators' Effect on Historical Recognition", *The American Behavioural Scientist* (Beverly Hills) 65, no. 1 (2021): 25–43. <https://doi.org/10.1177/0002764218800145>.

⁷⁵ Tihana Puc, "Exhibition Networks in the "Globalized" Contemporary Art Field — The Case of Contemporary Artists from Croatia", in *Život umjetnosti*, 105 no. 2 (2019): 42-75. <https://doi.org/10.31664/zu.2019.105.03>.

and secondary sources, and they publish data in different forms, such as lists of information, charts, maps, and research results. Unfortunately, a majority of these cross-institutional and research databases are not openly accessible or available as structured data. The Artl@s project offers the most possibilities for data reuse with the option to download data. The Expofinder Project is the best documented and provides some insights into the preparation of structured data on exhibitions and the consideration of metadata standards and ontologies for better data interoperability. In the next chapter, I will focus on what metadata categories are needed to describe complex entities such as exhibitions, and what standards are available to make data interoperable.

3. Literature review: standards for exhibitions

In my literature review, I explore the reasons for the lack of consensus about exhibitions and the different standards used in the cultural heritage field. First, I introduce the cultural heritage institutions, holding records on them, then I describe the idea behind the different standards to clearly distinguish them from each other, and give examples for widely accepted ones. Next, I discuss their suitability for describing and semantically conceptualizing exhibitions. I consider it important to introduce these concepts in order to be able to help cultural heritage establishments and projects outside the GLAM institutions that collect information about events, especially exhibitions, to organize and publish their data.

In the cultural heritage field, the information available is rich and heterogeneous, posing considerable challenges for extracting and integrating data. Martin Doerr compares historians to detectives.⁷⁶ They focus on the careful collection of all the evidence that contributes to the wide variety of materials available. Rodríguez-Ortega and Cruces Rodríguez refer to the exhaustiveness of available digital sources, which need to be filtered and authorized, and the demand for developing tools to access them.⁷⁷ Here, the adoption of common standards and markup languages plays a crucial role. Finding ways for standardization supports the interoperability of data between disciplines and can lead to new conclusions through the interrelated knowledge discovery and the sharing of methods and tools. In the interdisciplinary cultural heritage field, it is a high priority despite the significant challenges.

Bruseker, Carboni, and Guillem thoroughly summarize the reasons for data heterogeneity in the cultural heritage field:⁷⁸

- Different data recording and retrieval traditions
- Data structures are adapted to individuals rather than objects
- Expensive and technically complicated to switch to new data production technologies

⁷⁶ Martin Doerr, "Ontologies for Cultural Heritage", in *Handbook on Ontologies. International Handbooks on Information Systems*, ed. Staab, Steffen and Rudi Studer, Springer, 2009, 481. https://doi.org/10.1007/978-3-540-92673-3_21.

⁷⁷ Rodríguez-Ortega and Cruces Rodríguez: "Development of technological ecosystems for cultural analysis, 425.

⁷⁸ George Bruseker, Nicola Carboni, and Anaïs Guillem, "Cultural Heritage Data Management: The Role of Formal Ontology and CIDOC CRM," in *Quantitative Methods in the Humanities and Social Sciences*, ed. Vincent, Mathew L., Victor López-Menchero Bendicho, Marinos Ioannides, Thomas E. Levy, Springer, 2017, 95-97. https://doi.org/10.1007/978-3-319-65370-9_6.

- New techniques for describing objects of interest may reveal new features, leading to new data structures without necessary standards
- Lack of sufficient resources and standards
- Limiting funding to adopt new standards
- By forcing data into formats that they don't fit, they lose their original semantically meaningful structure in which they were generated, leading to even more heterogeneity.

Several different standards have been established to describe objects, events, and semantic concepts and to make data interoperable among different institutions. These are metadata schemas, controlled vocabularies, taxonomies, thesauri, ontologies, and the concept of the semantic web. These concepts are sometimes hard to distinguish, and there are controversial categorizations in the literature. For example, thesauri are defined as lightweight ontologies by Jannidis⁷⁹ or clearly distinguished from ontologies by Gartner⁸⁰ and Doerr⁸¹. They allow different levels of description and can be complementary or mapped to each other for domain-specific purposes. However, it is important to keep in mind that interoperability through established standards can result in a certain loss of semantic information.

3.1 Record keepers on exhibitions

The cultural heritage materials are maintained by different types of establishments. The so-called GLAM institutions (galleries, libraries, archives, museums) describe, document, classify, explain, relate cultural heritage items to their historical context, link information to each other, and construct knowledge about our culture. Culture is constantly evolving and needs to be passed on to future generations, which requires careful curation by identifying the elements worth preserving and strategies for their documentation.⁸² The international umbrella organizations, such as the International Council of Museums (ICOM), the International Federation of Library Associations (IFLA), and the International Council of Archives

⁷⁹ Fotis Jannidis, Hubertus Kohle, und Malte Rehbein, *Digital Humanities: Eine Einführung*. 1st ed., J.B. Metzler, 2017.

⁸⁰ Richard Gartner, *Metadata. Shaping knowledge from Antiquity to the Semantic Web*. Springer eBooks, 2016. <https://doi.org/10.1007/978-3-319-40893-4>.

⁸¹ Doerr, "Ontologies for Cultural Heritage".

⁸² Gartner, "Metadata", 12.

(ICA), maintain the required documentation policies and standards and make their suggestions to the institutions.⁸³

In all of these institutions, the focus of preservation is on objects; therefore, the established standards document these items. Although exhibitions are related to all these institutions, as museums organize and document them, libraries hold catalogs of exhibitions, and archives preserve documentary material about them, there is no widely accepted and overarching standard for documenting exhibitions in the required granularity.

Art museums house collections of artefacts and display them to the public. According to Harpring, these institutions have kept historical records of their works by establishing their local practices based on methods common in the art historical literature, rather than using a standard set of rules like libraries and archives.⁸⁴ The need for greater consistency in the 1990s and 2000s resulted in data standards like Categories for the Description of Works of Art (CDWA)⁸⁵ and Cataloging of Cultural Objects (CCO)⁸⁶. As museums care for their unique works, they require detailed administrative information (conservation, exhibition history, provenance, etc.) and the integration of scholarly research.⁸⁷

Libraries collect documents and records to make them available for borrowing. Librarians are trained to catalog and classify books, journals, and other textual materials. These are not unique items, as in museums, which enables data sharing between libraries. For this reason, they have a long tradition of common guidelines, rules, and standards (FRBR, MARC, RDA).⁸⁸

Archives are “repositories for noncurrent records of individuals, groups, institutions, and governments that contain information that is rare or of enduring historical value”.⁸⁹ They preserve the products of everyday activities, such as unpublished materials, manuscripts, diaries, sketches, photographs, films, videos, audio recordings, digital files, etc.⁹⁰ An archivist usually describes documents in

⁸³ Doerr, “Ontologies for Cultural Heritage”, 464.

⁸⁴ Patricia Harpring, *Introduction to Controlled Vocabularies: Terminology for Art, Architecture, and Other Cultural Works*, Getty Research Institute, 2010, 3.

⁸⁵ “CDWA List of Categories and Definitions.”

⁸⁶ Cataloging Cultural Objects Manuel (CCO), Visual Resources Association (VRA), accessed July 21, 2025, <https://www.vraweb.org/cco>.

⁸⁷ Harpring, *Introduction to Controlled Vocabularies*, 4.

⁸⁸ *Ibid*, 6.

⁸⁹ *Ibid*, 6.

⁹⁰ *Ibid*, 6-7.

accordance with the standards of the archival community. They focus on the function and provenance of archival materials and usually document larger groups or collections, ensuring their retrievability in the archive.⁹¹

3.2. Metadata standards

Metadata is defined as data about data. The prefix “meta” comes from the Greek and means “about”. The term has been used in computer science since 1968 and was introduced by Philip Bagley as “the ability to associate explicitly with a data element a second data element, which represents data ‘about’ the first data element.”⁹² Librarians have a long tradition of using metadata in cataloging their collections. In the 1990s, it referred to standards, documentation, and other data “for the identification, representation, interoperability, technical management, performance, and use of data contained in an information system”⁹³. They document information objects, characterized by their content, context, and structure,⁹⁴ and support the creation of information and knowledge by meaningfully connecting items and making information retrievable.⁹⁵ According to Gilliland, they have the following primary functions⁹⁶:

1. Creation, multi-versioning, reuse, and recontextualization of information objects.
2. Organization and description
3. Validation of data trustworthiness
4. Search and retrieval
5. Utilization and preservation
6. Documenting the disposition of the original object and the related information object

⁹¹ Ibid, 7.

⁹² Gartner, *Metadata*, 2.

⁹³ Anne J. Gilliland, “Setting the Stage,” in *Introduction to Metadata*, ed. Murtha Baca, 3rd ed., Getty Publications, 2016, <http://www.getty.edu/publications/intrometadata/setting-the-stage/>.

⁹⁴ Ibid.

⁹⁵ Gartner, *Metadata*, 10.

⁹⁶ Gilliland, “Setting the Stage.”

Another important function of metadata is to guarantee the quality of data, as it defines the conditions for data entry.⁹⁷ Gartner distinguishes three main types of metadata:⁹⁸

1. Descriptive/Finding Metadata
2. Administrative Metadata
 - a. Technical Metadata
 - b. Rights Metadata
 - c. Preservation Metadata
3. Structuring Metadata

Descriptive metadata describes the intellectual content of the object and facilitates the discovery of the data.⁹⁹ Administrative metadata provides background information to ensure that data can be stored, preserved, and accessed when needed.¹⁰⁰ Technical metadata provides information for the operation of the system and is generated automatically.¹⁰¹ Rights metadata controls the different types of access to digital objects. Preservation metadata documents the handling of data, sharing information about what is done to the data, how, and by whom. Finally, structural metadata is defined as “information about the relationship between the parts that make up a compound object”.¹⁰²

On the other hand, Jannidis categorizes the following three types of metadata: descriptive, technical, and administrative, but doesn't mention structural metadata, and the technical data is not part of administrative data.¹⁰³ Gilliland also describes different categories: administrative, descriptive, preservation, technical, and use metadata.¹⁰⁴ For the later analysis of the metadata records of the Austrian databases, I consider the categorization of Jannidis (descriptive, technical and administrative metadata) the most useful and interpret them as follows: descriptive metadata focuses on the content, structure and context of the original object, technical metadata is automatically generated and is important for the functioning of the system, and

⁹⁷ Jannidis, “Grundlagen der Datenmodellierung”, in: Jannidis, Kohle, Rehbein, *Digital Humanities*, 100.

⁹⁸ Gartner, *Metadata*, 7.

⁹⁹ “Descriptive Metadata”, *Dictionary Archives Terminology*, accessed July 21, 2025, <https://dictionary.archivists.org/entry/descriptive-metadata.html>.

¹⁰⁰ Gartner, *Metadata*, 7.

¹⁰¹ Ibid, 7.

¹⁰² “Structural Metadata”, *Dictionary Archives Terminology*, accessed March 15, 2024, <https://dictionary.archivists.org/entry/structural-metadata.html>.

¹⁰³ Jannidis, “Grundlagen der Datenmodellierung”, 101.

¹⁰⁴ Gilliland, “Setting the Stage.”

administrative metadata documents the internal processes of the institution or research group that manages and preserves data and ensures the availability of information. To distinguish structuring metadata is especially important for compound objects and books. However, I focus on exhibition-related data, which is extracted from these objects. Rights metadata is not explicitly stated on the website of the Austrian databases; therefore, I don't handle it separately.

To ensure the quality and consistency of metadata, cultural heritage information professionals have developed community standards. Gartner quotes Priscilla Caplan, who defines metadata standards as follows: "a set of metadata elements and rules for their use which have been designed for a particular purpose".¹⁰⁵ There are several approaches to categorizing metadata standards. According to Gartner, metadata has three "fundamental components" that can be standardized:¹⁰⁶

1. Semantics: the meaning of the metadata fields and elements and their relationships
2. Syntax: encoding of the metadata, such as XML¹⁰⁷
3. Content rules: defining what should be recorded, in which form, and what should be omitted, such as AACR¹⁰⁸

Gilliland further organized metadata-related standards into five categories: schemas (metadata element sets as EAD¹⁰⁹, Dublin Core¹¹⁰, VRA Core¹¹¹), data value standards (vocabularies, controlled lists, thesauri as AAT, ULAN, TGN, ICONCLASS), data content standards (syntax rules, as CCO, RDA), data formats (such as RDF, EAD XML, LIDO), and the manifestation of particular data structures (such as XML).¹¹²

One of the most complete collections and categorizations of standards has been made by *Jenn Riley*, digital librarian of McGill University (Montréal), who has grouped them according to the domain/community using them and their function and

¹⁰⁵ Gartner, *Metadata*, 53.

¹⁰⁶ Ibid, 53.

¹⁰⁷ XML stands for eXtensible Markup Language and was designed to store and transport data, *W3Schools*, https://www.w3schools.com/xml/xml_what.asp.

¹⁰⁸ "Anglo-American Cataloging Rules", American Library Association, the Canadian Library Association, and the Chartered Institute of Library and Information Professionals, accessed July 21, 2025, <http://www.aacr2.org>.

¹⁰⁹ Encoded Archival Description is a metadata schema to describe archival collections and records in multiple levels. Library of Congress, <https://www.loc.gov/ead/>.

¹¹⁰ Dublin Core is a metadata schema and naming standard, that uses only 15 elements to describe objects. <https://www.dublincore.org/specifications/dublin-core/dcmi-terms/>.

¹¹¹ Visual Resources Association Core is a metadata standard for the description of visual works and the images that document them. <https://www.vraweb.org/vra-core-data-standard>.

¹¹² Gilliland, "Setting the Stage."

purpose.¹¹³ He depicts his Metadata Universe on a Venn diagram. I used this illustration to meet a selection of suitable communities and their standards and overtook his categorization of the relevance in the different domains. *Figure 1* shows a matrix of the “metadata standards” used in the communities (museums, libraries, and archives) in terms of how strongly relevant they are to specific user groups (strong, semi-strong, semi-weak, or weak). The long list of standards proves that the communities are far away from a universal approach, even though his summary is from sixteen years ago. The librarian community has the largest number of different standards and the most strongly used ones. Museums, on the other hand, have the fewest standards and most of the weakest ones.

There are only a few standards that are equally important to the communities, such as Linked Data and FOAF are semi-weak in all of them. However, libraries and archives share more of the same standards with the same strength. And certain standards, which are strongly used in museums, are only present there, such as Spectrum and MuseumDat. This is also true for libraries, but archives share their most popular standards with the library community.

Some of the standards mentioned go beyond metadata schemas and might be better described as ontologies, such as CIDOC CRM, taxonomies, such as the Dewey Decimal Classification, encoding languages, such as XML, and thesauri, such as the Art and Architecture Thesaurus (AAT). In the glossary, Riley lists them under the heading of metadata standards. As already mentioned, the boundary between the types of standards is fuzzy, and it can sometimes be complicated to differentiate between them. Doerr mentions that some authors regard metadata schemas as vocabularies and ontologies, because metadata labels remind them of concepts, and he emphasizes that “formal ontologies were introduced to computer science to describe common conceptualization behind multiple schemata, and not to become a synonym of schemata.”¹¹⁴

¹¹³ Jenn Riley, Glossary of Metadata Standards, accessed April 2, 2025, <https://jennriley.com/metadatamap/>.

¹¹⁴ Doerr, “Ontologies for Cultural Heritage”, 4667.

Metadata Standards in Cultural Heritage Communities (Color-coded by their significance)

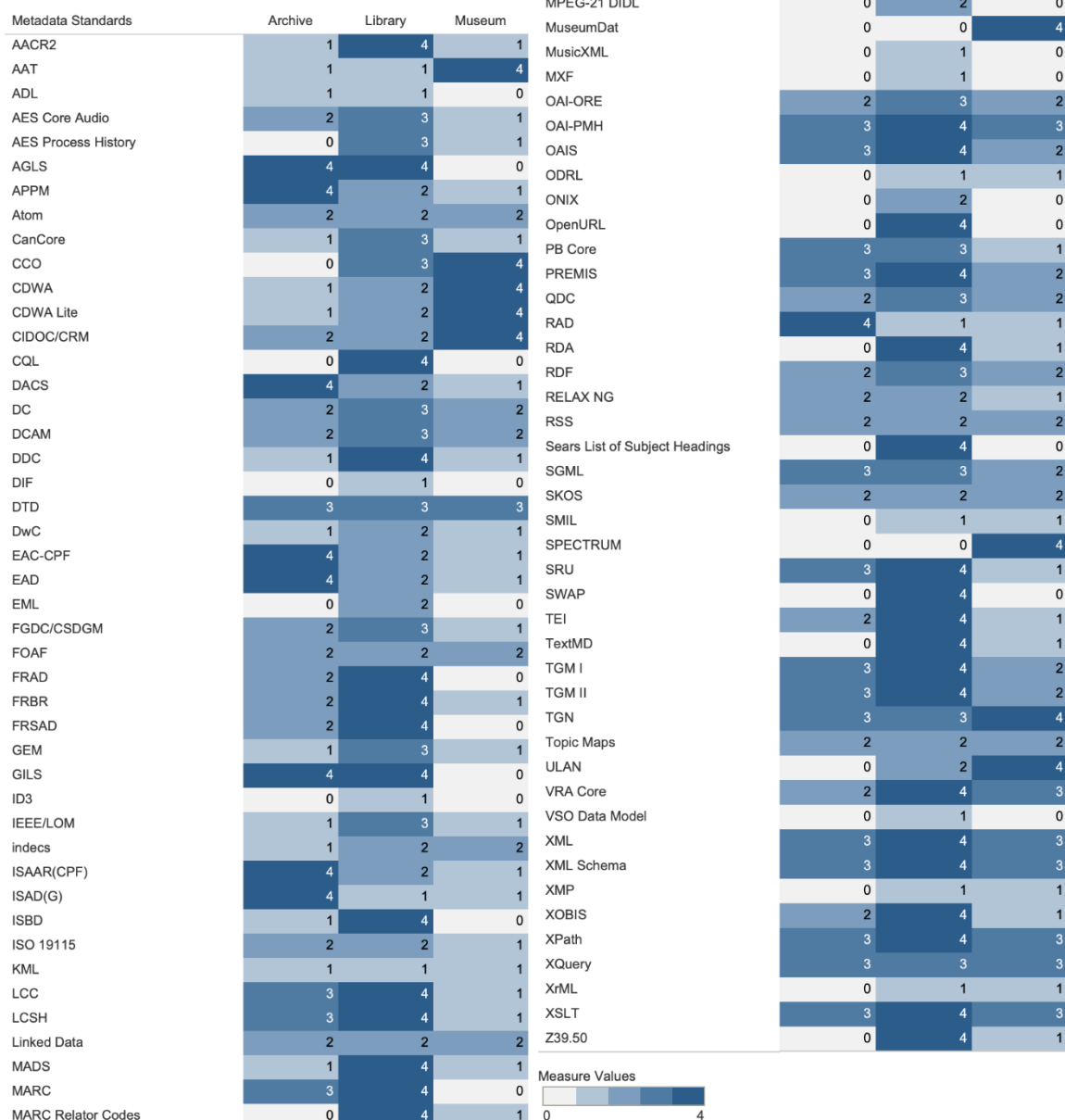


Figure 1: Color-coded matrix of the 96 standards in the three cultural heritage communities.

Based on Jenn Riley's *Diagram of the Metadata Universe* (made with Tableau): 0 = not relevant (white), 1 = weak (lightest blue), 2 = semi-weak (light blue), 3 = semi-strong (dark blue), 4 = strong (darkest blue)

In Austria, the “Museumsbund Österreich” (Austrian Museums Association) links to the website of the “Deutscher Museumsbund” (German Museums Association), which recommends the standards: LIDO¹¹⁵, Dublin Core, CCO, CDWA, and CDWA Lite.¹¹⁶ The “Österreichischer Bibliothekenverbund” (Austrian Library

¹¹⁵ Lightweight Information Describing Objects provides descriptive information for all kinds of objects related to culture and natural history. ICOM, <https://cidoc.mini.icom.museum/working-groups/lido/lido-overview/about-lido/what-is-lido/>.

¹¹⁶ Austrian Museums Association, <https://www.museumsbund.at>.

Network) suggests the usage of Resource Description & Access (RDA, AWR) and MARC21.¹¹⁷ And the “Verband Österreichischer Archivarinnen und Archivare” (Association of Austrian Archivists) endorses ISAD(G), ISDIAH, ISAAR(CPF) and ISDF.¹¹⁸ These examples show that each association is giving domain-specific recommendations, and at the level of metadata schemas, the cultural heritage institutions in Austria don’t share recommended standards. It can be explained by the purpose of the establishments and the different types of objects they collect. The recommendations are mostly influenced by the practices of German-speaking countries.

Choosing the appropriate metadata schema for the purpose of a particular institution remains a challenge, but users need to be able to find, interpret, and use their materials. There is no single standard or set of standards that is suitable for describing all types of collections. In some cases, when the collection contains complex objects or hierarchical structures, metadata schemas can be combined.¹¹⁹ Another important consideration is the level of granularity required, as there are core metadata standards and more detailed standards. Museums tend to use core standards (Dublin Core) to ensure interoperability, and libraries usually work with detailed metadata (MARC).

To enable the interoperability of data from different collections, metadata crosswalks have been developed. These are mappings from field to field, based on similar semantics: for example, there are crosswalks between Dublin Core (DC) and MARC¹²⁰, EAD, etc.¹²¹ The Getty Institute published a regularly updated metadata crosswalk on its website to map overlapping categories.¹²² These standards have been developed for different types of objects (artworks, books, administrative records, etc.) and contain only information about events related to these items. In the published table on the Getty website, metadata elements for exhibitions are part of the category “Exhibition/Loan History”. According to their comparison, CDWA and Linked Art have the most detailed information about exhibitions.

¹¹⁷ Austrian Library Network (OBV), <https://www.obvsg.at/en/>.

¹¹⁸ Association of Austrian Archivists, <https://www.voea.at>.

¹¹⁹ Gilliland, “Setting the Stage.”

¹²⁰ Gartner, *Metadata*, 55.

¹²¹ Woodley, Mary S. “Metadata Matters: Connecting People and Information.” Revised by Murtha Baca, in: *Introduction to Metadata*, edited by Murtha Baca. 3rd ed. Los Angeles: Getty Publications, 2016. <http://www.getty.edu/publications/intrometadata/metadata-matters/>.

¹²² Metadata Standards Crosswalk, Getty Research Institute, accessed July 21, 2025, <https://www.getty.edu/publications/categories-description-works-art/metadata-standards-crosswalk/>.

Metadata for exhibitions

Rodríguez-Ortega and Cruces Rodríguez also compared several metadata standards focusing on the description of exhibitions.¹²³ They defined a set of elements (Exhibitum), necessary for documentation, and mapped them to other schemas, such as Schema.org¹²⁴, DC, CDWA/CCO, LIDO, EDM, and Controlled Vocabularies. They defined six core elements (*Table 1*): entities or institutions (orange), people (pink), exhibitions (blue), inscription devices (green), companies involved in the production of art exhibitions (yellow), and featured artworks (purple).¹²⁵ All of these contain elements indicated by my additional color coding in the table. The brown color represents vocabularies that are not part of the core classes. The authors emphasize the need to define the roles of the actors, which is indicated by properties (curated by, organized by), and to differentiate between geographical locations and institutional locations, as well as to add satellite and traveling exhibitions and the narrative, curatorial discourse.¹²⁶ These elements demonstrate that an exhibition can be a very complex entity in time and space, with multiple participants and discursive contexts.

The existing standards don't include all these aspects, however most of them have the basic descriptive elements: title, description, date, location and unspecified actors. LIDO (events), DC and EDM have the most elements to be able to describe the categories, but with much less specificity than Exhibitum. In the table, the authors' comparison is supplemented by my addition of Linked Art (indicated by the grey background color). Linked Art is a simplified version of the event-based ontology CIDOC CRM with modelling examples specifically for the art field. Although, it would be more relevant to compare Linked Art to other ontologies, I intend to show its relevance to the Exhibitum categories. In the Getty crosswalk, it was one of the most compatible standards to CDWA, which motivated my decision to investigate its ability to describe detailed information about exhibitions. Unfortunately, it also contains only a subset of elements, but its suitability is comparable to EDM. Gartner emphasizes that metadata is not neutral, it makes a subjective statement about the world, meets a selection of information and uses specific terminology, which is proved by the

¹²³ Rodríguez-Ortega, Cruces Rodríguez, "Development of Technological Ecosystems for Cultural Analysis", 437-438.

¹²⁴ Schema.org is a collection of structured data schemas and vocabularies. <https://schema.org>.

¹²⁵ Rodríguez-Ortega, Cruces Rodríguez, "Development of Technological Ecosystems for Cultural Analysis", 433, 436.

¹²⁶ Ibid, 435.

comparison of these standards.¹²⁷ Each standard has been developed for specific purposes to describe objects. Only Exhibitum was created with the intention to describe exhibitions, therefore their metadata categories and used terminologies are more detailed.

Exhibitum	Schema.org	DC	CDWA / CCO	LIDO (events)	EDM	Control Vocabularies Used	Linked Art
ID		identifier		event ID			id
URL	URL						URL
title	name	title	title	event name			identified_by content
description	description	description	Description / descriptive note	eventDescriptionSet			referred_to_by content
abstract		abstract					
start Date	startDate	date		earliestDate	begin	ISO 8601 date format	timespan begin_of_the_begin
end Date	endDate	date		latestDate	end	ISO 8601 date format	timespan end_of_the_end
location (geographical place)	<i>location</i>	<i>location</i>	<i>Place name</i>	<i>eventPlace</i>	<i>place</i>	GeoNames	identified_by[type =Name] on the place
headquarter (institutional place)				<i>eventPlace</i>	<i>place</i>	VIAF	took_place_at
visitors range							
access type						Exhibitum	
geographical coordinates							
source of information (<i>_information provided by_</i>)		source	source	resource Source (Resource Elements)			referred_to_by (type: LinguisticObject)
organizing entity (<i>_organized by_</i>)	organizer	<i>contributor</i>		<i>actorInRole (role Actor)</i>	<i>agent (was present at)</i>	ULAN / VIAF / Exhibitum	carried_out_by

¹²⁷ Gartner, *Metadata*, 4.

Exhibitum	Schema. org	DC	CDWA / CCO	LIDO (events)	EDM	Control Vocabularies Used	Linked Art
collaborating entity (<i>_has collaborator_</i>)	<i>actor</i>	<i>contributor</i>		<i>actorInRole</i> (role Actor)	<i>agent</i> (was present at)	ULAN / VIAF / Exhibitum	
sponsor entity (<i>_sponsored by_</i>)	funder, sponsor	<i>contributor</i>	commis- sioner	<i>actorInRole</i> (role Actor)	<i>agent</i> (was present at)	ULAN / VIAF / Exhibitum	
artist featured (<i>_features artist_</i>)	<i>actor</i>	<i>contributor?</i>	<i>creator?</i>	<i>actorInRole</i> (role Actor)	<i>agent</i> (was present at)	ULAN / VIAF / Exhibitum	propositional object: about/ creation of the exhibition: influenced_by
curator (<i>_curated by_</i>)	<i>actor</i>	<i>creator?</i>	<i>creator?</i>	<i>actorInRole</i> (role Actor)	<i>agent</i> (was present at)	ULAN / VIAF / Exhibitum	carried_out_by or created_by/ carried_out_by on the abstract work
museography company (<i>_produced by_</i>)	<i>actor</i>	<i>creator?</i>	<i>creator?</i>	<i>actorInRole</i> (role Actor)	<i>agent</i> (was present at)	Exhibitum	
lender (<i>_has lender_</i>)	<i>contri- butor</i>	<i>contributor</i>		<i>actorInRole</i> (role Actor)	<i>agent</i> (was present at)	ULAN / VIAF / Exhibitum	
inscription device: publication related produced resource and material (<i>_documented/exp anded by_</i>)	<i>recorded- in?/review</i>	<i>IsRefe- rencedBy?</i>	<i>source?</i>				
Artwork (<i>_features artwork_</i>)	<i>workFea- tured</i>			<i>thingPresent</i> / <i>displayObject</i>	<i>isRelat- edTo</i>		<i>used_specific_ object member_of</i> (set)
exhibition type	<i>Additional Type</i>	<i>type</i>	Work type	<i>eventType</i>		Exhibitum	<i>classified_as</i>
movement/style			style / periods		Concept	Exhibitum / AAT	
period (time coverage)		Coverage. temporal	style/ periods	<i>periodName</i>	Time- Span	AAT	
type of object (present at exhibition)		<i>type</i>		<i>objectWork- Type</i> (Object Identification Elements)	Concept	AAT	
subject coverage	<i>about</i>	<i>subject?</i>	<i>subject</i> ?	<i>subjectConc ept*?</i> (Object Identification Elements)	Concept	AAT / Exhibitum	(propositional object) about

Exhibitum	Schema. org	DC	CDWA / CCO	LIDO (events)	EDM	Control Vocabularies Used	Linked Art
curatorial narrative and discourse					Concept	Exhibitum	influenced_by
geopolitical coverage		Coverage. Spatial				GeoNames	
associated itinerant exhibition (<i>_has itinerant exhibition_</i>)				<i>relatedEvent / relatedEvent- RelType</i>	<i>isRe- latedTo</i>		part_of/ influenced_by (propositional object)
associated satellite exhibition (<i>_has satellite exhibition_</i>)	<i>subEvent / super- Event</i>	<i>isPartOf / hasPart</i>			<i>isRe- latedTo</i>		part_of/ influenced_by (propositional object)

Table 1: Metadata Standard Intellectual Mapping.

By Rodríguez-Ortega, Nuria and Antonio Cruces Rodríguez, supplemented by Linked Art by the author.

The colors indicate the five core elements of the description of exhibitions and the vocabularies. "The broader properties that have needed a greater specification are marked in *italic*. The interrogations indicate the properties that have posed problems of conceptual equivalence."¹²⁸

To date (2025), Rodríguez-Ortega and Cruces Rodríguez have dealt with the topic of modelling exhibitions at the highest level of granularity and have come the closest to a metadata schema that describes exhibitions in all their complexity. However, they focused specifically on their research purpose of discovering networks in the art field. To do this, they created a field for featured artists and several roles. The object is no longer at the center of the schema, but the exhibition with an ID. Several metadata elements refer to information that is only available to the organizer of the exhibitions (*_has lender_*, *_features artwork_*, curatorial narratives and discourse) but is not part of a press release or invitation, becomes archival material or is published in online calendars. Their comparison reveals a lack of standards, such as persistent identifiers for exhibitions and standard vocabularies for curatorial narratives and discourses. In the next section, I focus on the terms and standard vocabularies that are an integral part of descriptive metadata.

¹²⁸ Rodríguez-Ortega, Cruces Rodríguez, "Development of Technological Ecosystems for Cultural Analysis", 437-438.

3.3. Controlled vocabularies, taxonomies, thesauri

Metadata standards define the elements that should be considered when describing an object, but they still don't ensure the consistency of the terms used to describe them. For this reason, controlled vocabularies have been developed, which restrict a set of allowed terms (data values). Patricia Harpring gives the following definition: "A controlled vocabulary is an organized arrangement of words and phrases used to index content and/or retrieve content through browsing for searching."¹²⁹ Vocabulary control is used to standardize naming and improve indexing, browsing, uniformity, and retrieval of the data described. There are different versions, such as flat terminological lists, hierarchical structures, and structures with defined relationships between terms. Harpring distinguishes between subject heading lists¹³⁰, simple controlled lists¹³¹, synonym ring lists¹³², taxonomies, and thesauri.¹³³ Authority files include alternate forms and can define personal names with different spellings (Library of Congress Name Authority File, The International Standard Name Identifier) as well as geographical names in variant versions (Thesaurus of Geographic Names, GeoNames) and are often associated with unique identifiers such as URIs or codes.¹³⁴

Subjects can be semantically more complex and are usually arranged according to overarching concepts and in relation to other terms. These structures are called taxonomies: "the term taxonomy derives from two Greek words, τάξις (an ordering or positioning) and νόμος (a law or principle)."¹³⁵ An example of a hierarchical taxonomy is the enumerative classification scheme of the Dewey Decimal Classification, which places all items in a hierarchy by assigning them to a group indicated by a number. This has been criticized for forcing entities into a rigid structure and ossifying knowledge instead of building it.¹³⁶ Iconclass is one example of this type and is used to describe iconographic categories.

¹²⁹ Harpring, *Introduction to Controlled Vocabularies*, 12.

¹³⁰ "... uniform words or phrases intended to be assigned to books, articles, or other documents in order to describe the subject or topic of the texts and to group them with texts having similar subjects." (Ibid, 18).

¹³¹ "... a simple list of terms used to control terminology." The terms are arranged in a logical order and have the same level of rank. (ibid, 19).

¹³² "A synonym ring is a simple set of terms that are considered equivalent for the purpose of retrieval." (Ibid, 20).

¹³³ ibid, 16.

¹³⁴ Gartner, *Metadata*, 55.

¹³⁵ Ibid, 65.

¹³⁶ Ibid, 69.

Thesauri are also hierarchical taxonomies, but arranged alphabetically. Terms are integrated into a context by linking broader, narrower, and related terms at the same level.¹³⁷ Bruseker et al. quote the following definition on thesauri: “a controlled vocabulary arranged in a known order and structured so that equivalence, homographic, hierarchical, and associative relationships among terms are displayed clearly and identified by standardized relationship indicators that are employed reciprocally” (National Information Standards Organization).¹³⁸ Unlike an enumerative system, a subject term may belong to different structures.¹³⁹ However, the relationship between terms is not clearly defined. It can be interpreted as a type, part, or instance of a broader term. Examples of such thesauri are Art and Architecture Thesaurus (AAT), the Getty Thesaurus of Geographic Names (TGN), the Cultural Objects Name Authority (CONA), and the Union List of Artist Names (ULAN) of the Getty Institute. As Harpring points out, cataloging institutions should consult existing vocabularies before creating their own controlled vocabularies, allowing the integration of their descriptions into shared retrieval environments.¹⁴⁰ She summarized the types of terms used to describe art and architecture as follows: names for persons and corporate bodies, locations, objects, iconographical subjects, and genres.¹⁴¹

Since there is plenty of vocabulary, it is not easy to find the most suitable ones. The Deutscher Museumsbund recommends the following criteria for selection:¹⁴²

- Best possible coverage of the knowledge area
- Accessibility of the vocabulary (free or paid)
- Multilingualism (required languages)
- Maintenance and long-term availability of the vocabulary
- Interlinking with other vocabularies
- Part of the LOD Cloud
- Usage of semantic web technologies

Standards have also been developed for the creation of vocabularies for proprietary purposes, addressing structure, relationships between terms, and

¹³⁷ Ibid, 70.

¹³⁸ Bruseker, Carboni and Guillem, “Cultural Heritage Data Management”, 100.

¹³⁹ Gartner, *Metadata*, 71.

¹⁴⁰ Harpring, *Introduction to Controlled Vocabularies*, 8.

¹⁴¹ Ibid, 49.

¹⁴² Winfried Bergmeyer, Paul Klimpel, *Digitale Grunderfassung: 10 Grundsätze*, Deutscher Museumsbund, Berlin, 2022, 27, <https://www.museumsbund.de/wp-content/uploads/2022/12/handreichung-digitale-grunderfassung.pdf>.

preferred terms. The National Information Standards Organization has published “ANSI/NISO Z39.19-2005: Guidelines for the Construction, Format, and Management of Monolingual Controlled Vocabularies”, which covers all of these issues. There are two ISO standards: “ISO 2788:1986: Documentation—Guidelines for the Establishment and Development of Monolingual Thesauri” and “ISO 5964:1985: Documentation—Guidelines for the Establishment and Development of Multilingual Thesauri”, which can be consulted when developing vocabularies for specific purposes.¹⁴³ In addition to terms, the controlled formatting is also essential for consistency, such as Unicode character encoding, definition of free text fields, the use of vocabulary terms, and restrictions on the number of digits, etc.¹⁴⁴

Table 2 compares a selection of the relevant choices of four authors (Jenn Riley¹⁴⁵, Anne J. Gilliland¹⁴⁶, Vladimir Alexiev¹⁴⁷, Patricia Harpring¹⁴⁸), the recommendations of the Deutscher Museumsbund¹⁴⁹ and ICOM¹⁵⁰), as well as those supported by Europeana¹⁵¹ and the LOD Cloud. Riley collected almost all available controlled vocabularies. Gilliland lists those used in archives in metadata schemas, Alexiev focuses on thesauri of museums that are part of the Linked Open Data Cloud, and Harpring mentions the relevant thesauri for the cultural heritage field. Europeana is a cultural heritage web portal containing the digitized collections of more than 3000 institutions across Europe. Its metadata standard, the Europeana Data Model (EDM), ensures the interoperability of data based on the Dublin Core Elements. Their website lists the vocabularies supported. The International Council of Museums links to the Encyclopedia of Museum Practice, which is a collection of different standards and guidelines for museums. Finally, the Deutscher Museumsbund (DMB) lists several standards as recommendations in their document “10 Grundsätze” (10 Principles).

¹⁴³ Harpring, *Introduction to Controlled Vocabularies*, 8-9.

¹⁴⁴ Ibid, 14.

¹⁴⁵ Jenn Riley, Glossary of Metadata Standards, accessed April 2, 2025, <https://jennriley.com/metadatamap/>.

¹⁴⁶ Gilliland, “Setting the Stage.”

¹⁴⁷ Vladimir Alexiev, Museum Linked Open Data: Ontologies, Datasets, Projects,” *Digital Presentation and Preservation of Cultural and Scientific Heritage* 8 (September 2018): 41–47, <https://doi.org/10.55630/dipp.2018.8.1>.

¹⁴⁸ Harpring, *Introduction to Controlled Vocabularies*.

¹⁴⁹ Bergmeyer, Klimpel, *Digitale Grunderfassung: 10 Grundsätze*, 28-30.

¹⁵⁰ “Encyclopedia of Museum Practice”, ICOM, <https://cidoc-dswg.org/wiki/DocumentationStandards>

¹⁵¹ “Vocabularies supported by Europeana”, accessed July 21, 2025, https://docs.google.com/spreadsheets/d/1BoDNolkcp_qfvVShdOZyGcf61XslcwKF2MdGcgYs20/edit?gid=0#gid=0.

Controlled vocabularies	Riley	Gilli-land	Ale-xiev	Harp-ring	DMB	ICOM	Euro-peana	LOD Cloud
Allgemeines Künstlerlexikon aller Zeiten und Völker (AKL)					x			
Art & Architecture Thesaurus® (AAT)	x	x	x	x	x	x	x	x
British Museum Object Names Thesaurus			x		x	x		
CAMEO - Conservation & Art Material Encyclopedia Online				x	x			
Chenhall's Nomenclature				x		x		
Getty Conservation Thesaurus (CT)				x				
Cultural Objects Name Authority (CONA)				x		x		
Encoded Archival Context - Corporate bodies, Persons and Families (EAC-CPF)	x							
Gemeinsame Normdatei (GND)					x		x	x
GeoNames							x	x
ICONCLASS		x	x	x	x	x	x	
LCSH (Library of Congress Subject Headings)	x	x	x	x		x	x	
LCNAF (Library of Congress Name Authority File)				x			x	
Objektbezeichnung sdatei (OBG)					x			
RDA Terms	x						x	
SHIC (Social History and Industrial Classification)						x		
Spectrum terminologies						x		
Thesaurus of Graphic Materials I (TGM I)	x	x		x	x			

Controlled vocabularies	Riley	Gilli-land	Ale-xiev	Harp-ring	DMB	ICOM	Euro-peana	LOD Cloud
Thesaurus of Graphic Materials I (TGM II)	x	x		x	x			
Thesaurus of Geographical Names (TGN)	x	x	x	x	x	x	x	x
Unesco Thesaurus					x		x	
Union List of Artist Names (ULAN)	x	x	x	x	x	x	x	x
Virtual International Authority File (VIAF)			x		x		x	
Wikidata			x		x		x	x

Table 2: Controlled vocabularies in the cultural heritage field.

Of the 24 controlled vocabularies/thesauri/taxonomies, only three are mentioned by all of them: AAT, TGN, and ULAN (indicated by the darker blue color), and three others were recognized by most of them: ICONCLASS, Library of Congress Subject Headings (LCSH) and Wikidata (indicated by the lighter blue color). AAT, TGN, and ULAN are all developed in the Getty Research Institute for cultural heritage objects. ICONCLASS is specifically used for describing the iconography of images. LSCH¹⁵² has been developed to express the subjects of bibliographical records, and Wikidata is a collective knowledge database using certain recommendations to describe heterogeneous records. At the same time, these belong to the most widespread thesauri in the cultural heritage domain.

3.3.1. The Getty vocabularies

As mentioned before, the common denominators of the different selections are the living thesauri of the Getty Research Institute (AAT, TGN, ULAN), which are maintained by the Getty Vocabulary Program (GVP) and constantly evolving with the help of contributors. They are interconnected, translated into several languages, co-referenced with other thesauri, such as LSCH and VIAF¹⁵³, and widely used by databases, research projects, search engines, and collection management

¹⁵² "Library of Congress Subject Headings", accessed July 21, 2025, <https://www.loc.gov/aba/publications/FreeLCSH/freelcsh.html>.

¹⁵³ The Virtual International Authority File was developed for libraries. It combines widely used authority files in one named-authority service. OCLC, accessed July 21, 2025, <https://viaf.org/en>.

systems.¹⁵⁴ They comply with the ISO and NISO standards for vocabulary creation. Getty ensures the stability of the entry-URLs and has prepared the thesauri for the Linked Open Data Cloud.¹⁵⁵ The vocabularies can be used free of charge as sources of terminology for art, architecture, material culture, archival materials, visual surrogates, and bibliographic materials.¹⁵⁶ They can provide knowledge for researchers and serve as search assistants. They are particularly used by art libraries, archives, museums, collections, art research projects, and information specialists.¹⁵⁷

The **Art & Architecture Thesaurus** (AAT)¹⁵⁸ contains “terms and other information relating to objects, materials, techniques, activities, and other concepts”¹⁵⁹ from antiquity to the present in a polyhierarchical structure. They are assigned to unique identifiers and supplemented by related synonyms or multilingual terms. The AAT is divided into seven facets: associated concepts, physical attributes, styles and periods, agents, activities (such as exhibitions), materials, and objects.

The **Union List of Artist Names** (ULAN)¹⁶⁰ is a structured vocabulary with the names of creators of cultural works, corporate bodies, and unknown artists as its three main facets, but also includes art historians, curators, patrons, family members, friends, and workshops.¹⁶¹ In addition to first names and surnames, it contains pseudonyms and variant spellings in several languages and documents changes. Records are identified by a unique numerical identifier. Related persons, corporate bodies, sources, and notes enrich the entries.

The **Getty Thesaurus of Geographic Names**¹⁶² is a hierarchically structured vocabulary of place names on a global scale from prehistory to the present, and their hierarchies, equivalences, and associative relationships.¹⁶³ The focus is on “administrative bodies defined by administrative boundaries and conditions”, such as

¹⁵⁴ Alexiev, “Museum Linked Open Data”, 41.

¹⁵⁵ “Getty Vocabularies as Linked Open Data”, The Getty Research Institute, <https://www.getty.edu/research/tools/vocabularies/lod/index.html>.

¹⁵⁶ Harpring, *Introduction to Controlled Vocabularies*, 51.

¹⁵⁷ Ibid, 52.

¹⁵⁸ “Art and Architecture Thesaurus Online”, The Getty Research Institute, <https://www.getty.edu/research/tools/vocabularies/aat/>.

¹⁵⁹ Harpring, *Introduction to Controlled Vocabularies*, 52.

¹⁶⁰ “Union List of Artist Names Online”, The Getty Research Institute, <https://www.getty.edu/research/tools/vocabularies/ulan/index.html>.

¹⁶¹ Harpring, *Introduction to Controlled Vocabularies*, 62-64.

¹⁶² Getty Thesaurus of Geographic Names Online, The Getty Research Institute, <https://www.getty.edu/research/tools/vocabularies/tgn/index.html>.

¹⁶³ Harpring, *Introduction to Controlled Vocabularies*, 59.

nations, cities, archeological sites, as well as physical features and historical places.¹⁶⁴ Records are identified by a unique numerical identifier and supplemented by information about the source of the data, types, roles, approximate coordinates, and notes. The hierarchy represents the current political and geographical situation, but some historical nations and empires are also included.¹⁶⁵

The AAT contains terms related to activities such as exhibitions, but not specific events with a unique identifier. *Ryan Shaw* addresses the problem of the lack of an event gazetteer in several papers.¹⁶⁶ Although people, places, and concepts have their thesauri and time has its standards, events don't have an enumerated controlled vocabulary that allows people, places, times, artefacts, and unambiguous events to be linked.¹⁶⁷

3.3.2. Controlled vocabularies for exhibition

Rodríguez-Ortega and Cruces Rodríguez use the following controlled vocabularies in their exhibition metadata model: ULAN, VIAF, AAT, and GeoNames¹⁶⁸. However, they introduce their own terms for access type, exhibition type, museographic company, as well as curatorial narrative and discourse. For certain metadata elements, they complement ULAN and VIAF (different roles) as well as AAT (movement/style, subject coverage). It seems that the interoperability of vocabularies is crucial for the description of exhibitions, as no single vocabulary is comprehensive enough to include names, geographical information, roles of actors, periods, subjects, and art discourses at the same time.

¹⁶⁴ Ibid, 60.

¹⁶⁵ Ibid, 60.

¹⁶⁶ Lewis Lancaster, Michael Buckland, Ryan Shaw, "Event: Occurrence and Agency in Digital Resources", in: *Cultural Heritage on the Semantic Web. 6th International Semantic Web Conference and the 2nd Asian Semantic Web Conference Workshop 9*. 12 Nov 2007. Busan, Korea, 2007 and Ryan Shaw, *Events and Periods as Concepts for Organizing Historical Knowledge*, UC Berkeley, 2010. <https://escholarship.org/uc/item/4111f1fw>.

¹⁶⁷ Ryan Shaw, "Event gazetteers for navigating humanities resources", in *Proceedings of the 2nd PhD workshop on Information and knowledge management*, Association for Computing Machinery, October 30, 2008, 89. <https://doi.org/10.1145/1458550.1458567>.

¹⁶⁸ The GeoNames vocabulary covers all countries and over eleven million placenames. For Vienna for example over 1400 records are listed. <https://www.geonames.org>.

3.3.3. Mapping

In addition, mapping between vocabularies can facilitate efficient data retrieval. To successfully map vocabularies, Harping fosters the investigation of the following factors: scope of mapping, similarity of content, intended audience, format, hierarchical structure, pre- and post-coordination for retrieval (general or unique terms), granularity and specificity, synonymy and near-synonymy, and authoritativeness.¹⁶⁹ The “ISO/CD 25964-1: Thesauri and Interoperability with Other Vocabularies. Part 1: Thesauri for Information Retrieval” addresses this issue by offering a standard.¹⁷⁰ There are different types of mapping, for example, direct mapping for one-to-one matching of terms, which requires the same vocabulary size; automated mapping by algorithms, such as co-occurrence mapping,¹⁷¹ switching vocabularies by using a third vocabulary for mapping and linking the terms of the other vocabularies to it. Similarly, semantic mapping relates vocabularies based on the meanings of terms and the nature of the relationships between them using a predefined scheme.¹⁷² In the next section, I present the models that could enable semantic mapping and organize our knowledge in a more complex structure.

3.4. Ontologies

Jannidis defines ontologies as “formal conceptual systems for modelling knowledge about a specific subject area and its technical implementation. Ontologies thus serve as a form of knowledge representation.”¹⁷³ They are particularly relevant for integrating heterogeneous data sources, making data interoperable, deriving logical conclusions, and are widely used in digital humanities.¹⁷⁴ Their aim is to reflect the symbolic meaning of real-world objects and provide semantic statements that can be understood by computers. They therefore contain a system of concepts: classes (divided into subclasses and containing instances), properties, and constraints for

¹⁶⁹ Harping, *Introduction to Controlled Vocabularies*, 86-89.

¹⁷⁰ *ibid*, 84.

¹⁷¹ *ibid*, 85.

¹⁷² *ibid*, 89.

¹⁷³ Original text in German: “formale Begriffssysteme zur Modellierung von Wissen über einen spezifischen Gegenstandsbereich und deren technische Umsetzung. Ontologien dienen damit als eine Form der Wissensrepräsentation” (Malte Rehbein, “Ontologien”, in *Digital Humanities: Eine Einführung*, ed. Jannidis, Kohle and Rehbein, 162.)

¹⁷⁴ Rehbein, “Ontologien”, 162.

attributes and relationships.¹⁷⁵ A class is “a category of items that share one or more common traits serving as criteria to identify the items belonging to the class”.¹⁷⁶ Properties “are generalizations of kinds of relations that can exist between classes”.¹⁷⁷ Instances can belong to more than one class and have multiple links in the concept network.

Jannidis categorizes ontologies into top-level/upper ontology (very general, domain independent), domain ontology (describes the concepts of a domain, specifying top-level ontologies), task ontology (for a specific activity), application ontology (terms for specific subjects and/or tasks), lightweight ontology (vocabularies, glossaries, thesauri) and heavyweight ontology (very expressive).¹⁷⁸ However, there are several other classifications according to the subject, the richness or type of the structure, and the dependency of particular tasks.¹⁷⁹ Daoudi, Chaker, and Azeddine specifically group cultural heritage ontologies into top-level, domain-specific, and auxiliary ontologies and categorize them under the main cultural heritage types: tangible, intangible, and natural heritage.¹⁸⁰ An exhibition may be modelled either in relation to objects, where ontologies for tangible heritage and top-level ontologies are relevant, or as events through ontologies for intangible heritage. The authors evaluated 28 ontologies in terms of their suitability for the specific domains (six domains in total, with more ontologies). As a top-level ontology, CIDOC was considered to be the best structured. For events, the “Event” ontology seemed to fulfill most requirements.

3.4.1. Event ontologies

Event ontologies describe a subject domain in terms of events instead of objects. Shaw differentiates between factual and colligatory relations between events and other entities.¹⁸¹ The first category represents the basic factual context of an

¹⁷⁵ Ibid, 164.

¹⁷⁶ Bruseker et al., “Cultural Heritage Data Management”, 105.

¹⁷⁷ Ibid, 106.

¹⁷⁸ Rehbein, “Ontologien”, 165.

¹⁷⁹ Ashour Ali, Shahrul Azman Mohd Noah, and Lailatul Qadri Zakaria, “Representation of Event-Based Ontology Models: A Comparative Study,” *International Journal of Computer Science and Network Security* 22, no. 7 (2022): 147. <https://doi.org/10.22937/IJCSNS.2022.22.7.18>.

¹⁸⁰ Houria Daoudi, Iham Chaker, and Azeddine Zahi, “Comparative Study of Cultural Heritage Ontologies”, in *IEEE International Conference on Technology Management, Operations and Decisions (ICTMOD)*, IEEE, November 22, 2023, 2. <https://doi.org/10.1109/ICTMOD59086.2023.10438114>.

¹⁸¹ Shaw, “Event gazetteers for navigating humanities resources”, 89.

event: what, where, when, and who. The second places events in a narrative structure and connects them to their interpretations. Westermann and Jain proposed eight requirements that a common multimedia event model should fulfil:¹⁸²

1. Formal definition
2. Media independence
3. Unique identifier for events
4. Discrete and continuous events
5. Expressiveness
 - a. Various temporal aspects (time stamp, duration, relative)
 - b. Various spatial aspects (global, local, media-related, relative)
 - c. Informational aspect (type, actors, entities, and their roles)
 - d. Experiential aspect (referring to media)
 - e. Structural aspect (event compositions)
 - f. Causal aspects (between events)
6. Complex data support
7. Association support (different views on the event)
8. Knowledge awareness (bridges to domain knowledge)
9. Uncertainty support
10. Extensibility and adaptability
11. Structure of participation
12. Associated documents
13. Various relations between events

Several event ontologies have been developed to address these needs, but most have not been adopted by the cultural heritage community. The introduction of a new model is usually supported by a comparison with other models.¹⁸³ Ali, Noah, and Zakaria compared event models according to their ability to represent spatial and temporal extent as well as participants in events.¹⁸⁴

¹⁸² Westermann, Utz, and Ramesh Jain, "Toward a Common Event Model for Multimedia Applications," *IEEE Multimedia* 14, no. 1 (2007): 22–26, <https://doi.org/10.1109/mmul.2007.23>.

¹⁸³ Ken Kaneiwa, Michiaki Iwazume, Ken Fukuda, "An Upper Ontology for Event Classifications and Relations", in *AI 2007: Advances in Artificial Intelligence. AI 2007. Lecture Notes in Computer Science*, vol 4830. Springer, 2007, https://doi.org/10.1007/978-3-540-76928-6_41, see later: Simple Event Model, Event-Model-F and LODE.

¹⁸⁴ Ali, Mohd Noah, Qadri Zakaria "Representation of Event-Based Ontology Models", 147-156.

Ontology	Domain and focus	Time	Space	Participation	Causal relationship	Composition	Format
The Event Ontology ¹⁸⁵	Domain ontology (Music)	time:TemporalEntity	geo:Spatial Thing (only spatial region)	foaf:Agent, event:factor	event:factor, event:has Result	event:sub_event	RDF, RDFs, OWL, Ntriple
DOLCE+ DnS Ultralite (DUL) ¹⁸⁶	Lightweight upper ontology	isObservableAt	hasLocation, hasRegion	hasParticipant, involves Agent	x	hasPart, hasConstituent, Situation	RDF/ OWL
CIDOC CRM ¹⁸⁷	Upper ontology for interoperability among metadata standards	P4.has_timespan	P7.took_place_at (only spatial region)	P12.occured_in_the_presence_of, P11.had_participant	P15.was_influenced_by	P86.falls_with_in, P9.consists_of	RDFS/ OWL
Simple Event Model (SEM) ¹⁸⁸	Domain independent ontology	Time, hasTime-Stamp hasBeginTime-Stamp hasEndTime-Stamp; hasEarliestBeginTime-Stamp, hasLatest-BeginTime-Stamp, hasEarliestEndTime-Stamp, hasLatest-EndTime-Stamp.	Place	hasActor; hasRole	x	x	RDF, RDFs
Event-Model-F ¹⁸⁹	Formal ontology based on DUL	F:Time, F:hasTime	F:Spatial Place, F:Has Location	F:Event ParticipationSituation, F:DescribedEvent, F:Participant	EventCausalitySituation, F:Cause, F:Effect	F:Composite F:Component, F:CompositionDescription	OWL
LODE ¹⁹⁰	Interlingua model	atTime	inSpace, atPlace	involved, involved-Agent	x (linking to F)	x (linking to F)	OWL

¹⁸⁵ Yves Raimond and Samer Abdallah, "The Event Ontology", <https://motools.sourceforge.net/event/event.html#>.

¹⁸⁶ "DOLCE+DnS Ultralite", https://akswnc7.informatik.uni-leipzig.de/dstreitmatter/archivo/ontologydesignpatterns.org/ont--dul--DUL--owl/2021.06.07-182648/ont--dul--DUL--owl_type=pyLodeDoc.html.

¹⁸⁷ "CIDOC CRM," ICOM, <https://cidoc-crm.org/versions-of-the-cidoc-crm>.

¹⁸⁸ Willem van Hage, Véronique Malaisé, Roxane Segers, Laura Hollink, Guus Schreiber, "The Simple Event Model Ontology", <https://semanticweb.cs.vu.nl/2009/11/sem/>.

¹⁸⁹ Ansgar Scherp, "Event-Model-F", <https://github.com/ascherp/ontologies>.

¹⁹⁰ Lynda Hardman and Raphaël Troncy, "LODE", <https://linkedevents.org/ontology/>.

Ontology	Domain and focus	Time	Space	Participation	Causal relationship	Composition	Format
ABC Ontology	Foundation model for interoperability among metadata standards	atTime	inPlace (only spatial region)	involves, hasPresence	x	isSubEvent-of, hasAction	RDF

Table 3: Comparison of event ontologies based on Shaw, Troncy, and Hardman (2009).

Shaw, Troncy and Hardman also aligned event ontologies by examining their main properties: type, time, space, participation, causality and composition. Based on these two interpretations, I summarize the main features of these event ontologies in Table 3, ignoring the domain-specific (BBCCORE¹⁹¹, SNaP¹⁹²) or very detailed ontologies (OpenCyc¹⁹³). Each of them has a particular focus or is used to solve different challenges by modelling events. The “Event” Ontology was created specifically for the music domain and links to existing models (FOAF, Geo Positioning Ontology, OWL Time Ontology).¹⁹⁴ The Simple Event Model (SEM) was designed with a minimal semantic commitment for interoperability, adding time stamps (sem:Temporary) and authorities (sem:View, sem:Authority) to the properties. It allows different roles for the same actor.¹⁹⁵ The DOLCE+DnS Ultralite (DUL) was created with the aim of modelling physical or social contexts and serves as a basis for other ontologies, such as the Event-Model-F. The latter models events at a higher level of complexity by including relationships between events (mereological, causal, correlational), roles of participants, interpretations, and documentations of events.¹⁹⁶ The ABC Event Model is a foundation ontology for domain-specific development, designed to facilitate interoperability between metadata vocabularies and “to model

¹⁹¹ Ontology for people, places, events, organizations, themes relevant for BBC, BBC, <https://www.bbc.co.uk/ontologies/core-concepts-ontology/>.

¹⁹² Jarred McGinnis, Paul Wilton, Paul Harman, John O'Donovan, “Simple News and Press Ontologies”, <https://iptc.org/thirdparty/snap-ontology/>.

¹⁹³ No official link to the ontology available anymore.

¹⁹⁴ Ali, Mohd Noah, Qadri Zakaria “Representation of Event-Based Ontology Models”, 149.

¹⁹⁵ Willem Robert Van Hage, Véronique Malaisé, Roxane Segers, Laura Hollink, and Guus Schreiber, “Design and Use of the Simple Event Model (SEM),” *Journal of Web Semantics* 9, no. 2 (2011): 128–36, <https://doi.org/10.1016/j.websem.2011.03.003>.

¹⁹⁶ Ansgar Scherp, Thomas Franz, Carsten Saathoff, Steffen Staab, “F - A model of events based on the foundational ontology DOLCE+DnS ultralite”, in *K-CAP'09 - Proceedings of the 5th International Conference on Knowledge Capture*, 2009, 137-144. <https://doi.org/10.1145/1597735.1597760>. and Kuys, Gerard, & Scherp, Ansgar: “Representing Persons and Objects in Complex Historical Events using the Event Model F”, *Journal of Open Humanities Data* 8 (September 2022), 22, <https://doi.org/10.5334/johd.84>.

physical, digital and analogue objects held in libraries, archives, and museums and on the internet.”¹⁹⁷ Another attempt to map different models is the Linking Open Description of Events (LODE), which relates existing event models to each other by focusing on the factual aspects of an event (what, where, when, and who).¹⁹⁸

CIDOC CRM is the most widely accepted ontology in the cultural heritage field, so I will discuss it in more detail. It is a foundational formal ontology specifically designed for the cultural heritage community, and is mainly used in Europe.¹⁹⁹ In 2006, it became an ISO standard, and is the only ontology in the cultural heritage field with this official recognition (ISO21127²⁰⁰).²⁰¹ CRM is an event-based model, established on the assumption “that historical context can be represented by things, people, and ideas meeting in time and space”²⁰². The model focuses on relationships rather than individual concepts to form a global knowledge network,²⁰³ describing singular items, their context, and their complex relationships with other categories.²⁰⁴ The design principles of the ontology are defined by Bruseker et al. as: symmetrical relationships, context-free interpretation, bottom-up creation starting with specific classes that are only generalized based on sufficient evidence, open-ended²⁰⁵ and modular structure (can be enriched by extensions).²⁰⁶ According to Doerr there are four central ideas in CRM: distinguishing between entities (real things) and identifiers (appellation), considering “types”, classification systems and documentation as part of the reality, introducing conceptual objects, that can reside on more than one physical carrier, documenting the past as a series of events involving “Persistent Items” (Physical

¹⁹⁷ Carl Lagoze, Jane Hunter, “The ABC Ontology and Model”, in *International Conference on Dublin Core and Metadata Applications*, 2001. <https://doi.org/10.23106/dcmi.952106556>.

¹⁹⁸ Shaw, Ryan, Raphaël Troncy, and Lynda Hardman, “LODE: Linking Open Descriptions of Events,” in *The Semantic Web. ASWC 2009*, ed. A. Gómez-Pérez, Y. Yu, and Y. Ding, 160–161. Lecture Notes in Computer Science, vol. 5926. Springer, 2009. https://doi.org/10.1007/978-3-642-10871-6_11.

¹⁹⁹ Alexiev, “Museum Linked Open Data”, 21.

²⁰⁰ “Information and documentation — A reference ontology for the interchange of cultural heritage information,” ISO, accessed 21 July, 2025, <https://www.iso.org/standard/85100.html>.

²⁰¹ Bruseker et al., “Cultural Heritage Data Management”, 108.

²⁰² Martin Doerr, Athina Kritsotaki, “Documenting Events in Metadata”, *The 7th International Symposium on Virtual Reality, Archaeology and Cultural Heritage VAST*, ed. M. Ioannides, D. Arnold, F. Niccolucci, K. Mania, The Eurographics Association, 2006, 2.

²⁰³ Ibid, 2.

²⁰⁴ Doerr, “Ontologies for Cultural Heritage”, 472.

²⁰⁵ One can differentiate between the closed and open world assumption. Former assumes that the ontology is complete, so everything which is not defined by it, is false. On the other hand, the open world assumption considers each statement, which is not explicitly stated to be false, right. (Reinhorn, “Ontologien”, 168) The latter is true for CIDOC CRM.

²⁰⁶ Bruseker et al., “Cultural Heritage Data Management”, 109.

Thing, Conceptual Object and Actor) that meet in time and space (enabling fuzzy spatio-temporal boundaries).²⁰⁷

Bruseker et al. determine certain CRM classes that form a powerful set for cultural heritage reasoning: Physical Thing (E18), Conceptual Object (E28), Actor (E39), Place (E53), Temporal Entity (E2), Appellation (E41), and Type (E55).²⁰⁸ The strong top-level classes act as a basis for multiple reasoning and can be extended by sub-properties and sub-classes. It allows the modelling of highly specialized data structures, access to information through queries at a more general level, and the linking of different data sets.²⁰⁹ It is not limited to modelling a certain perspective and can represent objects in depth. However, Alexiev mentions some disadvantages of CRM, such as shortcomings in describing relationships between people, dates, places, and objects, “not friendly for integrating with other ontologies”, not suitable for application to specific types of objects, and complicated to use.²¹⁰ One response to the complexity of CRM is the development of the Linked Art Data Model, which is specifically composed for the museum community with several use case examples, such as modeling a traveling exhibition. I go into more details in the Linked Data section.

3.4.2. Exhibition ontologies

Recently, two main attempts have been made in the literature to model exhibitions. One of them is by Nicola Carboni, who uses CIDOC CRM to represent the following aspects of an exhibition: temporal duration, spatial extension, objects, creators, knowledge source, reference, mereological structure, contingency relationships, participation, and spatio-temporal information (See *Figure 2*).²¹¹ He also examines the presence of these categories in seven different exhibition datasets. However, most of them only include information about the factual aspects of the exhibition (the first four categories).

²⁰⁷ Doerr, “Ontologies for Cultural Heritage”, 470.

²⁰⁸ Bruseker et al., “Cultural Heritage Data Management”, 111.

²⁰⁹ Ibid, 106.

²¹⁰ Alexiev, “Museum Linked Open Data”, 33.

²¹¹ Carboni, Nicola. "Ontological Patterns for Modelling Art Exhibitions: An Initial Investigation." In *Metadata and Semantic Research. MTSR 2024*, ed. Marios Sfakakis, Efthimia Garoufallou, Michalis Damigos, Athena Salaba, and Christos Papatheodorou, 241–252. Communications in Computer and Information Science, vol. 2331. Springer, 2025. https://doi.org/10.1007/978-3-031-81974-2_22.

In his interpretation, Exhibition is an *E7_Activity*. For the temporal description he chooses the class *E52_Time-span*, specified by the properties *P81a_end_of_the_begin* and *P81b_begin_of_the_end*. The location of the exhibition is expressed by the property *P7_took_place_at* and the class *E53_Place* (representing a room/street/city), which is linked to the latitude and longitude (geosparql:wktLiteral) by the property *P168_place_is_defined_by*.

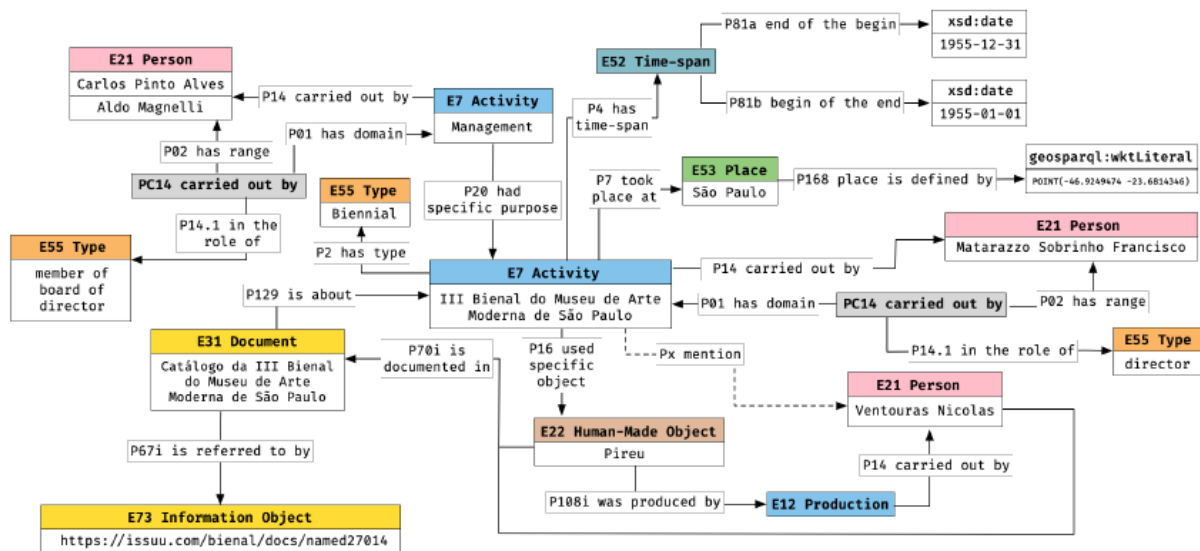


Figure 2: Exhibition model with CIDOC CRM by Nicola Carboni.

Screenshot, source: Nicola Carboni, "Ontological Patterns for Modeling Art Exhibitions" (2025).²¹²

The objects present in an exhibition are related to the *E7_Activity* through *P16_used_specific_object*, classified as *E22_Human-Made_Object* or *D1_Digital_Object*, and related to the artists through *E12_Production* event with the properties *P14_carried_out_by* and the *P108i_was_produced_by*. Exhibitions can consist not only of objects, but also of performances. For this purpose, the class of the CRM extension *LRMoo_F31_Performance* is used and linked to the activity by the property *P9_consist_of*. The knowledge source represents the documentation of the exhibition, which can include different media and can be analog or digital. The property *P129_is_about* links the class *E31_Document* to *E7_Activity*, and the document is related both to the object through the property *P70i_is_documented_in* and to the source called *E73_Information_Object* through the property *P67i_is_referred_to_by*.

²¹² Carboni, "Ontological Patterns for Modelling Art Exhibitions", 264.

An activity can consist of other activities that take place in different places and times, and can use different objects referred to by *P16_used_specific_object*. Carboni has two suggestions for defining roles. An activity could be *PC14_carried_out_by* an *E21_Person*, linked to the class *E55_Type* by the property *P14.1_in_the_role_of*. In the other model, the main activity *P9_consist_of* several activities carried out by a person. Finally, the spatio-temporal relation of objects and persons to the exhibition can be modelled by the class *E93_Presence*, which has *geo:Feature* and is connected to the person by the property *P195i_had_presence*. The presence is constituted by the *E53_Place* (*geo:hasGeometry*) and the *E52_Time_span* (*P164_is temporally specified by*). The author has found a solution to model each major aspect of an exhibition with CIDOC CRM. A missing link is the relationship between the exhibition and the artist, which exists only through the object exhibited. Carboni also didn't include the curatorial discourse or the possibility of multiple interpretations of a past event.

The second attempt to model exhibitions resulted in a new ontology called *OntoExhibit* built with OWL2 by Maria del Mar Roldán García, Martín Jerónimo Salvachúa, María Luisa Díez Platas, Nuria Rodríguez Ortega. “OntoExhibit (version 1.0)²¹³ is an ontology designed to enable the representation, publication, consumption, access, and reuse of semantically enriched encoded information related to the art exhibition domain.”²¹⁴ In their interpretation, the art exhibition is a “complex cultural ecosystem” that involves different actors, “both human and non-human” and represents, on the one hand, a “distinct discursive, social and cultural production” and, on the other, a “generator of discourses”.²¹⁵ Rodríguez-Ortega mentions some examples of previous exhibition models, such as Linked Art (traveling exhibition), the Prado's Digital Semantic Model,²¹⁶ and emphasizes that OntoExhibit focuses more on the socio-discursive and semantic aspects of exhibitions. They aim to integrate several information sources, which make up the art discourse, such as websites, catalogs,

²¹³ Maria del Mar Roldán García, Martín Jerónimo Salvachúa, María Luisa Díez Platas, Nuria Rodríguez-Ortega, “OntoExhibit”. Revision: 1.1.0. accessed July 21, 2025, <https://w3id.org/OntoExhibit#1.1.0>.

²¹⁴ Nuria Rodríguez-Ortega, “Contours of Knowledge: Epistemological Implications of Semantic Models in the Representation of the Art Exhibition Domain through the Lens of the OntoExhibit Ontology”, In *Život Umjetnosti*, no. 114 (2024):128, <https://doi.org/10.31664/zu.2024.114.06>.

²¹⁵ Ibid, 130.

²¹⁶ “Digital Semantic Model”, Museo del Prado, <https://www.museodelprado.es/en/grafico-de-conocimiento/modelo-ontologico>.

articles, social media interactions, curatorial texts, and production materials that can include interpretations, arguments, concepts, evaluations, etc.²¹⁷

The ontology is created in alignment with CIDOC CRM and FRBRoo²¹⁸ (See *Figures 3-4*). Two classes are differentiated: *Exhibition-Curatorial-Project* (intellectual tasks as a subclass of *Conceptual Work*) and *Exhibition* (materialization).²¹⁹ In this case, exhibition is not modelled under *E5_Event*, but as a subclass of *Work Manifestation*, and subsequently both *Propositional Object* and *Material Object*.²²⁰ The model includes facets for organizational structure, visual arrangement of artworks, and curatorial discourse. Relationships between events (traveling exhibition, re-edition) are established by an exhibition-curatorial-project, as several aspects of a traveling (*hasVersion*) or re-edition exhibition (*isReenactmentOf*) could be subject to change (display, design, number of objects and rooms). Interpretations, social media interactions, and other activities are also part of the model.²²¹ The *Proposition Assignment* is introduced to represent the diversity of *Propositions* about *Propositional Objects*.²²²

Based on a post-anthropocentric perspective, the authors included non-human-actants (biological species) and techno-actants (AI) as subclasses of the *Actant* class.²²³ Similarly, the class of *Material Objects* can include formal, digital, and physical entities and is subdivided into *Propositional Objects*, *Non-Propositional-Objects* (non-intellectual productions), and *Natural Objects*.

²¹⁷ Rodríguez-Ortega, "Contours of Knowledge", 130.

²¹⁸ FRBRoo is an extension to the CIDOC CRM model for bibliographic records, "FRBRoo model", IFLA Standards, <https://www.iflstandards.info/fr/frbr/frbroo.html>

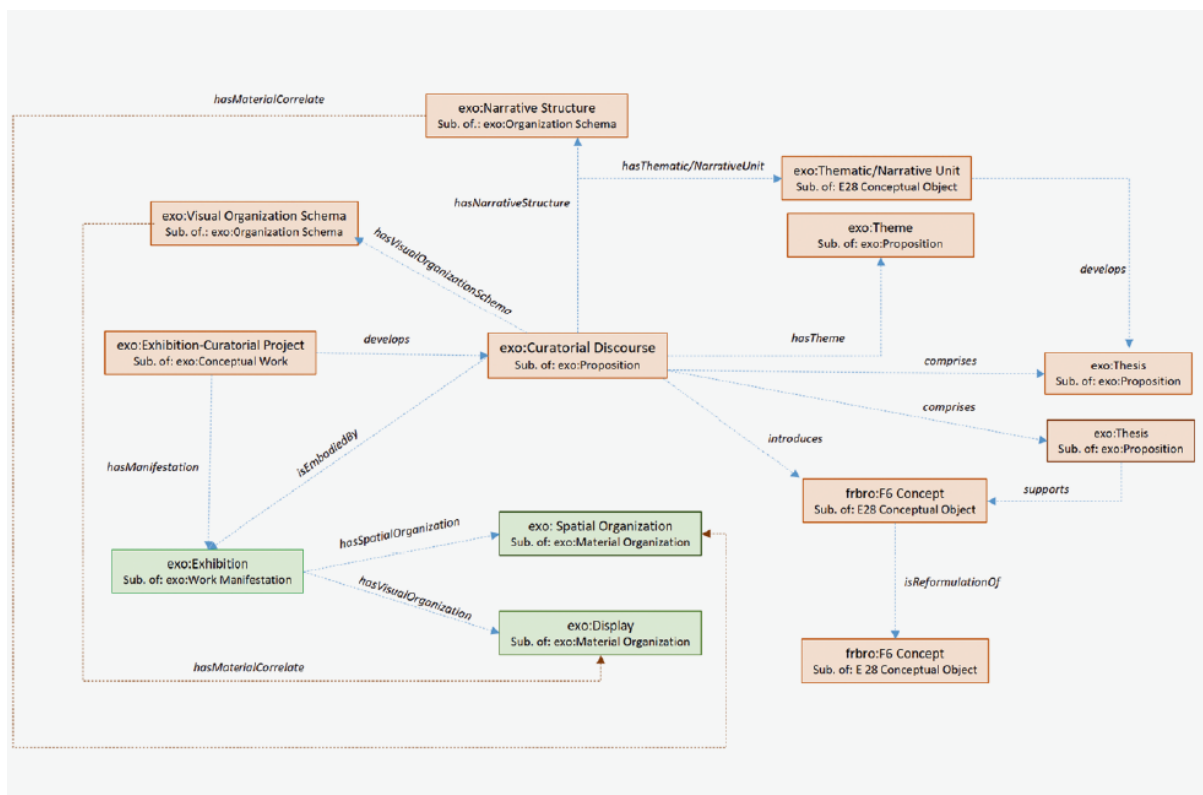
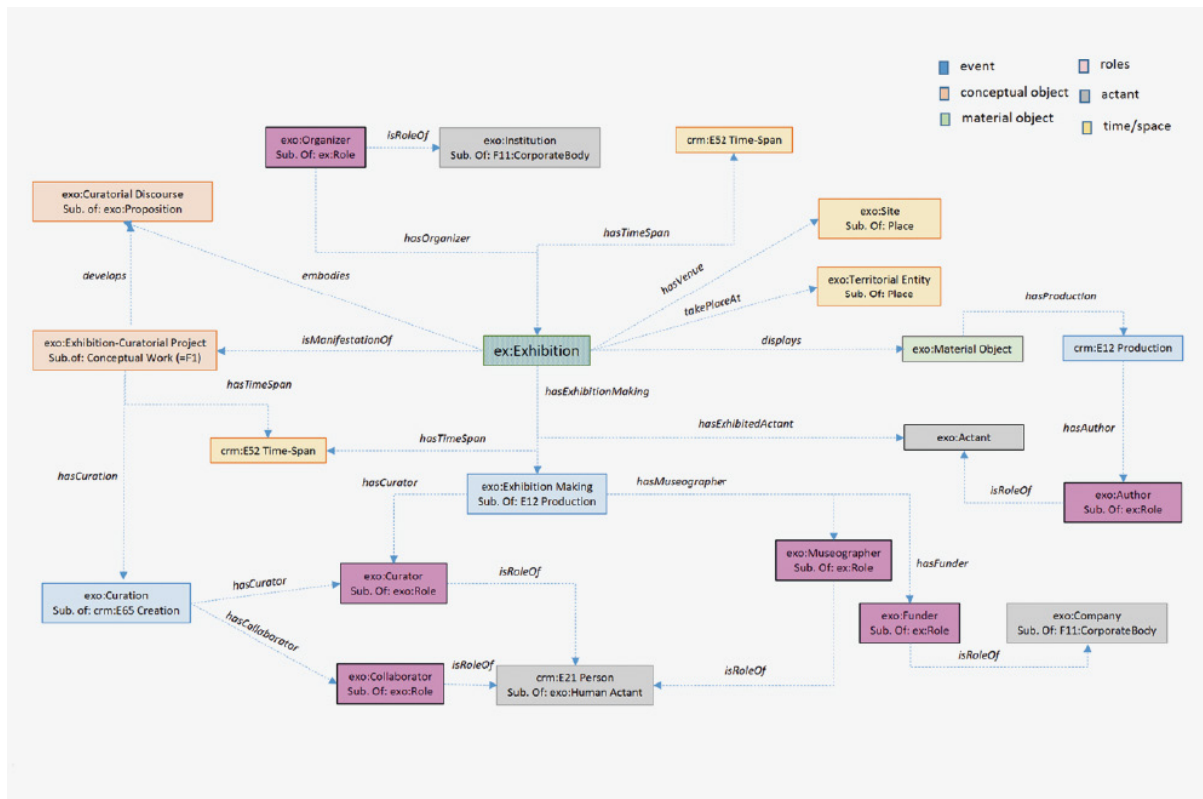
²¹⁹ Rodríguez-Ortega, "Contours of Knowledge", 134.

²²⁰ Ibid, 134.

²²¹ Ibid, 141.

²²² Ibid, 138.

²²³ Ibid, 144.



The authors emphasize that they don't agree with the binarism of the CIDOC CRM model, which divides the world into physical and conceptual objects, and that they consider multimedia objects and codes as part of the material world.²²⁴ Therefore, their *Propositional Object* unites material and conceptual objects and includes *Work Manifestations*, *Information Objects*, and *Computational Entities*.

García et.al. modelled exhibitions as complex organizational and discursive entities, with their main event classes for *Curation*, *Exhibition Making* and *Production* (of objects), where actors are linked to both objects and the material manifestation of *Exhibition-Curatorial-Project*. Although this ontology addresses several important aspects, it is highly complex and only useful for institutions that organize exhibitions and have the necessary domain knowledge to use the required terms for curatorial concepts and different interpretations, as well as possess comprehensive documentation. Nevertheless, the model relies on the curatorial practice, which emerged in the second half of the 20th century, and therefore, it is not suitable to describe historical exhibitions, such as the modern exhibitions in the DoME database.

Curatorial narratives are also addressed by the *CURATE* ontology in compliance with CIDOC and DUL by Paul Mulholland, Annika Wolff, and Trevor Collins. It is based on the division of narrative, story, and plot, where story is a set of events, plot is a subjective interpretation of the events, and the narrative is the way the story/plot is told in a particular medium.²²⁵ The *Semantic Model of the Museo del Prado* is likewise a hybrid of several ontologies, such as CIDOC CRM and FRBRoo, and is divided into twenty knowledge objects.²²⁶ One of them is the Ontology of Exhibitions, adapted to the needs of the museum. In this model, artists are also not directly linked to the class *E7_Exhibition_Activity*, which makes it more difficult to apply this ontology to data without information on exhibited objects.

Ontologies don't represent a neutral view of the world²²⁷, they serve specific purposes to reduce the ambiguity of concepts in their domain. The two selected exhibition models both combine existing ontologies in the same way, as only a mixture

²²⁴ Ibid, 145.

²²⁵ Mulholland, Paul, Annika Wolff, Trevor Collins, et. al. "Curate and Storyspace: An Ontology and Web-Based Environment for Describing Curatorial Narratives." In *The Semantic Web: Research and Applications*, 7295: 748–62. Springer Berlin Heidelberg, 2012. https://doi.org/10.1007/978-3-642-30284-8_57.

²²⁶ "The Museo del Prado' Ontological Model", Museo Nacional del Prado, <https://www.museodelprado.es/en/grafico-de-conocimiento/modelo-ontologico>.

²²⁷ Bruseker et al., "Cultural Heritage Data Management", 105.

of vocabularies is suitable to describe complex entities. Carboni relies on the CIDOC CRM ontology, which is the common practice in the cultural heritage field, while García et al. are more critical of it and introduce new concepts to be able to model the discursive context of exhibitions. For the three Austrian databases, I will analyze in chapter 5, Carboni's model is more suitable, because they preserve mainly factual data on exhibitions, which he also focuses on.

3.5. Linked Data

As previously mentioned, Karly Wildenhaus, research assistant in the Getty Research Institute, emphasized the necessity of Linked Data for art exhibitions and highlighted the possibilities it would offer for art historical research.²²⁸ But what is Linked Data exactly, and what kind of opportunities does it offer to model exhibitions? Tim Berners-Lee introduced the concept of the Semantic Web, an extension of the World Wide Web, in 2006. One major advantage of the Semantic Web is that it makes the web of data machine-readable by defining rules and relationships between entities. It enables people to search for information rather than documents. Linked Data is part of the Semantic Web, which Berners-Lee describes as follows: "Linked Data is a set of best practices for publication of structured data on the web".²²⁹ He defined the following principles for designing data for web publishing:²³⁰

1. Use URIs as names for things
2. Use HTTP URIs so people can look up those names
3. When someone looks up a URI, provide useful information, using standards (RDF, SPARQL)
4. Include links to other URIs so they can discover more things

In addition, to ensure the public accessibility and reusability of data, the "Five stars of the Linked Open Data" serves as a guideline:²³¹

- "★ make your stuff available on the Web (whatever format) under an open license
- ★★ make it available as structured data (e.g., Excel instead of an image scan of a table)

²²⁸ Wildenhaus, "The Possibilities of Constructing Linked Data on Art Exhibition Histories".

²²⁹ Tim Berners-Lee, "Linked Data", 27 Juli, 2006, <https://www.w3.org/DesignIssues/LinkedData>.

²³⁰ Tim Berners-Lee, "Linked Data".

²³¹ Tim Berners-Lee, "Linked Data".

★★★ make it available in a non-proprietary open format (e.g., CSV instead of Excel)

★★★★ use URIs to denote things, so that people can point at your stuff

★★★★★ link your data to other data to provide context”²³²

The Linked Open Data is represented by a knowledge graph, called the Linked Open Data Cloud.²³³ Data is structured in a language called Resource Description Framework (RDF) in triples: subject, predicate, and object, using uniform resource identifiers to avoid ambiguous statements. The triples are stored in triplestores and can be queried with the SPARQL query language. Ontologies are used to define the meaning of the terms in the triple statement. The choice of a widely supported ontology, such as CIDOC CRM and controlled vocabularies, ensures the compatibility of data across several institutions. The later addition of a “U” to the LOD acronym, called Linked Open Usable Data, stands for the usability of the published data, such as the use of developer-friendly languages (JSON-LD).²³⁴

Although Linked Data is a great way to create a network of knowledge, it has limitations due to its minimal structure of triples. Kahn and Simon emphasize that it is difficult to integrate “essential contextualizing data” such as provenance information, which would enable the authorization of data sources in a pool of data from different providers and increase the quality, trustworthiness, and reproducibility of the data for reuse.²³⁵ If this information is not included in the triple structure, it is not available to query tools.²³⁶ Andrews et al. also address this issue by using a new model for provenance data called the STAR Model, which adds the source and the author nodes to the subject, predicate, and object entities and links them to the “assertion” core object.²³⁷ Sikos and Philip compare and evaluate different solutions for extending

²³² 5 * Open Data, accessed July 21, 2025, <https://5stardata.info/en/>.

²³³ Margaret R. Geddes, *Strategies to Support Wider Adoption of Linked Open Data in Smaller Museums*, Johns Hopkins University, November 1, 2019, 6.

²³⁴ Ibid, 18-19.

²³⁵ Rebecca Josina Kahn and Rainer Simon. "Feast and Famine: The Problem of Sources for Linked Data Creation," in *Graph Technologies in the Humanities 2020: Vienna, Austria, February 21–22, 2020*, ed. Tara Andrews, Franziska Diehr, Thomas Efer, Andreas Kuczera, and Joris van Zundert, 89. CEUR Workshop Proceedings 3110, CEUR-WS.org, 2020. <http://www.ceur-ws.org/Vol-3110/paper5.pdf>.

²³⁶ Ibid, 95.

²³⁷ Tara Andrews, Márton Rózsa, Katalin Prajda, Lewis Read, and Aleksandar Anđelović, “Re-Evaluating the Eleventh Century through Linked Events and Entities”, *Historical Studies on Central Europe* 4, no.1 (2024): 220. <https://doi.org/10.47074/HSCE.2024-1.12>.

triples with provenance data, offering several choices.²³⁸ A similar challenge is the lack of versioning systems.²³⁹

Another aspect that is not accurately represented in the Linked Data structure is the concept of time, which is necessary to describe the complex temporal context in the cultural heritage domain. Bruns points out that it would be beneficial for cultural heritage professionals to be able to express complex events, timelines, and narratives using RDF.²⁴⁰ She suggests the following requirements for modelling temporal information in the cultural heritage domain: conceptual evolution of, terminological changes of, and temporal annotation of entities, temporal annotation of facts, time stamps and intervals, incomplete or unknown boundaries, uncertainty, temporal order, overlap, and other relations (during, before, etc.).²⁴¹ Burns also recommends an evaluation plan to compare different types of approaches, such as graph-level extensions, triple-level extension, and component-level extension of the RDF structure, and aims to find a user-friendly solution for reasoning about temporal data.²⁴² Wellington proposes a further extension of Linked Data by expanding the standard vocabularies with non-English terms and concepts to be able to preserve the cultural context of entities and encourage access from different cultural perspectives.²⁴³

Barbera underlines that for the cultural heritage field, publishing data in the LOD cloud is challenging because it must be generated from a tabular, flat data structure, and relational databases represent a Closed World Assumption compared to the Open World Assumption of Linked Data. The latter is better at dealing with incomplete information. Furthermore, there is a misunderstanding about the difference between statements on web pages (informational resources) and the real-world objects or

²³⁸ Sikos, Leslie F., and Dean Philp, "Provenance-Aware Knowledge Representation: A Survey of Data Models and Contextualized Knowledge Graphs." *Data Science and Engineering* 5, no. 3 (2020): 293–316, <https://doi.org/10.1007/s41019-020-00118-0>.

²³⁹ Michele Barbera, "Linked (Open) Data at Web Scale: Research, Social and Engineering Challenges in the Digital Humanities," *JLIS.It: Italian Journal of Library and Information Science* 4, no. 1 (2013): 93.

²⁴⁰ Bruns, Aleksandra. "The Persistence of Temporality: Representation of Time in Cultural Heritage Knowledge Graphs". In *Proceedings of the Doctoral Consortium at ISWC 2023*, ed. Claudia d'Amato and Jeff Z. Pan. CEUR Workshop Proceedings 3678. CEUR-WS, 2023, [2], <https://ceur-ws.org/Vol-3678/paper1.pdf>.

²⁴¹ Ibid, [4]-[5].

²⁴² Ibid, [5]-[6].

²⁴³ Robert Wellington, "Metadata, Material Culture, and Global Art History," in *The Routledge Companion to Digital Humanities and Art History*, ed. Kathryn Brown, Routledge, 2020, 333. <https://doi.org/10.4324/9780429505188-29>.

concepts, about which the webpage contains information (non-informational).²⁴⁴ Geddes fosters the development of easy-to-use plug-ins for collection management software to support smaller institutions in converting their legacy data to LOD.²⁴⁵ It is necessary not only to increase the amount of data in the semantic web, but also to improve the diversity of data available.

There is still a relatively small amount of data published as Linked Data in the cultural heritage field, and it is difficult to know which museums have published their data in the LOD data cloud. For this reason, Geddes suggests a centralized space to list museums that have already published Linked Data, which can encourage users to discover their triplestores. There are several projects initiated by GLAM institutions to publish their collections, such as American Art Collaborative (ACC)²⁴⁶, Europeana, Getty Provenance Index, LODAC Museum²⁴⁷, Nomisma.org²⁴⁸, SAMPO²⁴⁹. Collaborations can result in either federated data, where the institutions themselves are responsible for data maintenance (ACC), or aggregated data, harvested in or translated into a particular format and largely dependent on the aggregator itself (Europeana).²⁵⁰ However, these can be combined.

There are more ways of remodeling data. ACC started by defining a target ontology model based on the CIDOC CRM ontology and developing ready-to-use tools.²⁵¹ This was a precursor to the Linked Art data description model for cultural heritage institutions, led by the Getty Research Institute.²⁵² Linked Art served as a target model for the mapping of the Getty Provenance Index, as it is more intuitive to use for cultural institutions than CIDOC CRM.²⁵³ Another approach is to map the relational data directly to RDF triples and then model it with an ontology, as was the case at Museum

²⁴⁴ Barbera, „Linked (Open) Data at Web Scale”, 97.

²⁴⁵ Geddes, *Strategies to Support Wider Adoption of Linked Open Data in Smaller Museums*, 10.

²⁴⁶ “AAC Demonstration Prototype”, American Art Collaborative, <http://browse.americanartcollaborative.org>.

²⁴⁷ LODAC Museum published Linked Data of 114 museums and research institutes in Japan. “LODAC Project”, Linked Open Data for Academia, <http://lod.ac>.

²⁴⁸ “Nomisma.org”, American Numismatic Society, <http://nomisma.org>.

²⁴⁹ “Sampo”, Semantic Computing Research Group, <https://seco.cs.aalto.fi/applications/>.

²⁵⁰ Geddes, *Strategies to Support Wider Adoption of Linked Open Data in Smaller Museums*, 20.

²⁵¹ Knoblock, Craig A., Pedro Szekely, Eleanor Fink, et al. “Lessons Learned in Building Linked Data for the American Art Collaborative.” In *The Semantic Web - ISWC 2017*, 10588: 263–79. Springer International Publishing AG, 2017. https://doi.org/10.1007/978-3-319-68204-4_26.

²⁵² Geddes, *Strategies to Support Wider Adoption of Linked Open Data in Smaller Museums*, 15.

²⁵³ Davis, Kelly. “Old Metadata in a New World: Standardizing the Getty Provenance Index for Linked Data.” *Art Libraries Journal* 44, no. 4 (2019): 163. <https://doi.org/10.1017/alj.2019.24>.

Finland and Amsterdam Museum.²⁵⁴ Mapping a relational database to a knowledge graph model can be challenging and requires a trade-off between data complexity and interoperability, often resulting in data loss.²⁵⁵ This is one of the main criticisms of Europeana, that the Europeana Data Model (EDM) doesn't have the granularity required for cultural heritage data. It only captures web sources and is therefore not suitable for describing physical objects.²⁵⁶ Further challenges are the messiness of museum data due to a lack of or changing standardization over time, and the text fields containing unstructured strings with valuable information about the exhibition history, provenance of the object, curatorial interpretations, etc.²⁵⁷

Several tools have been developed to map data from relational databases to triples.²⁵⁸ One of these is Karma,²⁵⁹ used by the ACC to transform data from 14 museums into a CIDOC-CRM-model and automatically generate triples.²⁶⁰ Karma has the advantage of providing an easy-to-use visual interface, suggesting classes, properties, and URIs from the LOD Cloud and allowing adjustments if necessary.²⁶¹ A similar tool has been developed for German-speaking countries, called WissKI, which is not only a linked open data management software, but also a research environment, and is part of the open source content management system Drupal.²⁶²

Once the data is mapped, it should be connected to other data, which poses the next challenge in the heterogeneous cultural heritage field. Common terminology and

²⁵⁴ Knoblock, Szekely and Fink, "Lessons Learned in Building Linked Data for the American Art Collaborative," 277.

²⁵⁵ Kahn and Simon, "Feast and Famine", 89.

²⁵⁶ Danfeng Liu, Antonis Bikakis, and Andreas Vlachidis. "Evaluation of Semantic Web Ontologies for Modelling Art Collections," in *New Trends in Databases and Information Systems. ADBIS 2017*, ed. Marite Kirikova, Kjetil Nørnvåg, George A. Papadopoulos, et al., 350 (9). Communications in Computer and Information Science, vol. 767. Springer, 2017. https://doi.org/10.1007/978-3-319-67162-8_34.

²⁵⁷ Kahn and Simon, "Feast and Famine", 90.

²⁵⁸ "14. An inventory of tools for converting data to RDF", Faircookbook, <https://faircookbook.elixir-europe.org/content/recipes/interoperability/rdf-conversion.html>

²⁵⁹ "Karma: A Data Integration Tool", University of Southern California Information Sciences Institute, <https://github.com/usc-isi-i2/Web-Karma>

²⁶⁰ Knoblock, Szekely and Fink, "Lessons Learned in Building Linked Data for the American Art Collaborative," 264.

²⁶¹ Eleanor E. Fink, Pedro Szekely, and Craig A. Knoblock, "How Linked Open Data Can Help in Locating Stolen or Looted Cultural Property," in *Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection. EuroMed 2014*, ed. M. Ioannides, N. Magnenat-Thalmann, E. Fink, R. Žarnić, A. Y. Yen, and E. Quak, 228–237 (233), Lecture Notes in Computer Science, vol. 8740, Springer, 2014, https://doi.org/10.1007/978-3-319-13695-0_22.

²⁶² "WissKI", <https://wiss-ki.eu/de>, More about the infrastructure: Georg Hohmann and Bernhard Schiemann: "An Ontology-Based Communication System for Cultural Heritage: Approach and Progress of the WissKI Project", in *Scientific Computing and Cultural Heritage*. ed. H. Bock, W. Jäger, M. Winckler, Contributions in Mathematical and Computational Sciences, vol 3. Springer, 2013, https://doi.org/10.1007/978-3-642-28021-4_14.

available authority files can ensure interoperability, but as mentioned above, there are no authority files for exhibitions, and the gazetteers for concepts, names, and locations are not complete. Translating historical terminologies into standard vocabularies could change the meaning and lead to loss of information.

Linked Open Data should also be available as Open License data, but in many cases, it is hard to determine the exact copyright of museum objects (multiple copyright holders, lack of information), and the rights are constantly changing over time and need to be updated.²⁶³ This makes the work of aggregation portals difficult. Blijden analyzed the right statements on Europeana and found that the right metadata was only correctly identified for 61,8 % of the sample objects.²⁶⁴ She suggests that Europeana should inform institutions that facts are part of the public domain and that data providers should add information about the expiry date of copyrights.²⁶⁵

Linked Data can be accessed via a SPARQL endpoint for advanced users, who can filter data by writing queries and eventually visualize the results as a knowledge graph (Wikidata), or via a way simpler graphical user interface (GUI) with limited search and customization capabilities and less contextual information (Europeana). Europeana also provides an API for data re-use. Much remains to be done to make linked open cultural heritage data intuitively accessible with contextual information, such as historical timelines, related works, geospatial relationships, exhibition, and conservation history.

As Kahn and Simon note, there is a downside to publishing open data, if data that is “culturally insensitive, or contains outdated terminologies, can inadvertently be released into the LOD ecosystem, without a tempering mechanism to draw users’ attention to the issues at hand”.²⁶⁶ It is difficult for the user to determine whether the data retrieved is trustworthy. This is particularly the case with community projects such as Wikidata, where at least the history of editing can be consulted, but the individuals behind the data entries remain anonymous.

There are some initiatives that use Wikidata for research purposes, such as the Open Art Data, which publishes SPARQL queries and query results for information on persons and organizations involved in art looting. However, it requires a large amount

²⁶³ Kahn and Simon, “Feast and Famine”, 94.

²⁶⁴ Judith Blijden, “The Accuracy of Rights Statements on Europeana.eu,” Kennisland, 2018, 20. <https://www.kl.nl/wp-content/uploads/2018/02/The-Accuracy-of-Rights-Statements.pdf>.

²⁶⁵ Ibid, 25.

²⁶⁶ Kahn and Simon, “Feast and Famine”, 97.

of reliable data to ensure the significance of the research results. Wikidata has a subsite that collects GLAM institutions that provide data to Wikidata.²⁶⁷ The museums listed only publish their collection data without exhibition context, even though Wikidata would allow exhibition histories to be represented.

Exhibitions as Linked Data

In the course of this research, Wikidata is the only Linked Open Data initiative, I have been able to find that includes URIs for exhibitions. The Wikidata community added records of MoMA exhibitions, based on MoMA's official exhibition dataset available on GitHub. The dataset and the entities in Wikidata are not interrelated, so updates to the document are not submitted to Wikidata, and the exhibition identifiers are not imported into the CSV file. Another source for examining Linked Data models on exhibitions is the Linked Art community, which provides examples of how to model exhibitions in RDF. Despite these possibilities, the practice of publishing exhibition data as Linked Data is not yet well established.

Nevertheless, exhibition data is particularly suited to Linked Data, because it represents complex relationships between people, objects, institutions, spatial and temporal dimensions, as well as cross-disciplinary concepts. An exhibition URI could connect all these entities. However, ontologies emphasize objects and do not use exhibitions as central nodes. It might be useful to prioritize participants instead, as in several cases, there is no data available on objects, or they are ephemeral or immaterial.²⁶⁸ According to Wildenhaus Linked Data “holds perhaps the greatest promise for representing art exhibitions in a meaningful way”.²⁶⁹ The study of Linked Data on exhibitions could contribute to an understanding of canon-making and institutional exhibition practices, and shed light on forgotten art histories.²⁷⁰ Researchers could also analyze “artistic networks, relationships, and exchanges”.²⁷¹ Wildenhaus emphasizes the importance of developing a Linked Data standard for representing art exhibitions and controlled vocabularies, along with federated websites for querying data intuitively.

²⁶⁷ “Wikidata:GLAM”, <https://www.wikidata.org/wiki/Wikidata:GLAM>.

²⁶⁸ Wildenhaus, “The Possibilities of Constructing Linked Data for Art Exhibition Histories, 33.

²⁶⁹ Ibid, 32.

²⁷⁰ Ibid, 22.

²⁷¹ Ibid, 29.

I compare two Linked Data approaches to exhibition modelling. One is an exhibition record in Wikidata, created and updated by enthusiastic users, and the other is the Linked Art Data Model, which recommends ready-to-use JSON-LD patterns for different types of exhibitions.

In Wikidata, I wrote a SPARQL query to find a specific traveling exhibition with all its properties: “Radical Software: Women, Art & Computing 1960-1991”, which was on display in 2025 at the Kunsthalle Wien.²⁷² It is an instance of art exhibition, temporary exhibition, and traveling exhibition and has the following properties: country, location (Museum and Kunsthalle Wien), start time, end time (in both museums), curator, and exhibited creator. There is no description or further contextualizing information given. One can display the connections between entities as a graph, showing both properties and classes as nodes, and all are connected to three classes of which the exhibition is an instance, but the title is not present as a node, and the edges are not properties, only directed links (See *Figure 5*). The display is not suitable for showing the triple structure and the links between the classes.

Linked Art is unique in distinguishing between exhibition concepts and activities. They give examples of different types of exhibitions, for example, exhibition activity, exhibition concept, known artists without known objects, multiple venues, objects, provenance events for exhibitions. They offer several download options, such as JSON-LD and Turtle. In this case, I examine their example of the multiple venue exhibition “Manet and Modern Beauty” at the Art Institute of Chicago. The exhibition is a subclass of “Activity” and is classified as an exhibition with an AAT term. It is identified by the title of the exhibition, has a time span with the temporal entities “beginning of the begin” and “end of the end”, took place in Chicago (AAT), carried out by the museum, used specific objects (set of objects), is influenced by the exhibition idea, and is part of an exhibition entity. Here, the relations between the entities are indicated, and common vocabularies are used for identification, but the exhibition itself doesn’t get a unique ID. The IDs of the core nodes (orange nodes) in *Figure 6* are automatically generated and change with each iteration. In this example, the artists involved are not listed. If the objects are not known, Linked Art suggests linking the artist to the conceptualization of the exhibition through the “influenced by” property.

²⁷² Wikidata SPARQL Query of “Radical Software: Women, Art & Computing 1960-1991”, <https://w.wiki/EerF>.

Both the Wikidata and the Linked Art model lack some contextualizing data and the provenance of the entities. They use a container approach to include more exhibitions, which is hardly suitable for investigating networks. Wikidata doesn't display the exhibition itself as a node, and the Linked Art model treats artists as influences on the concept, which can lead to confusion when not only artists, but also other persons and concepts influence the exhibition.

4. Methodology

In this chapter, I will describe the methodology I used to compare the three Vienna-based databases. I aim to show the different approaches that were used by Austrian event databases to represent exhibitions, to find similarities between them, and to demonstrate how this data could be used for research purposes. Two of the databases include data on exhibitions from the second half of the 20th century, and one of them is the collection of data on exhibitions from the beginning of the 20th century. My main objective is to discover which impacts the domain of the database and the content of data have in structuring data on exhibitions. Furthermore, I investigate if there are commonly used approaches and standards in Austria. The published descriptions on the databases were of different detail, therefore I used various methods to collect information on them.

4.1. Data collection

The DoME database is well-documented on the website of the database. The architecture of the database, the selection criteria for the exhibitions to include, the challenges in entering data, and the potential of the database are described in the paper published in 2020 in *The Routledge Companion to Digital Humanities and Art History*.²⁷³ I first started to use their data in 2024 in a university project with Manuel Meschiari and Stefan Česká for investigating networks of the Secession movements in Austria and Germany. From the research assistant, Theresa Kamencek, we also received a data entry guideline and got access to their Neo4j database. For my case study, I utilize the data analysis experience we gained.

While working in the contemporary art field as a cultural manager, I became aware of the existence of the basis wien archive, and I also read their publication “Archiving the present”²⁷⁴, when I was looking for materials on art databases. I visited the archive two times and presented my case study results at the annual meeting of European-

²⁷³ Christina Bartosch, Nirmalie Mulloli, Daniel Burckhardt, Marei Döhring, Walid Ahmad, and Raphael Rosenberg, "The Database of Modern Exhibitions (DoME)," in *The Routledge Companion to Digital Humanities and Art History*, ed. Kathryn Brown, 423–434, 1st ed. Routledge, 2020, <https://doi.org/10.4324/9780429505188-36>.

²⁷⁴ Reddeker, Lioba, ed., *Gegenwart dokumentieren: Handbuch zur Erschliessung von moderner und zeitgenössischer Kunst in Archiven und Datenbanken = Archiving the present : Manual on Cataloguing Modern and Contemporary Art in Archives and Databases*, Wien: Basis Wien, Kunst, Information und Archiv, 2006.

art.net.²⁷⁵ For the first meeting with Andrea Neidhöfer, one of the archivists at basis wien, I prepared interview questions and also recorded our conversation (See Excerpts in the Appendix).²⁷⁶ Afterward, I got a flow chart of the database structure²⁷⁷ and requested the data for my case study via email by sending an example dataset.²⁷⁸ In the second meeting, Helena Baur, the director of the archive, Ms. Neidhöfer, and I discussed the results of my data analysis.²⁷⁹ Finally, I sent my text for approval to Andrea Neidhöfer.

I got to know the eSeL calendar in 2014 and used it to discover upcoming art events in Vienna. In 2024, I found out in a job advertisement that they had been archiving their calendar data and integrating it into Europeana, which helped me to clarify the topic of my master's thesis. It made me especially interested in the way digital information on events is incorporated into a platform for cultural heritage objects. Could a unique event without any traditional or ritual aspect be interpreted as intangible cultural heritage? Could a digital-born description of an event, based on the press release or invitation text of an institution without universal value and unique form, be a tangible cultural heritage object? To understand the implementation of the project, I talked to Xenia Kopf, who managed the archiving project, about the challenges of their endeavor. As the project was constantly evolving and there was no publicly available documentation on the progress, all my information came from Ms. Kopf. We met two times to discuss the development of the archive, and she shared materials on the database structure and entities in the database.²⁸⁰ My first discussion with her was informal. For the second meeting, I prepared questions, but the circumstances didn't allow me to record the conversation; I only made notes in my working document.

4.2. Comparison of the databases

In the humanities, comparison is a well-established method to gain new knowledge. Angelika Eppele and Walter Erhart discuss the practices of comparing, such as thinking tool, social practice, and scientific method originated in the 18.

²⁷⁵ Online presentation on the annual meeting of European-art.net, March 28, 2025, 10 am.

²⁷⁶ Meeting in the basis wien archive, November 11, 2024, 3 pm.

²⁷⁷ E-mail of Andrea Neidhöfer (basis wien), November 18, 2024.

²⁷⁸ E-mail of Andrea Neidhöfer (basis wien), January 17, 2024.

²⁷⁹ Meeting in the archive, March 27, 3 pm.

²⁸⁰ Conversation with Xenia Kopf (eSeL), December 3, 2024, e-mail of Xenia Kopf, July 31, 2024: flow chart of the data structure, e-mail of Xenia Kopf, December 3, 2024: list of entity types, tags.

century.²⁸¹ As the comparative literature professor at the State University of New York, Radhakrishnan points out, comparison is never neutral.²⁸² It aims to find similarities or differences between certain entities. He suggests avoiding the comparison of apples with oranges. On the contrary, Eppe and Erhart argue that everything can be compared to everything if one assumes comparability.²⁸³ Although comparison focuses on the common features, it also deals with the features outside “the frame of comparison”.²⁸⁴

In art history, qualitative comparative analysis is conducted for several purposes, such as identifying the creator of an artwork, localizing its origin, defining the date it was created, as well as comparing the changing styles of an artist or the artworks of different artists or to distinguish the original from the forgeries. These comparisons rely on the visual analysis of the “connoisseurial art history”.²⁸⁵ The publication, “Comparativism in art history” collects essays of practitioners of comparative art history, which investigate the weaknesses and strengths of this method in art historical research.²⁸⁶

On the other hand, quantitative methods can help to find patterns in big data and detect changes, exceptions, differences, or similarities. In comparative political research, for example, two approaches were developed, the comparative method of the “most similar system design” (MSSD) and the “most different system design” (MDSD). With the first, very similar cases with one different “dependent” variable are compared. With the latter, cases with one similar feature are investigated, and similarities are to be determined.²⁸⁷

In my thesis, I compare three Austrian databases based on my selected criteria. For my research purposes, I consider a comparative analysis with qualitative

²⁸¹ Eppe, Angelika, and Walter Erhart. “Practices of Comparing: A New Research Agenda Between Typological and Historical Approaches.” In *Practices of Comparing: Towards a New Understanding of a Fundamental Human Practice*, edited by Angelika Eppe, Walter Erhart, and Johannes Grave, 12-13. transcript Verlag, 2020. <https://doi.org/10.2307/j.ctv2f9xscg.4>.

²⁸² Rajagopalan Radhakrishnan, “Why Compare?” *New Literary History*, 40, No. 3 (2009): 454, <https://doi.org/10.1353/nlh.0.0100>.

²⁸³ Eppe and Erhart, *Practices of Comparing: Towards a New Understanding of a Fundamental Human Practice*, 15.

²⁸⁴ Radhakrishnan, “Why Compare?”, 456.

²⁸⁵ Elsner, Jaś, and Stanley Abe, “Introduction. Some stakes of comparison”, in *Comparativism in Art History*, ed. Elsner, Jaś, 3., Studies in Art Historiography 12. Routledge, Taylor & Francis Group, 2017.

²⁸⁶ Elsner, Jas, ed. *Comparativism in art history*. Routledge, 2017.

²⁸⁷ Carsten Ankar, “On the Applicability of the Most Similar Systems Design and the Most Different Systems Design in Comparative Research,” *International Journal of Social Research Methodology* 11, no. 5 (2008): 389–401. <https://doi.org/10.1080/13645570701401552>.

approaches the most useful, since I only compare three databases publishing data in different ways and are not integrated in a single platform or made available through an API. The common denominator of the databases is that they include data on exhibitions, and they have been created in Vienna, Austria. I intend to find other shared features. Even though the MDSD is a quantitative method, my approach shows similarities to it by selecting one dependent variable, “exhibition data,” and investigating which factors influence its design in different domains.

My criteria for comparing the databases are their data structure, metadata categories, and user interface, as well as the data usage and the FAIR principles they fulfil. To be able to describe their data structure, I used the image in the paper of DoME²⁸⁸ and got depictions from basis wien and eSeL of their models²⁸⁹. The categories in the flow chart of the basis wien database were abbreviations in the German language, so I translated the terms to English. The calendar eSeL provided example data structures for exhibition records, which I utilized to model a particular exhibition.

For comparing their metadata categories on exhibitions, I relied only on publicly published information of exhibition records on the websites. Regarding the user experience, I describe their user interfaces, focusing on data retrieval, such as filter functions, query hits, their special features, and the connections between entities.

The FAIR principles²⁹⁰ are widely known in the research field as guidelines for proper data management. A lot of data has been produced, but they are not necessarily reusable. Therefore, diverse stakeholders developed a guideline to enhance the machine readability and usability of databases.²⁹¹ They are perfectly suitable to compare how findable, accessible, interoperable, and reusable the databases of the three institutions are. To be able to determine which criteria they fulfil, I relied on the previously mentioned information I collected on the databases (research paper, description on the websites, correspondences, and discussions with the contributors), and on my user experience by discovering the databases.

²⁸⁸ Bartosch et al., “The Database of Modern Exhibitions (DoME)”, 427.

²⁸⁹ E-mail of Andrea Neidhöfer (basis wien), November 18, 2024; e-mail of Xenia Kopf (eSeL), July 31, 2024

²⁹⁰ “FAIR Principles”, GO FAIR International Support and Coordination Office (GFISCO), <https://www.go-fair.org/fair-principles/>.

²⁹¹ Mark D. Wilkinson, Michel Dumontier, IJsbrand Jan Aalbersberg, et al, “The FAIR Guiding Principles for scientific data management and stewardship,” *Sci Data* 3, 160018 (2016). <https://doi.org/10.1038/sdata.2016.18>.

4.3. Case studies

After the general comparison of the databases, I demonstrate their usability for answering research questions and conducting quantitative data analysis. To do so, I pose domain-specific research questions and use three different visualization methods. The first task is to collect the data for analysis. Here, I was already confronted with three different ways to gain access to the datasets.

For the use case of DoME, I investigated the network of a Hungarian and a Czech artists' group. In a blog post on the website of the database, Krisztina Passuth describes the groups called "The Eights" in Hungary (Nyolcak) and the Czech Republic (OSMA) and states that these artists didn't know about each other, only met occasionally in Paris, where they exhibited.²⁹² I intend to prove or disprove her theory based on qualitative research by using quantitative approaches.

First, I filtered the database with the advanced filter function to show all the exhibitions in the four European countries, Austria, Germany, France, and Italy, featuring Hungarian artists. Then, I downloaded the "Catalog entries" Excel file containing the items (exhibition objects) with the names of the artists, among others. Next, I deleted all the items of the "other media" object type and selected exhibitions in which Czech artists also participated. Finally, I deleted the artists from other countries and the columns that I didn't need for my network analysis. I kept the following features: Item_ID, Artist_ID, Person_Name, Gender, (Preferred) Nationality, Exhibition, Exh.Date, City, Venue, Organizing Body. Using the Data Analysis Tool of Excel, I removed duplicate artist names exhibiting more items in one exhibition and renamed the columns for the network analysis. I filtered the names of the group members. Previously, when investigating the groups of Secessions, I already used the R tutorial of Martin Schweinberger to visualize networks with the R programming language, using the quanteda, igraph, tidygraph, and ggraph packages.²⁹³ At this time, I analyzed a significantly smaller network in order to avoid a hairball layout. To be able to filter and design the network visualization more intuitively, I additionally used the Cytoscape network visualization program, which was originally made for visualizing

²⁹² Krisztina Passuth, "Transfers of Ideas and Styles in Central Europe Before", 25.06.2018, Blog, Database of Modern Exhibitions, accessed July 21, 2025, <https://exhibitions.univie.ac.at/blog/transfers-of-ideas-and-styles-in-central-europe-before-1920-by-krisztina-passuth>.

²⁹³ Martin Schweinberger, "Network Analysis using R", in *Language Technology and Data Analysis Laboratory*, The University of Queensland, 2024 <https://ladal.edu.au/tutorials/net/net.html>.

molecular information networks in the domain of bioinformatics and offers several filter functions and customization options for nodes, edges, and the whole network layout.²⁹⁴ I exported a GraphML XML file with R and imported it into Cytoscape, which immediately recognized the constituents of the created networks. Finally, I color-coded the nationalities, set the size of the nodes according to the number of exhibitions an artist exhibited, and customized the lines of the edges to represent the number of cases, the artists exhibited together.

I requested a dataset with 18 features on “curated by” from basis wien, because it is an annually organized festival in Vienna since 2009 and demonstrates the consistency of data entry in the archive. The basis wien archive doesn’t only contain information on events, but persons and institutions, which enables the investigation of the internationality, gender, and popularity of artists, curators, and authors. After cleaning the data and deleting duplicates with the help of OpenRefine and the panda library in Python, I visualized the trends in the dataset with Tableau. I chose Tableau because one can intuitively create visualizations in an appealing design and in several different visualization types: map, scatter plot, bar chart, line chart, etc. It is also useful for statistical analysis, therefore suitable for investigating correlations between features.

The database of eSeL is still not integrated into Europeana, only into Kulturpool. Originally, I intended to use the API of Europeana for my case study, but I altered my plan and used data published on the archive website. This resulted in the investigation of fewer features (names of institutions and the number of events per year) and more manual work, such as selecting the relevant institutions and collecting the addresses of institutions. Since the search function didn’t work properly, I harvested data on the number of events per institution per year from the landing page with Python. Python, being one of the most popular programming languages in the field of digital humanities, was my first choice for conducting simple data collecting using the BeautifulSoup library and printing the name of the institutions as well as the number of events per year in a CSV and merging the separate years in one CSV file. I deleted all the institutions that are not exhibition places and visualized the number of institutions and events per year in Tableau. In addition, I looked up the addresses and coordinates of the institutions with the help of ChatGPT. I used artificial intelligence

²⁹⁴ Cytoscape, accessed July 21, 2025, <https://cytoscape.org>.

because of the large number of institutions (2017: more than 300, 2018: more than 400). As the results were incorrect, I needed to control each address manually. Next, I visualized the institutions on a map. The results needed to be revised and complemented, as in some cases the addresses were not available, or the institutions were located erroneously in the wrong city. As Tableau is only suitable for visualizing data at the country level, I used My Maps of Google to illustrate the changing institutional landscape between 2017 and 2018 in Vienna through uploading two separate CSV files for these years and adding two separate layers with a different color coding on Google Maps.

5. Analysis: comparing art event databases in Austria

In this chapter, I introduce three event databases created by Vienna-based institutions related to art history or the contemporary art field. They contain data on a great number of exhibitions organized by different institutions and publish their data online. Each of them documents events according to their internal rules, following certain standards, and represents unique approaches to describing or modelling exhibitions. They were established for different purposes, such as archiving, research, or providing information, which determines the focus of the collections and how they preserve and make data accessible. I compare the data they collect and publish on their websites, paying particular attention to exhibition-related information, the standards used, the user interface, and their alignment with FAIR principles.

5.1. Research project: DoME

The research project, *Exhibitions of Modern European Painting 1905-1915*, was initiated at the University of Vienna by Raphael Rosenberg to gain more insight into the several art exhibitions that shaped the history of modern painting before the First World War and to develop the Database of Modern Exhibitions (DoME).²⁹⁵ It was designed to fulfil the needs of scholars. The project was underpinned by research questions and aimed to discover the geography and social networks associated with modern paintings, as well as their relationship to contemporary discourses and their influence on the popularity of artists.²⁹⁶ The main questions of the project were:

- “Where when and with whom artists exhibited?”
- “Which kinds of paintings were exhibited when and where?”
- “How did artists choose the works to present in which exhibitions?”
- “Did they pursue specific practices to make themselves publicly known?”
- “How did exhibitions and their catalogues relate to contemporary art criticism?”

The research focused on the European continent and the years between 1905-1915, when avant-garde movements flourished. The collection and selection of data were based on art historical domain knowledge, as exhibitions with a more traditional

²⁹⁵ The project was funded by the Austrian Science Fund FWF, duration: 2017-2021.

²⁹⁶ Bartosch et al. “The Database of Modern Exhibitions (DoME),” 423.

focus were excluded. The team relied on Donald E. Gordon's 1974 publication on modern art exhibitions²⁹⁷ 1900-1916 (850 exhibitions, 426 artists), and collected data from modern art exhibition catalogs from European countries.²⁹⁸ When entering the data, they tried to preserve as much contextual information as possible (addresses, descriptions, committees, and their members) and the original structure and spelling of the source. Information in Eastern European languages was translated into English.²⁹⁹ From some catalogs, data was collected with the aim of OCR (Optical Character Recognition) and data extraction. For the manual collection of data, a guideline was developed to ensure consistency.

The team added further exhibitions when they included artists from the database or took place in an exhibition space dedicated to modern art. The database currently contains 1.367 exhibitions, 13.266 artists, 304 venues, 219 organizing bodies, 100 exhibiting cities, and 207.931 catalog entries (paintings and drawings).³⁰⁰ Due to copyright issues, images of the objects (exhibition views) and catalogs are not available online but are linked to external digital sources.

5.1.1. Data

Data has been collected in a relational database (MySQL), where data on exhibitions is directly linked to "Publication" (source catalog), "Catalogue entry" (paintings and drawings), and "Venue" (*Figure 7*).³⁰¹ "Venue" is connected to "Location", "Person" is linked to the objects, and through objects ("Catalogue entry") to "Exhibition". If the objects could be identified in the artist's catalogues raisonnés, they were listed under the "Work" tab in the artists' profiles.

In most cases, the entries have been referenced using controlled vocabularies. For persons, they added the ULAN and GND identifiers and used their information to define the spelling of artists' names, nationalities, dates, places of birth, and death. DoME provided artist names for the Getty ULAN database with the requirement that Getty, in return, would create unique identifiers for them.³⁰²

²⁹⁷ Donald E. Gordon, *Modern art exhibitions: 1900–1916; selected catalogue documentation*, München, Prestel, 1974, <https://archive.org/details/modernartexhibit0000gord>.

²⁹⁸ Bartosch et al. "The Database of Modern Exhibitions (DoME)," 424.

²⁹⁹ Ibid, 425.

³⁰⁰ Accessed July 21, 2025, <http://exhibitions.univie.ac.at>.

³⁰¹ Bartosch et al. "The Database of Modern Exhibitions (DoME)," 427.

³⁰² Ibid, 432.

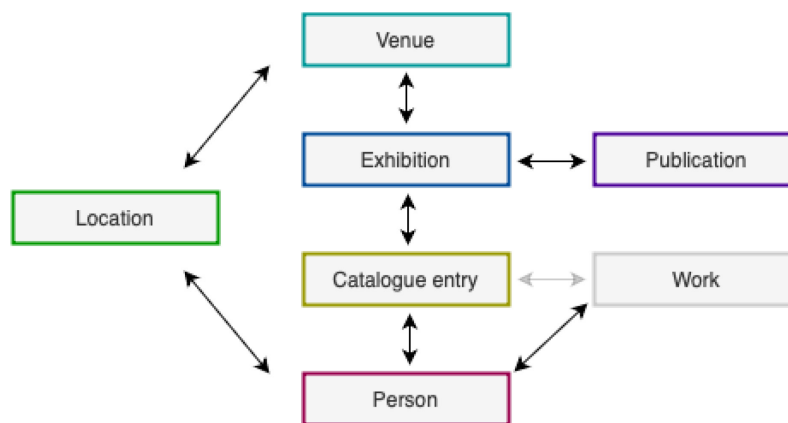


Figure 7: Relations between entity types in the DoME database.

The diagram is based on the image in the original research paper³⁰³ and made by the author in draw.io.

They also link to the corresponding Wikidata identifiers and several online artists' lexica such as Benezit, RKD, Art UK, Sikart, and Le Dictionnaire des Peintres belges. The source for all places is TGN, which provides geographical coordinates. And for art-related terms, AAT was used.³⁰⁴

The DoME team faced significant challenges in translating historical data and classifying nationalities, especially due to changes in street names and country borders, and they decided to combine historical data with contemporary geographic data with coordinates at the city level.³⁰⁵ The organizers of the exhibitions were missing in most cases. This led to host institutions being identified as the organizers.³⁰⁶

5.1.2. User interface

The database is published on a subsite of the University of Vienna. The website offers the possibility to browse and filter data with advanced search functions. In the "Blog" section, related text is published. The "Info" section gives details about the project, the contents of the database, the use of the data, and publications based on the data. The user can save queries under "My Data" in order to keep useful search results.

³⁰³ *ibid*, 427.

³⁰⁴ *ibid*, 428.

³⁰⁵ *Ibid*, 429.

³⁰⁶ *Ibid*, 431.

The screenshot shows the 'Browse' function on the DoME website. At the top, there are navigation links: 'Browse', 'Advanced Search', 'Blog', 'Info', and 'My Data'. The page title is 'Exhibitions'. Below the title is a search bar with a 'Search' button. Underneath the search bar are 'Additional Filters' for 'Exhibition Date Range', 'Exhibition Type', 'Artists' Nationality', and 'Artists' Gender', along with an 'Advanced Search' link. The main content area has tabs for 'Exhibitions', 'Map', and 'Statistics'. A table displays a list of exhibitions with columns for Date, Title, City, Venue, Type, Org. Body, # of Cat. Entries, and # of Artists. The first row shows an exhibition from Dec 1, 1904–Jan 5, 1905, titled 'Exposition De Peintures, Pastels, Aquarelles, Dessins & Croquis' in Paris at Galerie B. Weill, of the 'group' type, organized by Galerie B. Weill, with 83 catalogue entries and 9 artists.

Date	Title	City	Venue	Type	Org. Body	# of Cat. Entries	# of Artists
Dec 1, 1904–Jan 5, 1905	Exposition De Peintures, Pastels, Aquarelles, Dessins & Croquis	Paris	Galerie B. Weill	group	Galerie B. Weill	83	9

Figure 8: The “Browse” function on the DoME webpage.
Source: screenshot of the DoME webpage (January 16, 2025)

The “Browse” option allows users who don’t have a specific research question to discover a list of exhibitions filtered by date, type, organizer, place, nationality, or gender of artists, and specific search terms (Figure 8). The results can be displayed as a list, a map, and statistical charts generated by highcharts.com. The user can further filter the data using the checkbox function and save the hit list to an Excel file or as a sample query.

The screenshot shows the 'Advanced Search' function on the DoME website. It features a 'Filter by:' section with checkboxes for 'Exhibition', 'Artist', 'Catalogue Entry', 'Venue', and 'Organizing Body'. Below this is a 'fulltext search' box. A 'Search' button is located on the right. Below the search box, several filters are applied and listed: '(Starting) Year of Exhibition is within the range 1910-1915', 'Type of Exhibition is equal to group', 'Additional Information is equal to - Exclude Exhibitions without Catalogue Entries -', 'Type is equal to art galleries', and 'Nationality is one of Austria, Hungary'. Each filter has a 'remove' button next to it.

Figure 9: “Advanced Search” with selected filters applied in the DoME database.
Source: screenshot of the DoME webpage (January 17, 2025)

The “Advanced Search” allows the user to combine several detailed filters categorised by the main data categories of the database (exhibitions, artists, venues, organising bodies) and to obtain a downloadable list, a map (city level), and statistical charts separately for all types of entities (*Figure 9*). Most of the properties for statistical visualizations are available for exhibitions (gender, nationality by country, number of exhibitions by year, by month, age of artists at exhibition, city distribution, types of organising body) and artists (nationality, year of birth/death, number of exhibitions per person, popularity according to the visits to their Wikipedia page). The visualization types are well-suited for the representation of the specific data values. Bar and bubble charts for time-based data, a pie chart for distribution, matrix for multiple-dimensional data, such as the percentage of artists’ nationality in the exhibiting countries. The full text search can be used to retrieve additional information, such as descriptions and lists of members. As a special feature, one can compare the popularity of artists in the selected period, indicated by the frequency of their participation in modern art exhibitions, and their popularity today, indicated by their Wikipedia page views. This demonstrates a successful use case for linking open data.

The website offers a range of insights into the exhibition practice, the participants, and key stakeholders in modern exhibitions, and its visualizations make quantitative data exploration accessible to researchers without a statistical or technical background. The project members are transparent about their data collection processes, the selection and transfer of data from the sources, and the possible biases (geographical locations, organizers).³⁰⁷ They indicate when the information from a particular catalog is not complete,³⁰⁸ and emphasize the need for a critical approach when using the data for individual research purposes.

5.1.3. Case study: Network of Czech and Hungarian artists

In her blog post on the DoME webpage, the Hungarian art historian Krisztina Passuth investigated the relations between Hungarian and Bohemian artists at the beginning of the 20th century.³⁰⁹ In her text, she briefly introduces the two avant-garde

³⁰⁷ More information about entering the data in the DoME database is available here: https://exhibitions.univie.ac.at/pdf/Data_Entry_Guidelines.pdf.

³⁰⁸ More information about data usage is provided on the subsite “Using the Database”, accessed July 21, 2025, <http://exhibitions.univie.ac.at/info/using>.

³⁰⁹ Krisztina Passuth, “Transfers of Ideas and Styles in Central Europe Before”.

groups known as "The Eights": OSMA in Prague and Nyolcak in Budapest. She states that these groups were unaware of each other's existence, but both had connections to Paris. Central European artists generally exhibited in Austria, Germany, Italy, and France, where they could occasionally meet. I aim to prove or disprove this statement using quantitative analysis.

The following seven artists from Nyolcak are represented in the database: Berény Róbert, Czigány Dezső, Czóbel Béla, Kernstok Károly, Márffy Ödön, Orbán Dezső, Tihanyi Lajos. Six artists are represented from OSMA: Vincenc Beneš, Bedřich Feigl, Emil Filla, Bohumil Kubišta, Willi Nowak, and Antonín Procházka. The OSMA group was founded in 1907, and Nyolcak was active between 1909 and 1919. There are only six exhibitions in the database in which members of both groups participated between 1905 and 1913, in Berlin, Cologne, Munich, Paris, and Vienna. After running the R script, I loaded the GraphML file into Cytoscape to customize the design more precisely and filter the data by year and exhibition ID more intuitively. (*Figure 10*).

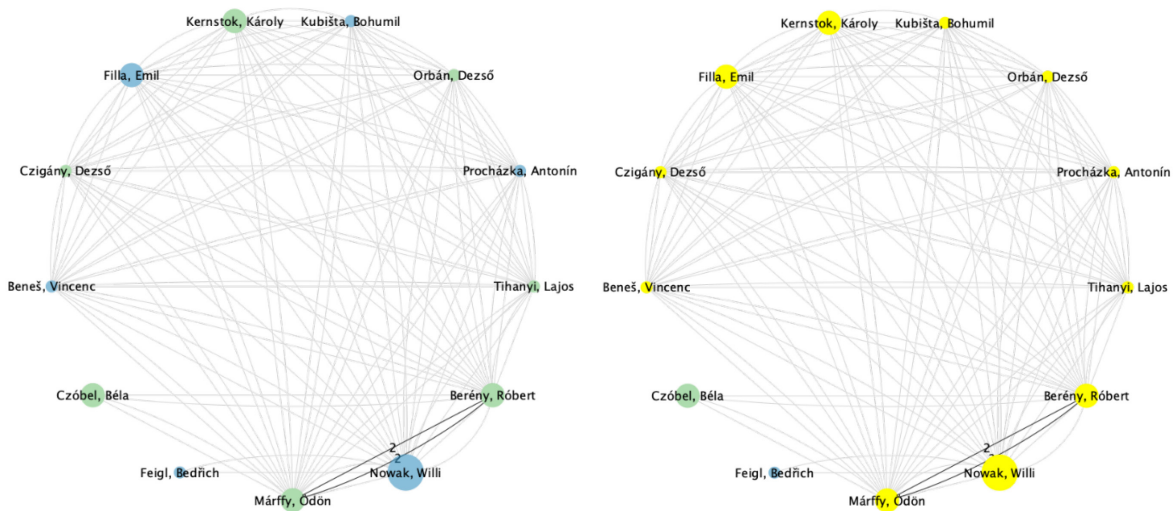


Figure 10 and Figure 11: Cytoscape network diagrams of Nyolcak and OSMA.

Based on the data in the DoME database. The second image shows the filter by the exhibition_ID "43", standing for the Sonderbund exhibition in Köln in 1912. The filter results are represented by the yellow color of the nodes.

The only exhibition in which both artists from the Hungarian and Czech group exhibited was the "Internationale Kunstausstellung des Sonderbundes Westdeutscher Kunstfreunde und Künstler zu Cöln" (*Figure 11*). The green nodes represent the Nyolcak members, and the blue nodes represent the OSMA members. Willi Nowak has the highest betweenness centrality in the whole network, meaning he acts as an intermediary most often along the shortest path between other nodes. Róbert Berény

has the highest closeness centrality, meaning he has the shortest paths to other nodes, and the highest degree centrality, because he has the most direct connections to other nodes. The size of the nodes expresses the number of exhibitions the artists took part in. Only Berény and Márffy exhibited together more times, indicated by the black lines and the label. The second image shows the results of applying the “43” exhibition ID filter to the 1912 Sonderbund exhibition in Cologne. This was the year when most artists exhibited together, and as mentioned before, the only exhibition featuring both nationalities. Based on the data available in the DoME database, it can be proven that the artists of OSMA and Nyolcak met only once between 1905-1915, not in Paris as expected, but in Cologne.

Although it was not possible to filter the data on the DoME website according to my criteria to show only the intersection of the exhibitions by Czech and Hungarian artists, the data didn’t require extended editing for analysis. Data cleaning was only required to sort out irrelevant entities by editing the Excel spreadsheet (see “Methodology” chapter), and due to its structured format, the relevant features could be used instantly for my analysis. My simple research question, which aimed to prove or disprove the statement of the renowned expert of modern art using quantitative methods, could be executed. While the database may not include all the exhibitions in which the artists of “The Eights” exhibited together, the detailed and well-structured dataset enables the question to be answered.

5.2. Archive: basis wien

The short definition of an archive is “a physical or digital collection of historical records”.³¹⁰ The archival materials are preserved for the long term because they provide valuable insights into past events.³¹¹ They can be texts and multimedia objects in both analogue and digital formats. According to the International Council of Archives (ICA), archives should meet the following requirements to be trustworthy sources of knowledge: authenticity, reliability, integrity (completeness), and usability.

The *basis wien* archive ensures these criteria by being transparent about the history and purpose of the archive and database, the authors of data, the focus of the

³¹⁰ “Archive”, Dictionary of Archives Terminology, Society of American Archivist, accessed July 21, 2025, <https://dictionary.archivists.org/index.html>.

³¹¹ “Discover Archives”, Website of the International Council of Archives (ICA), accessed July 21, 2025, <https://www.ica.org/discover-archives/what-are-archives/>.

collection, the terminology used, and by publishing data on its website. The information online, conversations with Andrea Neidhöfer, archivist and art historian at basis wien, and the publication “Archiving the present”³¹² form the basis of the following description of the archive.

The art historian and curator Lioba Redekker initiated the basis wien archive in 1997 with the aim of documenting contemporary art in Austria in an international context, with a focus on individuals, institutions, exhibitions/events, and objects.³¹³ The archive material was based on the work documentation of artists. Since then, it has been continuously expanded by adding information from different actors in the art field in Austria (exhibition spaces, art galleries, off spaces, curators, critics, artists) and the inclusion of digital media information (online publications, websites, newsletters).

The database was created as a relational database in Microsoft Access and was inspired by the standardization practices of libraries; however, it was tailored to the requirements of a contemporary art archive.³¹⁴ It was published online in 1999.³¹⁵ The original relational structure has remained unchanged since then.

The archive participated in international projects to contribute to the development of guidelines for contemporary art archives and to exchange data within these networks, such as the EU Culture 2000 project vektor³¹⁶ and the European-art.net³¹⁷. The vektor project was realized between 1999-2003 in an international network for contemporary art archives with the goal of developing guidelines for cataloguing modern and contemporary art in archives and databases based on the Dublin Core metadata standard.³¹⁸ The name vektor emphasizes that the actors in the art field are not independent of each other and their context (media, presentation, networks).³¹⁹ The research project resulted in a publication on archiving, a

³¹² Redekker, *Gegenwart dokumentieren*.

³¹³ “History”, basis wien, accessed July 21, 2025, <https://www.basis-wien.at/information/history-59?lang=en>.

³¹⁴ Andrea Neidhöfer (basis wien), e-Mail, May 19, 2025.

³¹⁵ Andrea Neidhöfer (basis wien), personal communication, November 11, 2024 (3 pm).

³¹⁶ “vektor project”, basis wien, accessed July 21, 2025, <https://www.basis-wien.at/projects-9/vektor-39?lang=en>.

³¹⁷ Website of the European-art.net, accessed July 21, 2025, <https://european-art.net>.

³¹⁸ Andrea Neidhöfer (basis wien), e-Mail, May 19, 2025.

³¹⁹ vektor, basis wien, accessed July 21, 2025, <https://www.basis-wien.at/projects-9/vektor-39?lang=en>.

guideline³²⁰, an incomplete thesaurus in the German language³²¹ for archiving contemporary art, and a research platform³²², which is no longer accessible.³²³ The European-art.net is a follow-up cooperation of vektor and a still active network of contemporary art archives.³²⁴ As a central access point for archival collections, it provides access to information on persons, groups, institutions, activities, exhibitions, and publications on 20th and 21st century art. It links the partner databases through a search engine for individuals, groups, and institutions, with separate links to institutions' records. Although this project makes it possible to find material from different archives on persons and institutions on a common website, the data itself wasn't integrated because of the wide variety of database structures and library software used by the partner institutions, which would have needed to be converted to more up-to-date systems, and the constant changing of the databases. By linking to the website of the archives, it is guaranteed that the user is provided with the most up-to-date information on the entities and the specific features of the archives are also retained.³²⁵

These initiatives represent on the one hand, the demand for making data findable and interoperable in the field of contemporary art documentation and the linking of data on archival documents, as well as the difficulty of working with heterogeneous archival material collected in different database structures and software, without using the same standards, vocabularies and languages and the existence of persistent identifiers for exhibitions, exhibiting places and young artists.

5.2.1. Data

The basis wien database contains data on 112.190 persons, 19.189 institutions, 80.657 events (projects, exhibitions, and other events), and 119.844 objects (archive materials).³²⁶ In *Figure 12*, I have depicted the relationships between the main

³²⁰ Henriette Kurschel: "Planning a project for the selection and implementation of a collection management system for archives and museums", in Reddeker, *Gegenwart dokumentieren*, 159-167.

³²¹ Christina Jacoby, Irene Müller, Mechtild Widrich, Gerd Zillner: "The subject catalogue for material on contemporary art: general considerations and the vektor thesaurus model", in: *ibid*, 140-148.

³²² "vektor. European Contemporary Art Archives", basis wien, accessed July 21, 2025, <http://www.vektor.at/home.html>.

³²³ Reddeker, *Gegenwart dokumentieren*.

³²⁴ Website of the Europa-art.net.

³²⁵ Reddeker, Lioba, "How this book came about and what it seeks to do", in Reddeker, *Gegenwart dokumentieren*, 13-14.

³²⁶ Accessed April 28, 2025.

elements in connection with the exhibitions on the basis of a diagram from basis.wien. The names of the metadata categories are mostly not identical to the original appellation, which are in German and are often abbreviations. For better understanding, I have tried to avoid abbreviations and translated them into English.

Each entity type (represented by the tables in the relational database) is entered only once in the database and is linked to other related categories. For example, entering a group exhibition with 21 participating artists updates the biographies of 21 artists. The tables are connected by identifiers. In the table, the red text color indicates the metadata categories that are displayed on the website. These are mostly descriptive metadata (grey background color). Other information is hidden, like technical information, such as “SORTING” (blue background color), and most of the administrative metadata, such as identifiers, internal information, and status (white background color). Only two administrative metadata, the information on the last update (date) and the remarks (text), are displayed on the website. Some of them are not in use anymore (red background color).

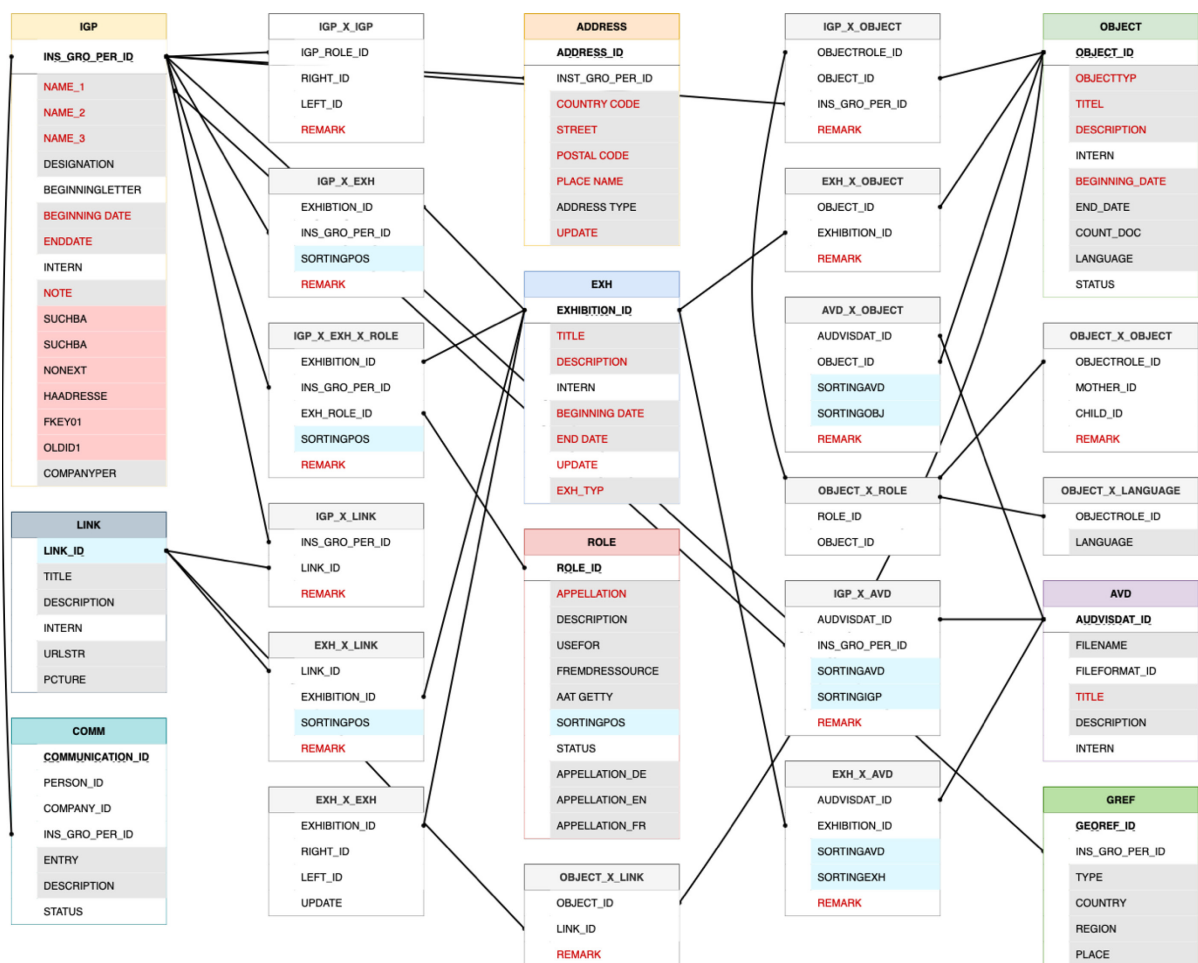


Figure 12: The structure of the basis wien relational database with exhibition relevant data.

The illustration is based on diagrams provided by basis wien and was drawn by the author in draw.io. The red color of the text indicates the data published on the website. The background colors indicate the following metadata categories: grey = descriptive metadata, white = administrative metadata, blue = technical metadata, and red = not in use anymore.

The digital records describe archival materials, such as invitation cards, postcards, posters, catalogs, portfolios, autographs, and digital resources (art gallery information, museum subsites, press releases, online publications), and are created by the archivists in accordance with international standards (Dublin Core), using controlled vocabularies (GND; AAT).³²⁷ They provide a guide to data preparation, a description of how to submit data to the archive, and information on the most important metadata terms used in the database.³²⁸

5.2.2. User interface

The basis wien website has a clear hierarchical structure with a stable navigation bar at the top of the page. The landing page is the “Search” subpage of the “Database” tab. There is an option for simple and advanced searches with several filter functions. It is possible to narrow down the search results using the following four categories:

- Persons/Groups (indicated by the color brown-grey)
- Institutions (indicated by the color blue)
- Exhibitions/Events (indicated by the color green)
- Works, publications, and archival documents (indicated by the color grey)

The categories on the website are color-coded to visually distinguish between them (see above). *Figures 13-17* are screenshots of the interface showing the search fields, an example of search results, and the categories to which an exhibition entry is related. The search results for *Hermann Nitsch* in the period between 01.01.2019-02.01.2025 show a list of event titles ordered chronologically.

³²⁷ About archive/library, basis wien, accessed July 21, 2025, <https://www.basis-wien.at/archive-library/about-archive-library?lang=en>.

³²⁸ “Guidelines for data preparation for basis wien – Art, Information and Archive”, basis wien, Oct. 2011, https://www.basis-wien.at/wp-content/uploads/2011/11/Guidelines_-data-preparation_basis-wien_2011.pdf.

[Search](#)
[About the database](#)
[Help](#)
[My entry](#)
[Links](#)

Database > Search / Advanced Search

Simple Search

Advanced Search

Choose category

Exhibitions / Events

Title

City / Country

☒ Wien / Österreich (Vienna)

Year / Duration

01.01.2019 - 02.01.2025

Institutions

Persons / Groups

☒ Add person

☒ Hermann Nitsch

☐ Activate OR-search for persons.

Figure 13: Simple and Advanced Search on the basis wien webpage.

Source: screenshot of the basis wien webpage (January 4, 2025)

By selecting the exhibition *Hermann Nitsch. Aktionsfotografie 1963-1984* the user receives a description of the exhibition with a link to the archived version of the Westlicht gallery's website on web.archive.org, which guarantees the sustainability of the digital source (Figure 14).³²⁹ The participants in the exhibition opening are listed below the text with their role. In the example exhibition, the curators were only mentioned in the description of the exhibition. In this case, the roles were originally defined based on the invitation card for the exhibition opening. The word "speech" appears next to the names of the two persons who opened the exhibition (one of whom was the curator), and the name of the artist is mentioned without his or her role as "artist" being explicitly stated. The archivists collect data from various sources (invitation, catalog, newsletter), and if they recognize that some information is missing, they complete the record afterwards. For the Nitsch exhibition, they added the role of curator to the record after finding out from my description that this information was missing.

³²⁹ Hermann Nitsch. Aktionsfotografie 1963-84, Web Archive, accessed July 21, 2025, <https://web.archive.org/web/20230322105413/https://www.westlicht.com/westlicht/de/programm/ausstellungen/hermannnitsch>.

Hermann Nitsch. Aktionsfotografie 1963-1984

02.03.2023 - 14.05.2023

WestLicht. Schauplatz für Fotografie, Wien / Österreich

Die Ausstellung im WestLicht rückt erstmals das fotografische Werk von Hermann Nitsch in den Mittelpunkt. Die Dokumentation seiner wild umstrittenen Aktionen wie auch die eigenständigen Werke aus der Blütezeit des Wiener Aktionismus bieten außergewöhnliche Einblicke in die Denk- und Arbeitsweise des im vergangenen Jahr verstorbenen Künstlers.

Mit der Präsentation ausschließlich fotografischer Werke rückt das Wiener Fotomuseum WestLicht erstmals einen bisher kaum beachteten Aspekt im umfangreichen Schaffen des im Vorjahr verstorbenen österreichischen Künstlers Hermann Nitsch ins Zentrum einer Ausstellung.

Dabei, so das Kurator:innen-Duo Julia Moebus-Puck und Fabian Knierim, waren Fotografie und Film für das Orgien Mysterien Theater von Anfang an ein ebenso wichtiger Bestandteil wie Malerei, Zeichnung, Druckgrafik und Musik. „Nitsch wollte mit der Fotografie das unmittelbare sinnliche Erleben, das bei seinen Aktionen im Vordergrund stand, auch für die Nachwelt greifbar machen“, betont Moebus-Puck. „In unserer heutigen Zeit, in der wir zunehmend auf Abstand zueinander gehen und die Alltagsfotografie oft nur schöne Scheinwelten produziert ist eine Auseinandersetzung mit diesem Teil seines Werkes aktueller denn je.“

[Quelle:
<https://web.archive.org/web/20230322105413/https://www.westlicht.com/westlicht/de/programm/ausstellungen/hermannnitsch>]



Einladung: Hermann Nitsch. Aktionsfotografie 1963-1984. 2023

Solo exhibition

show all close all

- Participants [3]

Julia Moebus-Puck - speech

Hermann Nitsch

Rita Nitsch - speech

- Publications [4]

Nicole Scheyerer: **Blutspritzer auf der Linse**. in: Falter. 10.05.2023

Nicole Scheyerer: **Blitzlicht auf verschmiertes Schüttblut**. in: Falter. 19.04.2023

Christina Böck: **Blut ohne Mätzchen**. in: Wiener Zeitung online. 10.03.2023

apa - Austria Presse Agentur: **Wiener WestLicht zeigt "Aktionsfotografie" von Nitsch**. in: Salzburger Nachrichten online. 01.03.2023

- Archival documents [1]

2023 **Einladung: Hermann Nitsch. Aktionsfotografie 1963-1984**

Figure 14: „Hermann Nitsch. Aktionsfotografie 1963-84“ in the basis wien database.³³⁰

Source: screenshot of the basis wien webpage (January 4, 2025)

A list of publications follows, some of which are available as physical printed materials at the archive, and some of which were made available online as PDF (exported website contents) with a download option. All the entries in the lists are linked to the relevant sub-pages, such as further information on the exhibited artist, “archival documents” belonging to the event (Figure 16), “texts and criticism” (Figure 17) about the exhibition and the organizing/hosting institution (Figure 15).

³³⁰ Hermann Nitsch. Aktionsfotografie 1963-84, basis wien, accessed July 21, 2025, <https://www.basis-wien.at/db/event/114484>.

WestLicht. Schauplatz für Fotografie



since 06.2001
Wien / Österreich

2011 // Kunstsponsorings-Preis „Maecenas“

show all | close all

- Persons [4]

Peter Coeln - Directorship - Gründer (since 2001)

Angelika Gründler

Ema Kaiser-Brandstätter - Presse (2009 - 2011)

Agnes Reintaler

+ Exhibitions / Events [137]

+ Publications [18]

+ Archival documents [1]

- Relations

WestLicht. Schauplatz für

Galerie OstLicht

Leica Galerie Wien



Informationsfolder: WestLicht. Schauplatz für Fotografie. 2005

Contact

Westbahnstraße 40
1070 Wien
Österreich
T +43 (0)1 5226636-0
F +43 (0)1 52233908
info(at)westlicht.at
museum(at)westlicht.at
www.westlicht.at

see also

Galerie OstLicht
Leica Galerie Wien

Einladung: Hermann Nitsch. Aktionsfotografie 1963-1984

archival document

Location

Wien / Österreich

Year / Date

2023

Note

Typ / Format: Karte, DIN A5

Events

Hermann Nitsch. Aktionsfotografie 1963-1984. WestLicht. Schauplatz für Fotografie



Einladung: Hermann Nitsch. Aktionsfotografie 1963-1984. 2023

This Object can be accessed at the basis wien archive.

Wiener WestLicht zeigt "Aktionsfotografie" von Nitsch

text and criticism

Creator

apa - Austria Presse Agentur.

Location

Salzburg / Österreich

Year / Date

2023

Source

Salzburger Nachrichten online

Mentions

Fabian Knierim, Hermann Nitsch, Julia Moebus-Puck.

Events

Hermann Nitsch. Aktionsfotografie 1963-1984. WestLicht. Schauplatz für Fotografie



Wiener WestLicht zeigt "Aktionsfotografie" von Nitsch. Salzburger Nachrichten online 01.03.2023

Figure 15-16: Hyperlinked data entries: location³³¹, "archival document",³³² and one record of "text and criticisms".³³³

Source: screenshot of the basis wien webpage (January 4, 2025)

Within the category "Person/Institution", a special feature, "Relations", illustrates the most important connections of a person or institution to other institutions, including memberships in artists' groups. For instance, Hermann Nitsch was a member of the artists' group "Selten gehörte Musik" and the artists' association

³³¹ "Westlicht. Schauplatz für Fotografie", basis wien, accessed July 21, 2025, <https://www.basis-wien.at/db/institution/53502>.

³³² "Invitation card", basis wien, accessed July 21, 2025, <https://www.basis-wien.at/db/object/154630>

³³³ "Wiener WestLicht zeigt 'Aktionsfotografie' von Nitsch", basis wien, accessed July 21, 2025, <https://www.basis-wien.at/db/object/154749>.

“Künstlerhaus”. An archive, a museum, and a foundation were dedicated to him (Figure 17). However, the nature of the relationship is not indicated and requires further deduction through close reading of the biographical data.

Below the name of the artist or institution, a static bar chart shows the sum of data entries per year for all data categories together (exhibitions/events, publications, and archival documents) in the last 18 years. Each bar represents a year. In the case of Nitsch a period between 2007 and 2025 is displayed. In 2022 and 2023, the same number of exhibitions showcased artworks by Hermann Nitsch, but in 2022, 18 more articles were written about him, which can be explained by the fact that several newspapers commemorated his death in 2022. The difference between the years is observable on the chart.

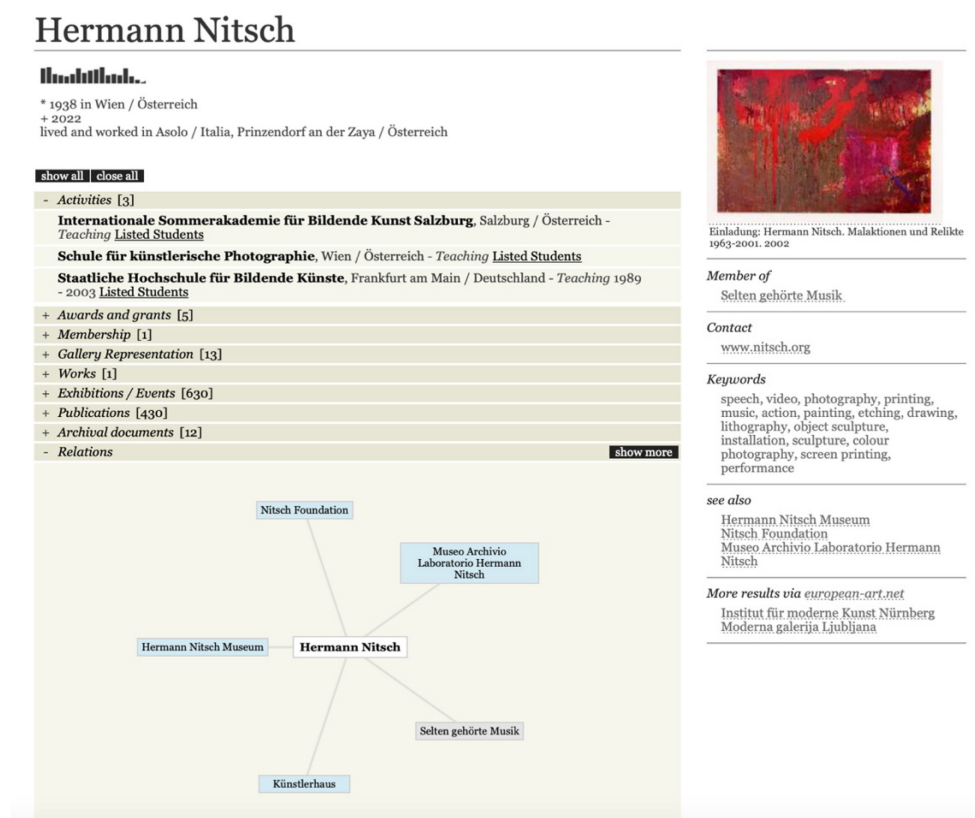


Figure 17: Information on Hermann Nitsch in the basis wien database.³³⁴

Source: screenshot of the basis wien webpage (January 4, 2025)

In terms of usability, the database website has a clear structure and provides a good overview of the data categories, facilitating research in a similar way to Wikipedia by linking related entities with hyperlinks. Some information is missing from the structured metadata (in this example, the role of the curator and artist was originally

³³⁴ “Hermann Nitsch”, basis wien, <https://www.basis-wien.at/db/person/15415>.

missing), but can be found in the description. In this case, that is a result of the type of archival document that was used as a source (an invitation card with information about the participants at the opening), by creating the record. The basic information, such as place and date, is separated from the description of the event and is placed at the top of the page, which helps the user to orient themselves. All the other information is presented in a compact manner in expandable and collapsible accordions.

The online archive doesn't offer download options for datasets; therefore, it doesn't support quantitative approaches. Although the number of entries in a category is given in parentheses, and could be harvested or manually collected in a dataset. The database gives a valuable insight into the collected archival material, including several digitized documents, and facilitates the close reading of them. The archive's website does not mention this, but for research purposes, they provide CSV datasets on request by filtering and exporting data from their local database. The offline database contains more information than the online record. Some of this is private data protected by the DSGVO or documents protected by copyright, and some is additional annotation for archival purposes. This includes the persistent identifiers of GND, AAT, TGN, and ULAN, which can support data interoperability for institutional collaborations.³³⁵

5.2.3. Case study: Curated by

To demonstrate how the basis wien database can be used for research, I chose to analyze data from the annual Vienna-based art festival curated by. Since 2009, contemporary Viennese art galleries have organized a festival for curating with the aim of establishing an international network of curators and artists. They decide on an annual theme and invite international curators to curate an exhibition in their galleries. The archivists have classified curated by as an institution, and the annual festivals are subordinated to it, including each gallery's exhibition as a subevent. The database contains information on each exhibition, including duration, location, participants (artists, curators), publications, and archival documents. I requested 18 features of the event: name of the artist and institution (last name, first name), INS_GRO_PER_ID, ROLE_ID, gender, geographical reference, location, birth year, death year,

³³⁵ Andrea Neidhöfer (basis wien), personal communication, November 11st, 2024 (3 pm).

exhibition_ID, title of the exhibition, exhibition start year, exhibition end date, street, city, the number of archival objects and number of exhibitions included in the database on the corresponding artist. I have divided the data into participants, galleries, and curators. The contribution of the artists is not explicitly stated, but only the role “beteiligt” (involved) refers to their participation in the exhibition. Other roles might include giving an opening speech or reading. I have chosen to refer to anyone who is not a curator as a participant. Over the 16 years (2009-2024), there were 361 gallery participations and 54 distinct galleries. 2545 participants were involved in the exhibitions, and around 85 % of them participated for the first time. 348 curators curated exhibitions, and only 3 % of them curated more than once. I examine the answers to the following research questions:

1. How international is the festival? (features: ‘location’, ‘person_ID’, ‘aust_start_year’)
2. How has the gender distribution changed over time? (features: ‘gender’, ‘person_ID’, ‘aust_start_year’)
3. Which of the exhibited artists are the most popular based on the objects and exhibitions archived in basis wien? (features: ‘lastname’, ‘firstname’, ‘objk_count’, ‘aust_count’, ‘location’) Is there any correlation between the number of participations in the festival and the publications (objects)/exhibitions documented in the archive?

Internationality of the festival

To explore data, I use visualizations created in Tableau. The first question concerns the nationality of participants and curators. The dataset contains information about the participants' place of birth and/or address, but it doesn't allow any conclusions to be drawn about their nationality. As the multiple geographical references resulted in duplicates, I had to clean the data and remove the multiple entries. In some cases, the remaining geo-reference is a place of birth, in others it is an address, as some of the artists have only a place of birth and others only an address or several addresses. The country names are in the original language, which required translation into English. I have grouped the countries into continents. *Figure 18* shows the superiority of Western countries (Europe, North America), with Germany, Austria, the USA, and the UK dominating in most years. In 2009, only 18 different countries

were represented, and the most diverse year was 2016 with 38 countries (*Figure 19*). In 2009, there were only 4 curators, all from Europe, organizing exhibitions in several galleries (23 in total), which explains why the origins of the participants are not so diverse (*Figure 20*).

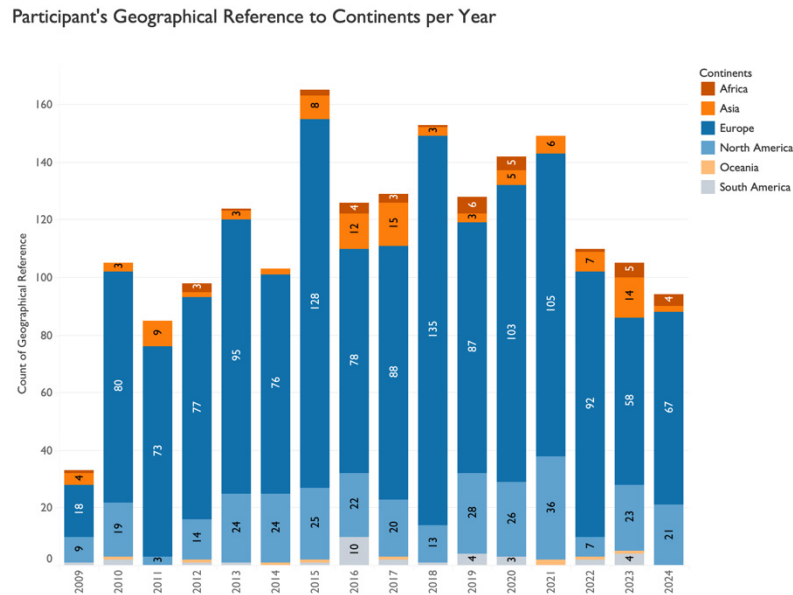


Figure 18: Distribution of geographical references of the participants, grouped by continent, per year.
The colors refer to the continents. Visualization was made in Tableau.

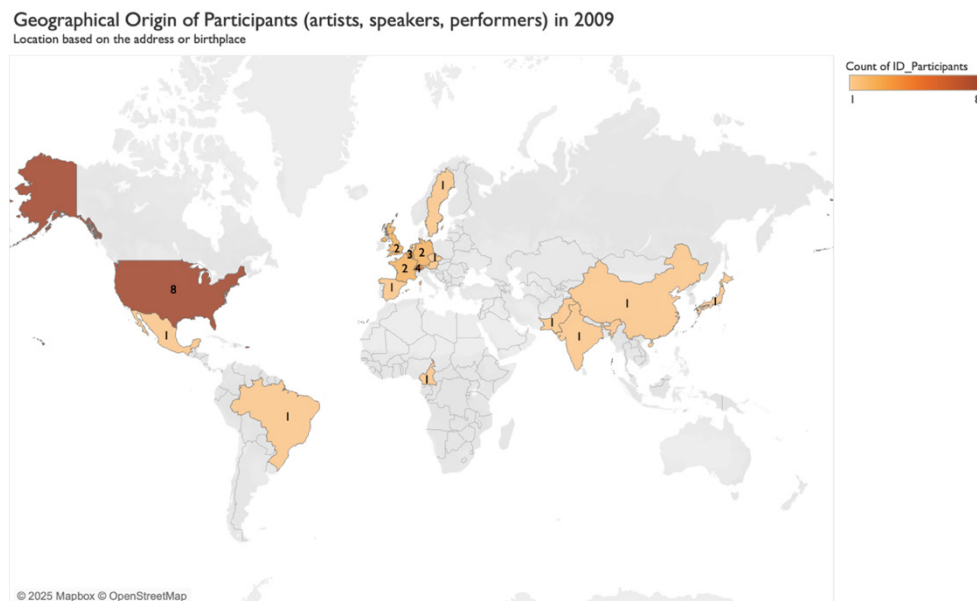


Figure 19: The geographical origin of participants in 2009 based on address or birthplace.
The color coding shows the number of participants per country. (The darker orange, the more participants).
Visualization was made in Tableau.

Four people have a smaller network than, for example, twenty curators in 2016. The origin of the curators doesn't explain the diversity of 2016 (*Figure 21*). Most came

from France (3) and Germany (3). There was only one curator from South America and one from Africa, but no one with an Asian geographical reference.

Geographical Origin of Participants (artists, speakers, performers) in 2016
Location based on the address or birthplace

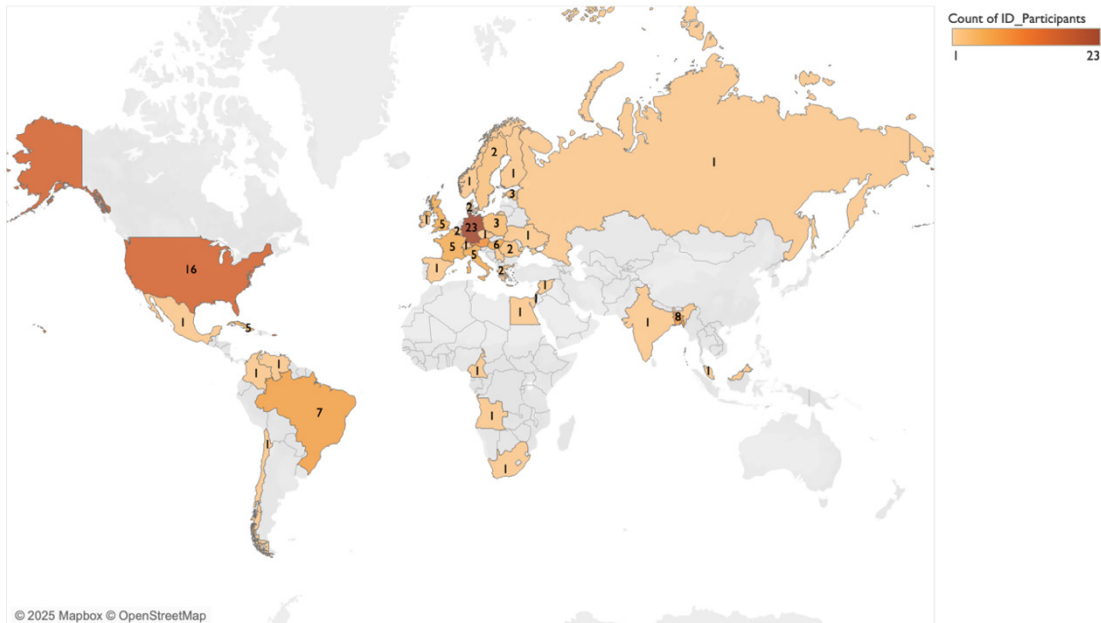


Figure 20: The geographical origin of participants in 2016 based on address or birthplace.
The color coding shows the number of participants per country. (The darker orange, the more participants)
Visualization was made in Tableau.

Geographical Origin of Curators in 2016
Location based on the address or birthplace

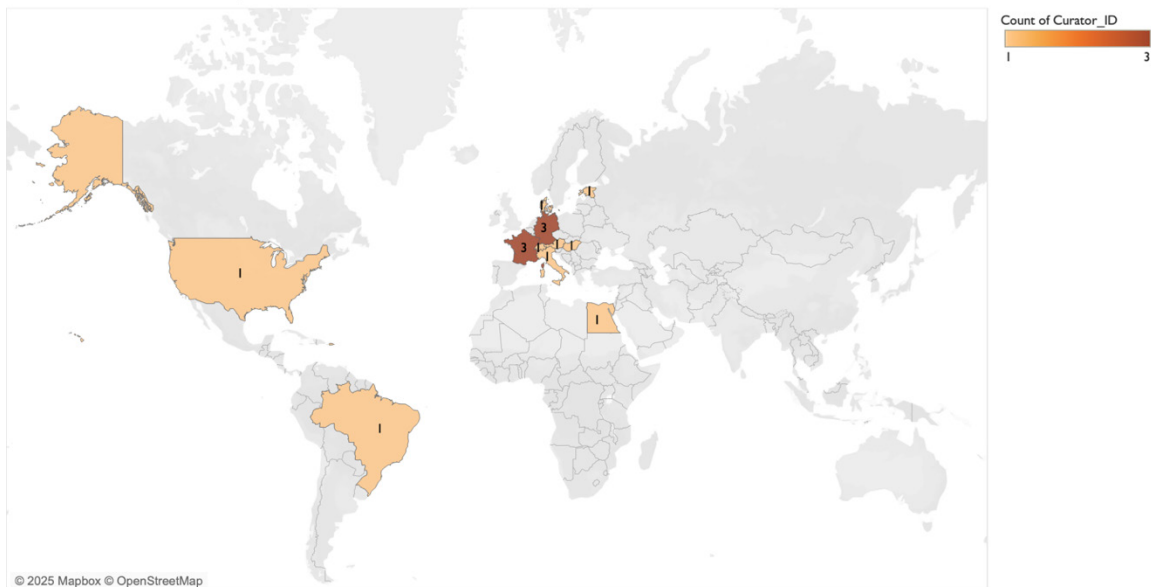


Figure 21: The geographical origin of curators in 2016 based on address or birthplace.
The color coding shows the number of curators per country. (The darker orange, the more participants)
Visualization was made in Tableau.

There were only three exhibitions where the geographical origin of the curator could have influenced the geographical focus of the exhibition. Knoll Gallery Vienna: Hungarian curator, 75 % percent of the artists are from Hungary; Lombardi-Kargl: Estonian curator, three Estonian and one Finnish artist; Gallery Meyer Kainer: German curator, only German artists. The diversity can be explained more by the personal networks of the curators and could be a result of the yearly topic “Meine Herkunft habe ich mir selbst ausgedacht” (I have invented my origin), which refers, among other things, to the need to investigate the personal origins of artists, especially if they belong to a minority or marginalized group.³³⁶

The curators come mainly from Western countries. The map shows the geographical origin of the curators in 16 years (*Figure 22*). The top 10 countries are: Germany, Austria, USA, France, UK, Poland, Italy, Hungary, and Lithuania. African, Asian, South American countries, Oceania, and Australia are under-represented.

Geographical Origin of Curators 2009-2024
Location based on the address or birthplace

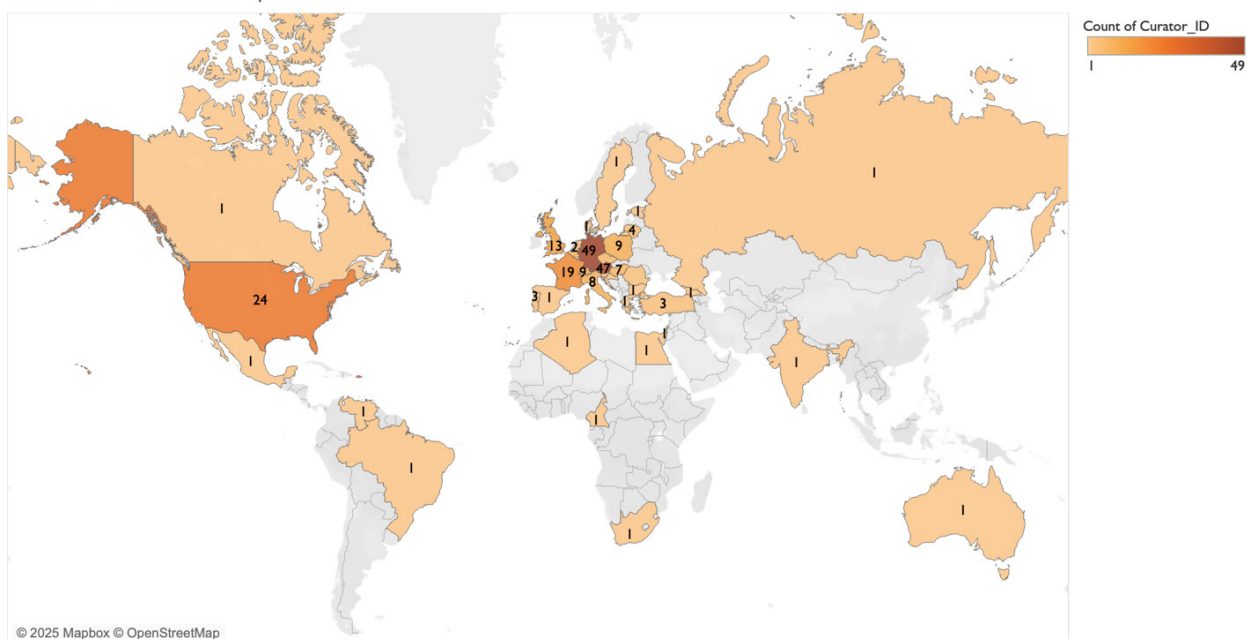


Figure 22: The geographical origin of curators between 2009 and 2024 based on address or birthplace. The color coding shows the number of curators per country. (The darker orange, the more participants). Visualization was made in Tableau.

³³⁶ “curated by_vienna 2016, Meine Herkunft habe ich mir selbst ausgedacht”, 08.09.2016, basis wien, accessed July 21, 2025, <https://www.basis-wien.at/db/institution/131475?lang=en>.

Gender of participants and curators

The gender distribution bar charts show a growing number or proportion of female participants and a more or less constant gender distribution among curators since 2011 (*Figures 23-24*). It is challenging to define the gender of persons who do not explicitly state it themselves. As the null and x values show, in several cases, it was not possible to determine the gender of participants or curators. In 2023, there were both more female participants (about 56 %) and more female curators (72,73 %, male: 18,18 %, rest: unknown). The topic of the festival was “Neutrality”, which supports non-binary thinking, transition, deviation, and marginalities. The highly political subject matter doesn't explain the dominance of women, but there is a positive correlation between the gender of the curators and the participants.

Analyzing the correlation for the whole data set, I found that for female curators, the Pearson correlation coefficient is lower: 0.5853089; for male curators, there is a strong positive correlation between the male gender of the curator and the number of male participants in the exhibition: 0.8265714. In 2023, for example, the proportion of female curators (73%) was much higher than the proportion of female participants (56%), because female curators also invited several male artists. And in 2017, when the number of male curators (15) was more than double the number of female curators (7), the proportion of male curators (65%) and participants (51%) was closer.

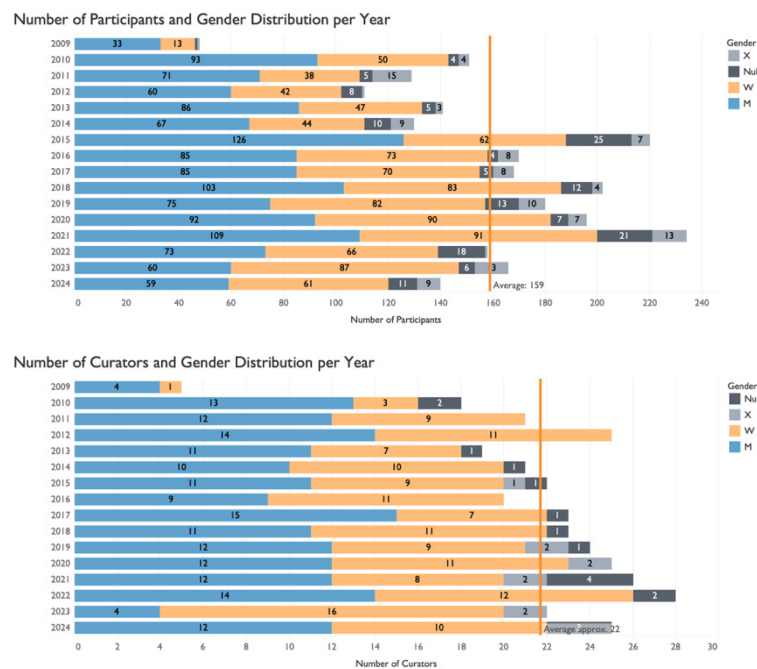


Figure 23-24: Number of participants and curators in “curated by” per year.

The color encoding indicates the gender distribution and the average line, the average number of participations.

Visualizations were made in Tableau.

Popularity of participants

The third research question is about the popularity of the artists participating in the curated by festival, based on the publications (objects) and exhibition history archived in the basis wien archive. There is a positive correlation between the number of objects and exhibition entries of the artists in the database, which can be explained by the type of publications, such as exhibition reviews and critics. Erwin Wurm,³³⁷ contemporary Austrian artist, has the most exhibitions (787), and Brigitte Borchhardt-Birbaumer³³⁸, art historian and journalist, has the most objects (1458 articles on art and exhibitions). The most popular male artist according to the objects is Hermann Nitsch. The most popular female artist is VALIE EXPORT³³⁹ from Austria, with the most exhibition count (520) and the most object count (341).

The two scatterplots show different correlation models. I expected the number of exhibitions to be more predictive of the number of objects (archival material, publications) in the database. In terms of causality, it would be more logical for the number of exhibitions to increase the number of objects in the archive. However, since the variation in the number of exhibitions is so high, the number of objects could be used more accurately to predict the number of exhibitions. 57 % of the variation in exhibitions can be explained by objects. But only 39 % of the variation in objects could be derived from the number of exhibitions in connection with the participants.

In the first case, gender has a strong influence on the correlation of the variables (*Figure 25*). The slope for male artists is higher (1.42) than for female artists (0.35), which means that as the number of objects increases, so does the number of exhibitions. It refers to the archival activity of adding new objects that lead to new exhibition records. The trend line of the female participants is strongly skewed by the outlier Brigitte Borchhardt-Birbaumer, with a low number of exhibition records and a high number of objects. In the second case, the gender slopes are not significantly different (*Figure 26*). There is still a positive correlation between the number of exhibitions and the number of objects. For both women and men, an additional exhibition record leads to an increasing number of archived materials and publications (such as articles, catalogs), for women to 0.54 more objects and for men to 0.48 more

³³⁷ Website of Erwin Wurm, accessed July 21, 2025, <https://www.erwinwurm.com>.

³³⁸ Record on Brigitte Borchhardt-Birbaumer, European-art.net, accessed July 21, 2025, <https://european-art.net/database?search=Brigitte+Borchhardt-Birbaumer>.

³³⁹ Website of VALIE EXPORT, accessed July 21, 2025, <https://www.valieexport.at>.

objects. Exhibition records have a stronger effect on the number of objects in the archive in the case of women, while concerning men, the number of new objects has a stronger effect on the number of exhibitions.

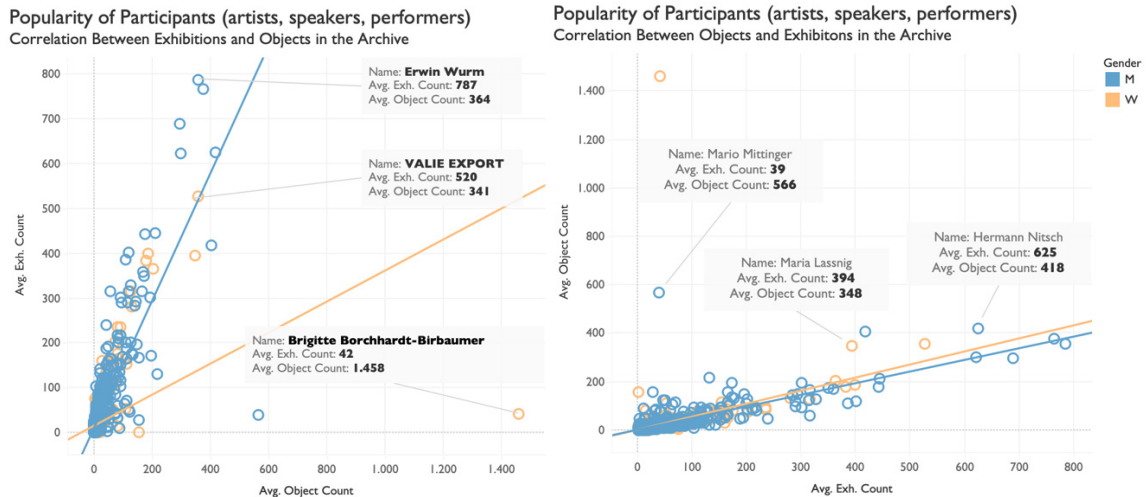


Figure 25-26: Popularity of participants in “curated by” based on the correlation between exhibitions and objects. The color coding shows the gender distribution, and the trend lines stand for linear regression, indicating the strength of correlation. Visualizations were made in Tableau.

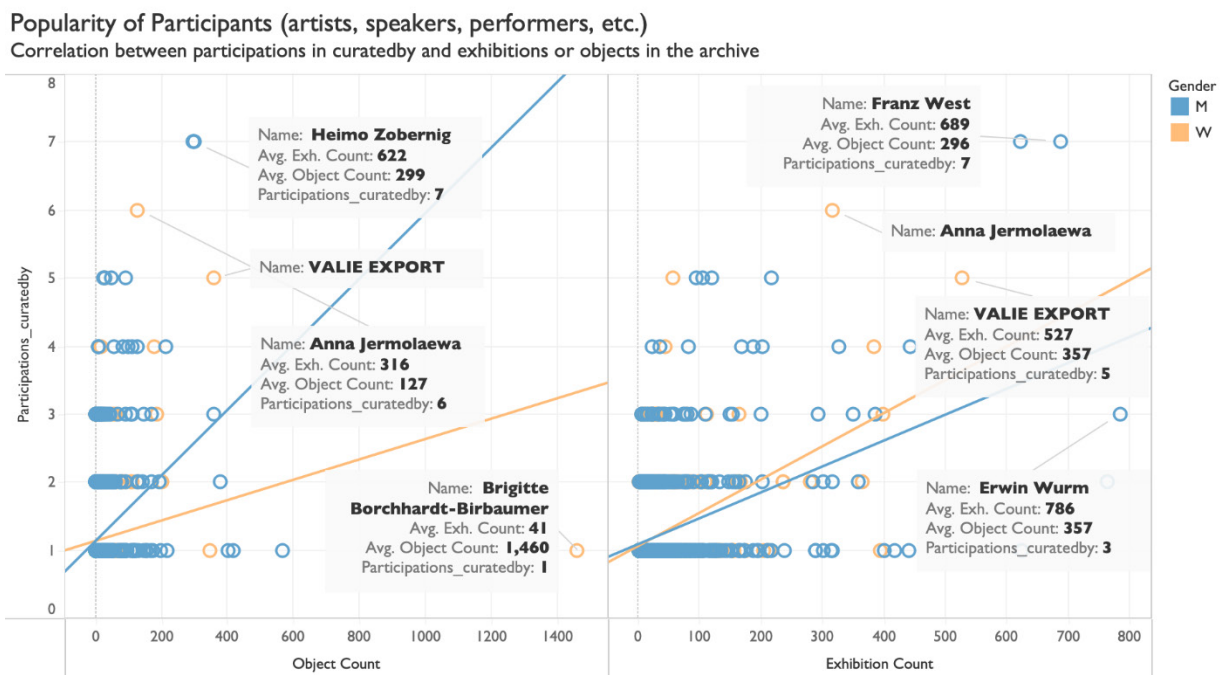


Figure 27: Popularity of participants in “curated by” in correlation with the number of participations. Based on the object count in correlation with the number of participations and the exhibition count in correlation with the number of participations. The color encoding shows the gender distribution, and the trend lines indicate the strength of correlation. Visualization was made in Tableau.

As the trend lines indicate, there is a statistically significant yet weak positive correlation between the number of participations in “curated by” and the number of objects (publications) archived in basis wien and it is significantly influenced by gender (*Figure 27*). If the number of objects by male participants is higher, the number of participations in “curated by” increases. Heimo Zobernig³⁴⁰ has exhibited seven times in curated by and has 299 objects (5th most among male artists) in the database. However, the linear model only explains 8.6% of the variance. The female artists who exhibited most often at the festivals are outliers, such as Anna Jermolaewa³⁴¹ and VALIE EXPORT. Anna Jermolaewa took part in the festival six times but has only 127 objects in the archive. A male outlier is the journalist Markus Mittringer³⁴², who took part in the festival only once, but, being a journalist for Der Standard, has 566 objects in the archive. The exhibition records are based on archival objects. These are connected to the exhibition, but they are not additionally listed by the artists to avoid redundancy. This could explain why certain popular artists (based on the exhibition count) don’t have a high number of objects.

The correlation between participation and exhibitions in the database has a weak but significant positive correlation, explaining 21 % of the variation in the data (*Figure 27*). Again, gender differences play a role. The number of exhibitions in the archive influences the number of participations of female artists more than that of their male counterparts. Erwin Wurm has the most exhibitions in the database, but his works were only shown in three exhibitions within the scope of the festival. As an exception (outlier), Franz West³⁴³ has the second most exhibitions listed (689) and participated in the festival seven times. Among the female artists, VALIE EXPORT has the most exhibition entries and has participated in the event five times. The outliers with the most exhibitions in the archive belong to the most famous contemporary artists living in Austria.

In summary, both the number of objects and the number of archived exhibitions per artist show a weak but significant positive correlation. While the number of objects correlates more with the participation of male artists, the number of exhibitions documented in the database correlates more with the participation of female artists.

³⁴⁰ Website of Heimo Zobernig, accessed July 21, 2025, <http://www.heimozobernig.com>.

³⁴¹ Website of Anna Jermolaewa, accessed July 21, 2025, <https://www.jermolaewa.com>.

³⁴² Record on Markus Mittringer, basis wien, accessed July 21, 2025, <https://www.basis-wien.at/db/person/18473>.

³⁴³ Website of Franz West, accessed July 21, 2025, <https://www.franzwestprivatstiftung.at>.

This could be interpreted as meaning that there are more publications about male artists that are not specifically related to exhibitions. However, as noted above, new publications significantly increase the number of archived exhibitions by male participants. In the case of women, the number of participations in exhibitions may have a greater influence on their visibility and popularity in the art field and may contribute slightly more to their selection for the “curated by” exhibitions than in the case of male artists. This is related to the previous conclusion that the number of exhibitions has a stronger influence on the number of publications in the archive than the publication has on the number of exhibitions. The most popular participants according to their number of objects and exhibitions are all representatives of the contemporary art field in Austria and often outliers in the scatter plots, such as Brigitte Borchhardt-Birbaumer with the most publications but only one participation, and Erwin Wurm with the most exhibitions but only three participations. Although there is a positive correlation between popularity (based on archival materials/publications and exhibitions) and participation in the festival curated by, the two artists with the most exhibitions (seven), Heimo Zobernig and Franz West don’t have the highest exhibition or object count, and Anna Jermolaewa, with six participations, has significantly fewer exhibitions and objects in the archive (316, 127) than the most popular female artist, VALIE EXPORT (530, 341), with five participations.

Data usage and conclusion

The archive basis wien publishes its database online, but not in a structured format. Instead, they make the data available to researchers on request. Based on the information published online, it is possible to deduce which data categories are available and to request a number of features. The archivists collect the data accordingly, using the MySQL query language. There are no missing entries, but some unknown information in the case of gender and location. In particular, the three features, role, gender, and nationality, are challenging and have to be adapted to archival practice. The roles are only defined in the case of the curator and the participants. Besides, there are two persons with the category of "reading" (“Lesung”) in the role column. For gender, I included the “unknown” and “X” values to show how difficult it is to define the gender of people in the database and to avoid skewing the results. In the location column, I had to remove duplicates and work with mixed

references, such as place of birth and artist's address, so I decided to use the term 'geographical origin' instead of nationality. A person may have different places of birth, citizenship, and addresses, and it is difficult to define which of these determines his or her national identity. The archivists are transparent about these challenges.

It is possible to answer the three questions in a slightly limited way. In the case of internationality, as already mentioned, the geographical references are mixed, and the nationalities of the artists cannot be clearly deduced. The festival is international, exhibiting many participants with geographical origins in Western countries, but there are still very underrepresented regions on a global scale: Africa, Asia, South America, Australia, and Oceania. The gender of participants has shifted over time towards a more balanced distribution of female and male participants. In the case of curators, with the exception of the years 2009, 2010, 2018, and 2023, the distribution is fairly unchanged, with a few more male curators. However, the results could change if the missing gender attributions were added. The most popular artist based on the archived exhibition records is Erwin Wurm, and according to the publications Hermann Nitsch. The most popular female artist, both in terms of the number of exhibitions and objects, is VALIE EXPORT. However, they are not the most represented ones in the exhibitions of "curated by". Franz West, Heimo Zobernig and Anna Jermolaewa were the most frequently represented artists. They are all well-known contemporary artists living in Austria.

5.3. Calendar: eSeL

The platform eSeL is an online calendar that has an additional website for archiving previously published events. The Collin's dictionary defines a calendar as follows: "A calendar is a particular system for dividing time into periods such as years, months, and weeks, often starting from a particular point in history. You can use a calendar to refer to a series or list of events and activities which take place on particular dates, and which are important for a particular organization, community, or person."³⁴⁴ The purpose of an online event calendar is to inform a particular community about selected events, and the structure of the provided information is determined by days.

³⁴⁴ "calendar", Collins Dictionaries, accessed July 21, 2025, <https://www.collinsdictionary.com/dictionary/english/calendar>.

The online calendar *esel.at* was established in 1998 by *Mag. Lorenz “eSeL” Seidler* with the aim of informing the Austrian art scene about upcoming art events in Vienna and neighboring area (mainly Lower Austria) and to connect various actors in the art field.³⁴⁵ The main focus is on art exhibitions and their accompanying events such as discussions, special guided tours, workshops and performances. However, recurring events, like regular guided tours of a museum’s permanent exhibition, are not published. The eSeL team curates the content of the calendar according to internal guidelines, with an emphasis on events that are easily accessible, free or low-cost, and that support the contemporary art discourse. The calendar has several partners,³⁴⁶ whose events are regularly monitored and published on the website. Other events are added on special request by e-mail and selected from newsletters.³⁴⁷ In addition, approximately 1450 photos documenting selected events, taken by the eSeL team, are published on the website. These event announcements refer to future activities but are automatically archived on the backend of the website after happening. The events already taken place after a certain time disappear from the website and have only been saved for internal archival purposes. Currently, the last event on the calendar website is from 18.03.2020. Seidler recognized the research value of this archived data, including participants of events, date, location, institution data, as well as descriptions of contemporary art events in Vienna and the surrounding and applied for a grant to integrate them into Europeana.

5.3.1. Data

The data was originally stored in a MySQL relational database, which was updated to PostgreSQL alongside the development of the new user interface. PostgreSQL combines object-oriented and relational database management systems, and can handle more complex data types than MySQL, such as XML, JSON, and GIS.³⁴⁸ Events are archived in an XML structure and can be handled as a whole object in the database. In the updated structure, events, locations, agents, and photos are all linked. In 2024, the event archive was published on the *rewind.esel.at* website, and

³⁴⁵ My description on eSeL was informed by discussions with Mag.a Xenia Kopf and their provided materials.

³⁴⁶ List of the partners of eSeL on the *esel.at*, <https://www.esel.at/de/about/partner-innen>.

³⁴⁷ Conversation with Xenia Kopf (eSeL), December 3, 2024

³⁴⁸ “About”, PostgreSQL, accessed July 21, 2025, <https://www.postgresql.org/about/>.

the records were integrated as cultural heritage objects (76.145) on the Kulturpool website,³⁴⁹ the Austrian aggregator of Europeana. The eSeL database currently contains 78.668 events, 2.463 venues, and 11.251 agents.³⁵⁰ The earliest event dates from 2008. The title images of the events have external copyrights and can't be integrated into an external database. Instead of these images, eSeL submits screenshots of the website announcements to Kulturpool (*Figure 28*).

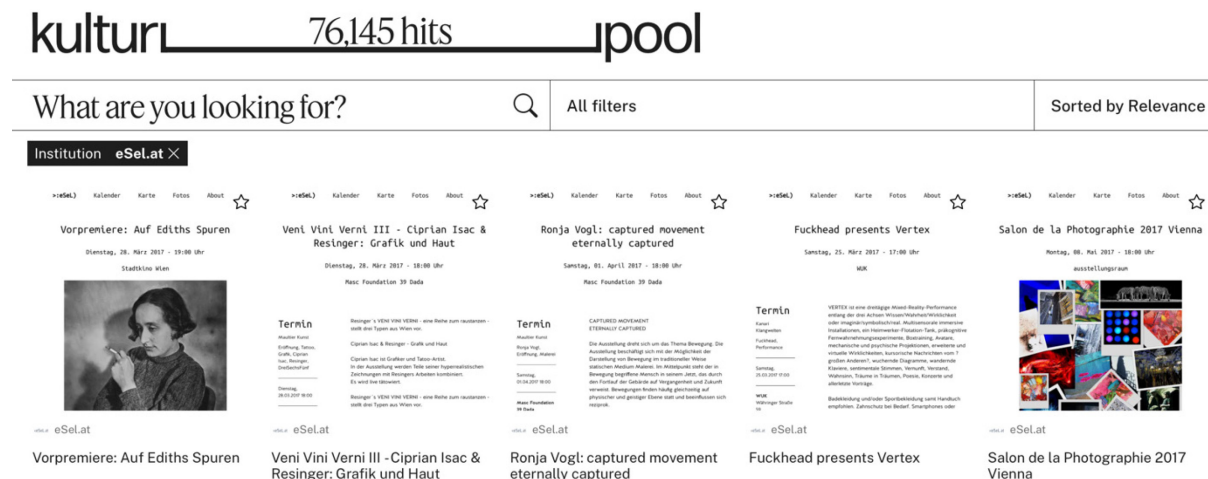


Figure 28: Search results for eSeL's object on the Kulturpool webpage.

Source: screenshot of the Kulturpool webpage (May 15, 2025)

The main challenge in developing the public archive was to find a solution for archiving past events and to ensure the automated archiving of future events. The data structure of the calendar had to be adapted. The team used the data schema of Linked Art and the entities of the CIDOC CRM ontology. For the choice of terminologies, they relied on the Getty's AAT thesaurus and linked to the persistent identifiers of AAT and Wikidata (data only available in the backend). "Agent" entities for persons and organizations had to be created, as the names of them were only available in the free text description of the events. Metadata such as the types of organization, events, and the roles of persons were added to the events as so-called tags. For example, the category "public_institution" and the type "museum". The eSeL team mapped the data categories of the archive to the minimum requirements of the EDM guideline, which consists of metadata on the aggregation object (administrative metadata), the cultural heritage object, and the digital resource (Dublin Core and EDM

³⁴⁹ Records of eSeL on the Website of Kulturpool, accessed July 21, 2025, <https://kulturpool.at/suche?refinementList=dataProvider%255B0%255D=eSeL.at>.

³⁵⁰ Conversation with Xenia Kopf (eSeL), December 3, 2024.

descriptive metadata categories).³⁵¹ As EDM is a data model for cultural heritage objects, it contains categories for objects. Events need to be fit into the “text” object category. This only allows for a high-level description of events, making it difficult to archive detailed information in a structured way, such as event participants, geodata, and date (see 5.3.3 for more details).

5.3.2. User interfaces

Calendar

The eSeL calendar is constantly being expanded to include actual cultural events. From 2024, film and theatre events have also been included, but were not transmitted to Kulturpool. The events on esel.at could be filtered temporarily (today, tomorrow, or exact date) without the option of selecting time intervals.³⁵² There are three further filters: categories, disciplines, and tips. The first one contains predefined categories of events. The second collects several disciplines, including terms that are difficult to interpret as disciplines, such as society & theory, and children & youth. The tips represent different target groups, distinguishing programs for children, tourists, and insiders in the art field. Multiple filter tags can be assigned to an event. In the following list of filters, I have underlined those terms that are relevant to art exhibitions.

Categories:

- opening & vernissage
- theatre
- performance & dance
- concerts & sound art
- art education & discourse
- presentation & lectures
- cinema & screenings
- new exhibitions
- festivals & co
- guided tours & co
- workshops, lectures

³⁵¹ “Kurzreferenz EDM-Pflichtfelder”, Kulturpool, accessed July 21, 2025, <https://wissen.kulturpool.at/books/europeana-data-model-edm/page/kurzreferenz-edm-pflichtfelder>.

³⁵² Accessed May 18, 2025.

Disciplines:

- architecture & urbanism
- fine art
- performing art
- film & video
- photography & design
- society & theory
- literature & poetry
- music & sound
- children & youth

Tips:

- scene and insider
- art tourists
- community perspectives
- parents and kids

rewind.esel

The event archive has its own website at the following URL: <https://rewind.esel.at>. The site is currently in beta mode. Users can search by event title, organization, and location name. Locations and organizations (including person names) are two entity types that have several entities in common, such as the Dom Museum Vienna and Westlicht. The former stands for the name of the location, while the latter represents the agents.

The user interface is simple. On the landing page, after a brief description and the logos of the funding institutions, there is a year filter. The default setting is 2018, even though data is available from 2008 to 2024. Users can select a year. The institutions that organized events in that year are displayed, with the number of events taking place at each institution shown in brackets. After opening the subpage of an institution, the events of the selected year are listed with their title, date, location, categories, disciplines, and address. These can be filtered by district, category, and discipline. The last two filters are also available on the calendar website, but they contain slightly different filter terms.

There is a search field in the site's navigation bar. Only a simple search is possible, which queries data in three categories: events, places, and organizations. When searching for an artist by name, the result for the agent is categorized as 'organizations/places' instead of 'organizations/persons'. A maximum of 10 results are listed below each other, and it is not possible to display all the results of a category on one page. Records are grouped in containers, and clicking on an arrow navigates to the next page. This also makes it more complicated to harvest data or copy all records of a category. The three containers of the three categories can only be set together. Selecting the second page of the event hit list automatically displays the second page of the places hit list.

The query term “Hermann Nitsch” returns a list of events with “Hermann Nitsch” in the title, as well as a hit for “found organization(s)/places” as agent. On his agent’s subpage, only events at which he was a lecturer are listed, and exhibitions in which he participated are not included. By contrast, the subpage of Erwin Wurm displays the last four related events without stating his role in them. Screenshots (Fig. 29–30) demonstrate that elements of the website overlap, such as the navigation arrow and the artist's name. Searching for the specific exhibition 'Hermann Nitsch: Aktionsfotografie 1963–1984”, no results are returned, unless the hyphen is removed.

Furthermore, it is not possible to download datasets or access data via an API, but only to harvest data, which poses a significant challenge, because data for several years or all events associated with an artist cannot be displayed on a single page and additional information, such as addresses of institutions and lists of events, is only available on sub-pages. These problems could be partially solved (see metadata published in Kulturpool) by integrating the data into Europeana and using its API, but this is delayed.

The example of esel.at illustrates some of the challenges that small institutions with a large amount of data may face when their website was not originally designed for archiving or publishing historical data and therefore needs to be restructured retrospectively. Another difficulty is the financial dependence of the archiving project on temporary funding, which cannot ensure continuous development and sustainable maintenance of the published data.

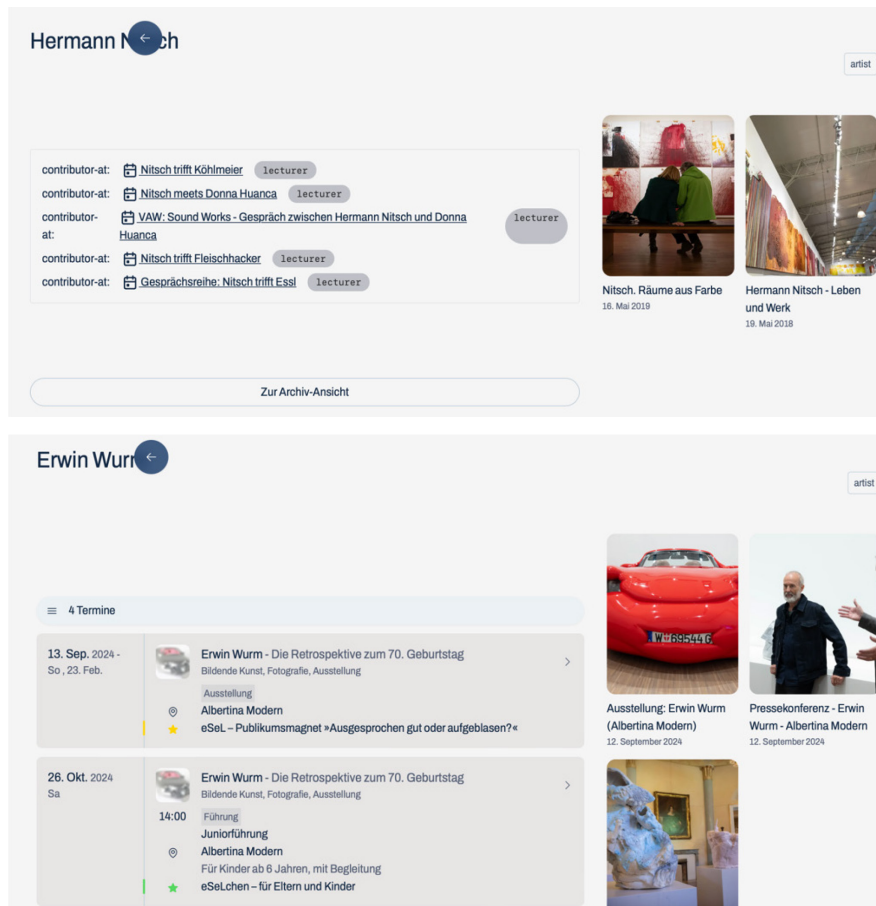


Figure 29-30: Subsites of Hermann Nitsch and Erwin Wurm on rewind.esel.at.
Source: screenshots of the eSel webpage (May 15, 2025)

5.3.3. Comparison of exhibition records

The basis wien and eSeL databases overlap in that they both store data on contemporary art events (basis wien since 1997 and eSeL since 2008). In order to be able to compare the information from the two databases, I selected an exhibition from 2023, which both published on their websites. To demonstrate a user experience, I have already described the entry of the Hermann Nitsch exhibition in the archive and explained how the data entities are related to each other. I will now focus on the information from eSeL and point out the differences in the interpretation of the data.

In eSeL, selecting the event from the list of hits takes one to the event's subpage. Below the title and title image, the discipline and event type tags are displayed (*Figure 31*). This is followed by the duration and location of the exhibition as a super event, as well as a list of related events, without indicating the event type. In this case, it is the opening of the exhibition. The description of the event is the same as in basis wien, with the difference that here the participants of the opening are

mentioned in the text and only the name of the artist is tagged on the right side, explicitly stating that the artist is Hermann Nitsch. In basis wien the role as artist is not stated, but the role as speaker by the opening.

The screenshot shows a web page for an exhibition. At the top, the title 'Hermann Nitsch: Aktionsfotografie 1963-1984' is displayed in white text on a dark red background. Below the title are two buttons: 'Fotografie' and 'Eröffnung'. To the right of the title is a photograph of Hermann Nitsch working on a large, abstract, red and white artwork. Below the title bar, the exhibition dates are listed: 'Von Mittwoch 01. März 2023' and 'bis Sonntag 14. Mai 2023'. The location is 'WestLicht. Schauplatz für Fotografie, Westbahnstraße 40, 1070 Wien'. A section titled '1 Termin' shows the dates '1. März 2023 - So 14. Mai 2023' and the time '19:00'. The artist's name 'Hermann Nitsch' is listed with a profile icon. The organizer's name 'Hermann Nitsch' is also listed with a profile icon. A link to the exhibition website is provided: 'www.westlicht.com/westlicht/de/.../hermannnits...'. The text below the link describes the exhibition and mentions the artist's role as a lecturer.

Figure 31: “Hermann Nitsch: Aktionsfotografie 1963-1984” in the eSeL database.

Source: screenshot of the eSeL webpage (May 15, 2025)

In the absence of archival objects, only two entities are linked: the name of the artist and the organizer. Clicking on the name of Hermann Nitsch opens the artist’s sub-page (Figure 29). Here, the related events in the database are listed without any context or biographical information. These are only discussions to which the artist contributed as a lecturer, as mentioned before. The list doesn’t include any information about exhibitions he participated in as an artist, although his name is linked on the exhibition’s site. In basis wien the links are bidirectional and additional information on Nitsch with an external link is provided.

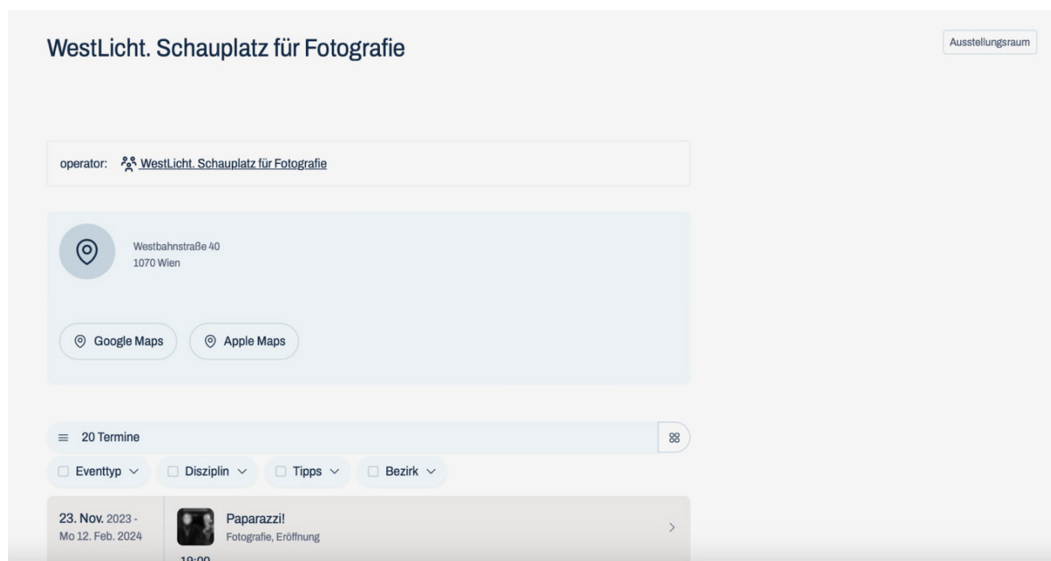


Figure 32: Linked information on the artist and location in the eSeL database.

Source: screenshot of the eSeL webpage (May 15, 2025)

About the exhibition space WestLicht following information is available: the address with links to maps and the related events of the last year (2024), which can be filtered by tags (Figure 32). In basis wien there is more information given about the hosting institution (staff, all events, all publications, related archival documents, related institutions, and contact information).

The following diagram, created with the Simple Dynamic Modelling tool, shows a possible mapping of the Hermann Nitsch exhibition using RDF-triples and based on the general event data model provided by eSeL (Figure 33).³⁵³ It is important to note that events can have subevents, that time is not divided into beginning date and end date, that agents are directly connected to events, and relations are unidirectional.

³⁵³ E-Mail from Xenia Kopf (eSeL), July 31, 2024

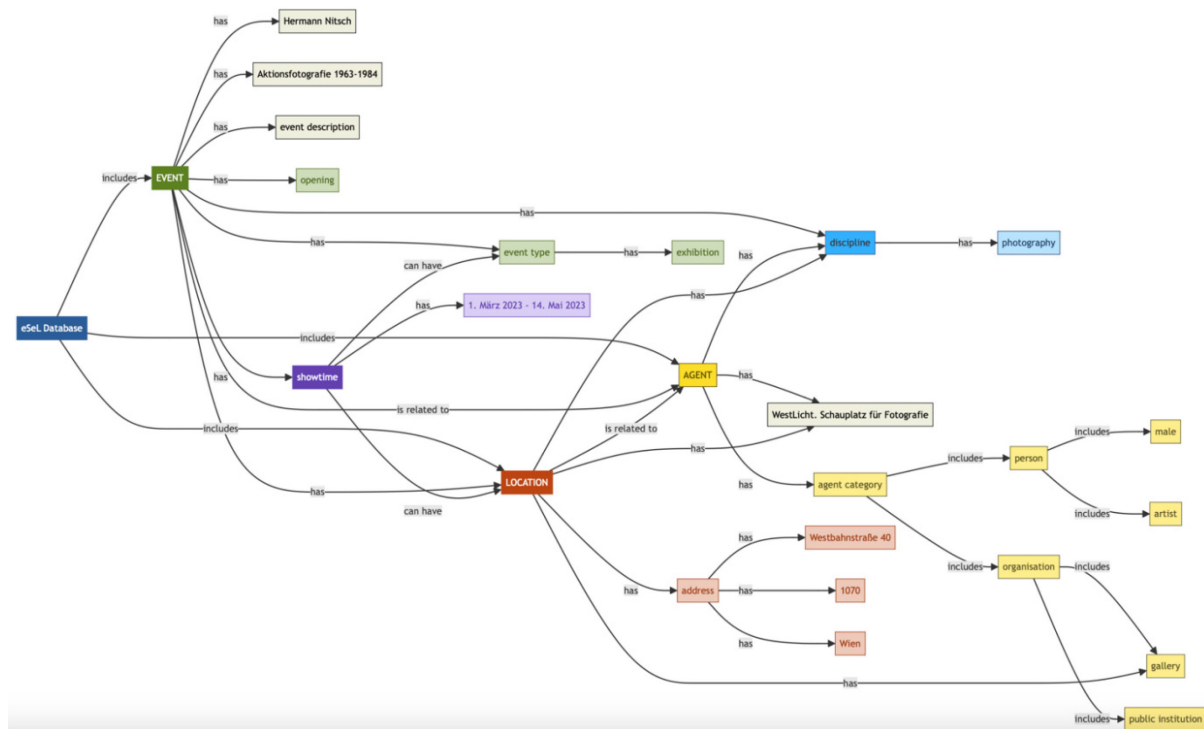


Figure 33: Flowchart of the data structure of the Hermann Nitsch exhibition in the eSeL database.
Made in Simple Dynamic Modelling³⁵⁴

The data published on the Kulturpool website is listed in *Table 4* and is the same as on the Rewind website. It is structured as general data, persons and entities (descriptive and administrative metadata), and media data (administrative and technical metadata). The exhibition duration shown on the Rewind website is not available on Kulturpool. The spatial coverage is restricted to Vienna and does not show the full address of the institution. The artist is listed as a contributor under 'persons and entities', without his role being specified. Certain metadata categories enrich the information, which are required by Europeana: event ID, language of the event, publisher, usage rights information (CC-BY-NC-SA), and links to thesauri. While the metadata structure of the event is clearer, standardizing data can also result in data loss, such as the specific location with geodata, the duration of the parent event, and the exact role of a contributor.

³⁵⁴ Joseph Padfield, "Sympel Dynamic Modelling", accessed July 21, 2025, <https://research.ng-london.org.uk/modelling/>.

DESCRIPTION	
Begrüßung: Peter Coeln, WestLicht Zur Ausstellung sprechen: Rita Nitsch Julia Moebus-Puck, Kuratorin der Ausstellung Wir freuen uns auf Ihre Anmeldung: anmeldung@westlicht.com Die kommende Ausstellung im WestLicht rückt erstmals das fotografische Werk von Hermann Nitsch in den Mittelpunkt. Die Dokumentation seiner wild umstrittenen Aktionen wie auch die eigenständigen Werke aus der Blütezeit des Wiener Aktionismus bieten außergewöhnliche Einblicke in die Denk- und Arbeitsweise des im vergangenen Jahr verstorbenen Künstlers. Mit der Präsentation ausschließlich fotografischer Werke rückt das Wiener Fotomuseum WestLicht erstmals einen bisher kaum beachteten Aspekt im umfangreichen Schaffen des im Vorjahr verstorbenen österreichischen Künstlers Hermann Nitsch ins Zentrum einer Ausstellung. Dabei, so das Kurator:innen-Duo Julia Moebus-Puck und Fabian Knierim, waren Fotografie und Film für das Orgien Mysterien Theater von Anfang an einen ebenso wichtigen Bestandteil wie Malerei, Zeichnung, Druckgrafik und Musik. „Nitsch wollte mit der Fotografie das unmittelbare sinnliche Erleben, das bei seinen Aktionen im Vordergrund stand, auch für die Nachwelt greifbar machen“, betont Moebus-Puck. "In unserer heutigen Zeit, in der wir zunehmend auf Abstand zueinander gehen und die Alltagsfotografie oft nur schöne Scheinwelten produziert ist eine Auseinandersetzung mit diesem Teil seines Werkes aktueller denn je.“ de	
GENERAL DATA	
Titel	Hermann Nitsch: Aktionsfotografie 1963-1984
Identifizier	AT-ESEL-ev_02vvBtds5xEliOlshrCfPG
Date	2023-03-01
Is part of	rewind.esel.at
Subject	photography (discipline) en vocab.getty.edu fotografie nl vocab.getty.edu fotografia (disciplina) it vocab.getty.edu arts (broad discipline) en vocab.getty.edu kunsten nl vocab.getty.edu œuvres artistiques fr vocab.getty.edu artes es vocab.getty.edu
Object type	exhibition openings en vocab.getty.edu tentoonstellingsopeningen nl vocab.getty.edu vernissages fr vocab.getty.edu
Spatial coverage	Wien WestLicht. Schauplatz für Fotografie, rewind.esel.at
Temporal coverage	2023
Language	German
PERSONS UND ENTITIES	
Publisher	esel.at
Contributor	Hermann Nitsch rewind.esel.at
MEDIA DATA	
Usage rights	CC BY-NC-SA creativecommons.org
Can I use it?	Yes, with conditions
Media type	Text

Table 4: Metadata on the exhibition “Hermann Nitsch: Aktionsfotografie 1963-1984” on the Kulturpool website.

Some of the differences in the interpretation of the exhibition data can be explained by the data source. The archive basis wien originally used the information on the invitation card to assign roles. Although eSeL created 33 different role tags, including the role of curator, they only linked the name of the artist when remodeling the unstructured text of this exhibition entity. Whereas basis wien does not provide geographical data for the address (which is also not available in the printed archive objects), eSeL, being an online event calendar, provides precise location data displayed on a map. Other differences are domain-specific: the archive publishes information about archival materials and publications related to exhibitions, while eSeL uses filter tags for event categories and disciplines to help users select their preferred categories. This comparison shows that the same event can be enriched with different information, depending on the domain and the purpose of the database.

5.3.4. Case study: Institutional landscape 2010-2024

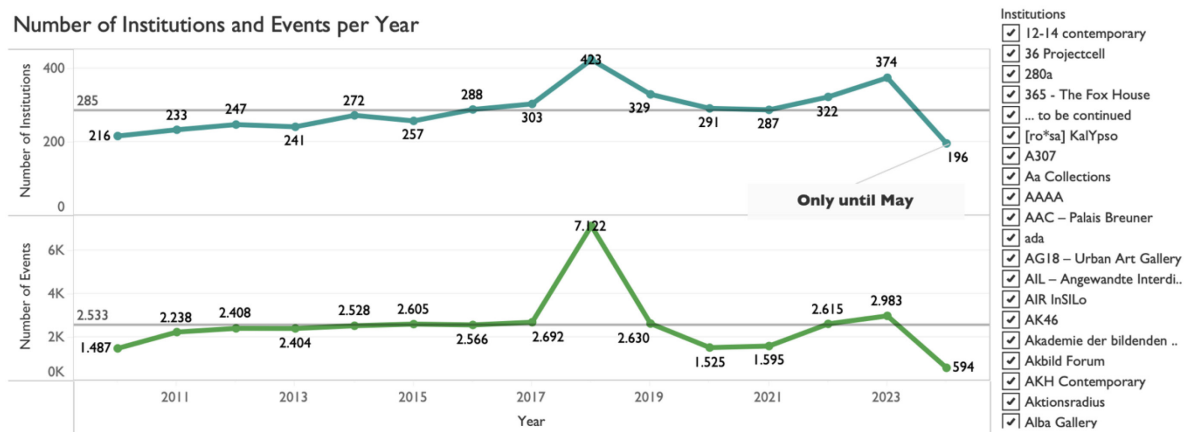
My original plan was to access the eSeL archive data via the Europeana API. Unfortunately, the data is currently (May 2025) only integrated into Kulturpool, which doesn't have an API. For this reason, I decided to investigate only the institutional landscape of Austria, harvesting the list of institutions and the number of events per year from the rewind.esel.at landing page. I wrote a Python script to download a CSV document for each year. Then, I merged all the separate documents into one CSV file. One of the biggest challenges was defining which institutions were exhibition spaces and deleting all those that hosted different kinds of art events, such as concert venues, cinemas, and theatres. I also excluded some occasional exhibition venues, as it would have been very time-consuming to check what kind of events took place in them. These venues included churches, schools, public spaces, bookshops, and universities. I only kept art universities, galleries, museums, ateliers, and off-spaces, and I had to look up several of them to identify their activity profile. The events that took place in the institutions were not only exhibitions, but also different types of accompanying events.

After cleaning the data, I created a visualization showing the number of events and institutions per year. The line graphs show a peak in 2018 (see *Figure 34*). I looked for historical or financial reasons to explain the increase in the number of recorded institutions and events. However, despite 2018 being the anniversary of the deaths of

Gustav Klimt, Egon Schiele, Otto Wagner, and Koloman Moser, the official report of the Federal Chancellery of Austria on the art and cultural budget states that the government invested less money in the fine arts than the previous year.³⁵⁵

Cultural Institutional Landscape of Vienna and its Surroundings between 2010 and 2024 (based on data published on rewind.esel.at)

Number of Institutions and Events per Year



Number of Events per Institutions

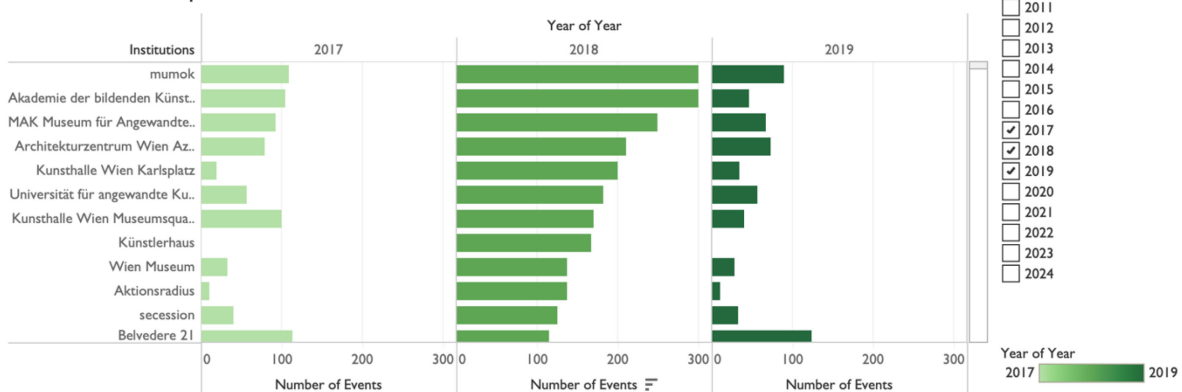


Figure 34: Dashboard on the number of institutions and events per year in the eSeL database.

Visualizations made in Tableau

Next, I visualized the locations on a map by looking up the addresses of the institutions, at first with the help of ChatGPT. However, I needed to control each address manually because most of the information was false.³⁵⁶ I was interested in whether there were focus districts that were particularly popular for events in 2018, such as Nordbahnhof or Seestadt, and compared the institutions that organized events in 2017 and 2018, excluding those that appeared in both years, on a map (Figure 35).

³⁵⁵ Herbert Hofreither, Reinhold Hohengartner, Sarah Klein, Theresia Niedermüller, Robert Stocker, Charlotte Sucher (ed.) *Kunst und Kulturbericht 2018*, Bundeskanzleramt, Sektion für Kunst und Kultur, Wien, 2019.

³⁵⁶ Map visualization of the curated-by-locations in 2017 and 2018 in Austria, Google My Maps, https://www.google.com/maps/d/edit?mid=1Y5T835Ikory8RI4eEE0IKUIDs_Wpv70&usp=sharing

The red markers represent 2018 and the green ones 2017. I didn't recognize any special patterns except for some institutions near Westbahnhof and in districts 4th, 10th, and 12th.

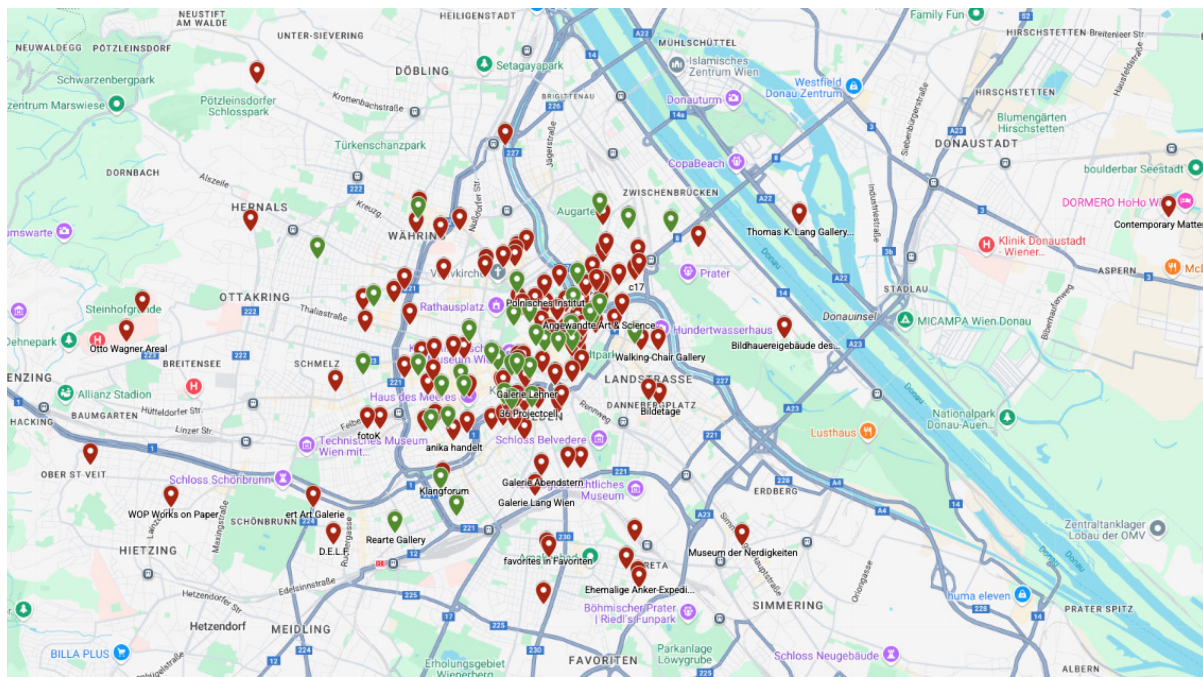


Figure 35: Map visualization of the event locations in 2017 and 2018 in Vienna (detail).

Red marks represent the institutions that organized events in 2018, and the green marks represent the institutions that organized events in 2017 without their intersection.

Source: screenshot of Google My Maps (May 24, 2025)

Finally, I took a closer look at the events archived in eSeL and found that several entries had been incorrectly assigned to 2018. For example, although the Künstlerhaus in Vienna was renovated between 2016 and 2020, the database lists 162 events in 2018. According to the harvested data, MUMOK organized considerably more events than in previous or subsequent years, but looking up the events reveals that some took place in 2009 and 2010. The published data requires thorough cleaning prior to being used for research purposes, in order to avoid drawing false conclusions based on it. At this stage, the data should only be used alongside close reading methods, as it is not suitable for drawing trustworthy conclusions using quantitative approaches. Data visualization proved less helpful in analyzing the changing institutional landscape in Austria (mainly Vienna), but was useful in detecting a large number of data entry errors and could be utilized for planning the next steps in the data cleaning process.

5.4. Comparison of the three databases

	DoME	basis wien	eSeL
Purpose	study the history of a crucial moment of modern European painting from the perspective of exhibitions.	recording information on contemporary art	informing about art events
Target group	researchers	researchers	not defined
Source of information	modern exhibition catalogues of Europe	invitation cards, posters, newsletters, catalogues	information online and newsletters, e-mails
Language	EN	DE/EN	DE
Date of data	1905-1915	since 1945 - ongoing	since 1998 - ongoing
Geographical focus	Europe	Austria in international context	Vienna and surroundings
Data	1.367 exhibitions, 13.266 artists, 304 venues, 219 organizing bodies, 100 exhibiting cities and 207.931 catalogue entries (paintings and drawings)	112.190 persons, 19.189 institutions, 80.657 events, and 119.844 objects.	78.668 events, 11.251 agents, 2.463 locations and 1450 photos
Standards/ Interoperability	georeference: TGN, vocabularies: GND, ULAN, linking to Wikidata identifiers, artists lexica: Benezit, RKD, Art UK, Sikaart, Linking Data to Wikipedia pageviews	similarities to DublinCore, georeference: TGN, vocabularies: GND, AAT, ULAN	LinkedArt, vocabulary: AAT, linking to Wikidata identifiers, EDM mapping
Database structure	relational database: LAMP	relational database: Microsoft Access	relational database: ProSQL, XML structure
Type of events	historical exhibition of modern art between 1905-1915, focusing on paintings and drawings	exhibitions, projects, discussions	group exhibition, installation, opening, presentation, sound installation, fest, festival, art exhibition, award, concert, discussion, exhibition, workshops, performances, showing, solo exhibitions, guided tours, intervention, messe, music festival, party, commemoration, theater, concert, premier, screening
Discipline	modern art	contemporary art	art, fine art, contemporary art, theory, performance art, sound art, architecture, urbanism, design, visual art, video, photography, media and technology, civil society, publicity, music, performing art
Entity types	exhibitions, artists, venues, organizing bodies, exhibiting cities, catalogue entries (objects)	persons/groups (brown) institutions (blue) exhibitions/events (green) works, publications and archival documents (grey)	events, agents, date, location
Tags	no tags	type of exhibition	disciplines, type of events
Website features	browsing and advanced search map, statistical graphs: bar charts, matrix, pie charts, bubble charts query can be saved in 'My Data'	simple and advanced search bar chart showing the quantity of the categories: exhibitions, publications, archivials per year relations as graph (memberships)	search filter options (district,
Accessibility	freely accessible through the user interface, download options for query hits in Excel/CSV/XLS format, chart visualizations and map data in JPG/PNG/SVG/PDF format	over userinterface, several filter options, no download options, but data on request	over userinterface, no download options beta version with several data retrieval issues data harvesting
Sustainability	project was finished 2021, but the database is serviced by the university staff (Cognitive Research in Art History (CReA))	continuity ensured by the archive	the calendar is continuously growing, the archive was financed by fundings, risk of continuity due lack of ongoing funding
Webpage	http://exhibitions.univie.ac.at	https://www.basis-wien.at/db/advsearch?lang=en	https://www.rewind.esel.at

Table 5: Comparison of the three Austrian databases.

Having provided more details about each database, it is necessary to highlight their similarities and differences (see *Table 5*). Each database is relational and contains information on exhibitions, albeit with different scopes: Vienna and its surroundings; Austria and Europe; art events between 1905 and 1915; events since 1945; and events since 2008. Basis Wien and DoME make information available for research purposes. Unlike the others, the [rewind.esel.at](https://www.rewind.esel.at) website doesn't mention a target user group or offer documentation on the published database. The three databases use various sources for data entry, such as invitation cards, online information, and catalogs, which influence the entities and structure of their databases. Only basis wien collects information from all three types of sources. The archive contains information on persons, groups, institutions, exhibitions, works, publications, archival documents, and media files (images and PDFs). In the eSeL archive, basic information on events is linked: Events, Agents, and Locations, and is enriched with information tags. While the DoME database contains more information on the exhibitions, including data on the exhibited objects, and explicitly distinguishes between the categories of organizer and venue, providing separate datasets for each.

According to the sum of the data, basis wien contains the most event and person entities. In the DoME database, the number of objects dominates (items), whereas in eSeL, it is the number of events. However, one should be cautious about what these

entities really represent. For instance, the objects in exhibition catalogs are difficult to identify from a historical perspective, making this data useful only for quantitative research. eSeL not only publishes data on exhibitions, but also on several accompanying events. Furthermore, the individuals listed in basis wien are not necessarily exhibition participants, but could be authors as well.

The data structure of the basis wien was influenced by standards used in archives and libraries (Dublin Core). In the DoME project, the data entry process was guided by the principle of preserving as much of the original source as possible and finding a structure to represent information contained within exhibition catalogs. The eSeL calendar, on the other hand, was not originally created for research or preservation purposes, but rather to provide information about upcoming events with various filtering options. Thus, Linked Art and EDM inspired their data mapping processes. They all link to certain thesauri and authority files, such as AAT, GND, ULAN, Wikidata, and TGN. GND, ULAN, and TGN are used by both DoME and basis wien; DoME and eSeL use Wikidata; and basis wien and eSeL use AAT.

Finally, copyright is a significant issue for all three domains. Basis wien is not allowed to publish images of the entire archival documents online or only in low resolution, eSeL can only transfer images they have taken themselves of events to Europeana and uses screenshots as media, and DoME has refrained from including visual documentation of exhibitions and digitized catalogs.

5.4.1. Metadata on exhibitions

Despite all these differences, the metadata they provide on exhibitions is similar. The comparison in *Table 6* is based on diagrams of the data structures in the case of basis wien and eSeL, but restricted to the entities displayed on the website, and includes the metadata categories in the downloaded exhibition dataset from DoME. Each institution adds its own domain-specific metadata, such as related archival documents, art discipline tags, total number of catalog entries, and data entry status, which may only partially be relevant for quantitative research purposes. The DoME database includes more metadata categories in the Item (catalog entries) dataset and is more suitable for research purposes. Additional categories are artist, life span, (preferred) nationality, owner, creation date, for sale, currency, price, room, catalog number, type of venue, and type of organizing body.

DoME	basis wien	eSeL
ID	ID	ID
Title	Titel	Titel
		Subtitle
Start date End date Display date	Year or Duration: tt / mm / jjjj to tt / mm / jjjj)	Start date with day Start time End date with day End time
Organizing body	Organizer/Institution	Organizer as Tag
Venue City	Venue (City, Country)	Location (street, zip-code, city)
Exhibition category	Category	Event type as tag
	Media genre	Art discipline as tag
	Description	Description
Sum of Artists	Participants with roles	Related agent with role
	Publications	
	Archival documents	
	Image	Image
		Weblink
		Subevent/Related event
Sum of Catalogue Entries		
Status of Data Entry		

Table 6: Metadata categories on exhibitions in the three Austrian databases.

Sources: basis wien and eSeL website and the downloaded exhibition dataset from the DoME website.³⁵⁷

5.4.2. FAIRness of the databases

The FAIR Guiding Principles for scientific data management, published in 2016, provide guidelines for the findability, accessibility, interoperability, and reusability of scientific data, with a particular focus on machine actionability. These principles can be used to compare the three databases, even though only one of them is the result of a research project; each database is intended to support researchers. There isn't much difference in the FAIRness of the databases. DoME fulfils most of the requirements for FAIR data (8/15). This may be explained by the academic domain and the project's starting point in 2017 (after the principles were declared). The basis wien archive is the least compatible with the principles (6.5/15), probably because it is the oldest of the three databases. As its structure hasn't changed significantly since

³⁵⁷ DoME includes more information in other categories, such as the "Items", "Organizing Bodies" and "Venues" dataset.

1997, the basis wien database is also not fully up to date in terms of interoperability and data reusability. Data on persons and institutions is linked on the European-art.net website and listed alongside data from several other contemporary art archives.

	basis wien	eSeL	DoME
Findable			
F1. (meta)data are assigned a globally unique and eternally persistent identifier.	x	x✓	x
F2. data are described with rich metadata.	✓	x✓	✓
F3. metadata clearly and explicitly include the identifier of the data they describe	x	x✓	x
F4. (meta)data are registered or indexed in a searchable resource.	✓	x✓	✓
Accessible			
A1 (meta)data are retrievable by their identifier using a standardized communications protocol.	✓	✓	✓
A1.1 the protocol is open, free, and universally implementable.	✓	✓	✓
A1.2 the protocol allows for an authentication and authorization procedure, where necessary.	not relevant	not relevant	x✓
A2 metadata are accessible, even when the data are no longer available.	not relevant	not relevant	not relevant
Interoperable			
I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.	x	x✓	x
I2. (meta)data use vocabularies that follow FAIR principles.	✓	✓	✓
I3. (meta)data include qualified references to other (meta)data.	✓	✓	✓
Re-usable			
R1. meta(data) have a plurality of accurate and relevant attributes.	x	x	✓
R1.1. (meta)data are released with a clear and accessible data usage license.	x	x	x
R1.2. (meta)data are associated with their provenance.	x	x✓	x✓
R1.3. (meta)data meet domain-relevant community standards.	x✓	x✓	x✓

Table 7: The alignment of the three Austrian databases with the FAIR principles.

x stands for not adopted, ✓ stands for yes, their combination means partially.³⁵⁸

Due to the integration of their data on the Kulturpool website, eSeL fulfils 7.5 criteria. Although they prepared the data structure based on the Linked Art data schema and in an interoperable RDF/XML format with links to thesauri and authority

³⁵⁸ For the interpretation of the principles, I consulted the official website of the FAIR principles. GO FAIR, accessed July 21, 2025, <https://www.go-fair.org/fair-principles/>.

files, the search function on the Rewind website does not allow data to be retrieved in a useful way. The user experience could be enhanced with advanced search options, and the database's accessibility would be further improved by making it available on the Europeana website via the API.

Table 7 shows which requirements are met by the databases in detail. The databases do not have a unique identifier. Only the integrated Kulturpool data from eSeL fulfils this criterion, but all the databases are published on searchable websites. In terms of retrieval and search filters, the `rewind.esel.at` website needs improvement. All three databases publish data on publicly accessible websites and don't require authorization. Only DoME allows users to create an account to save search results. They don't use a widely recognized knowledge representation structure to publish their data online, except for the eSeL database, which publishes its data on the Kulturpool website in the EDM data schema. However, for certain entities, they use vocabularies and authority files (persons, locations, and terms). User rights and licenses are clearly stated only on the Kulturpool website, where the provenance of the data is also mentioned. DoME is also transparent about the source of its data, adding information on the catalog from which the data was collected. Finally, the three databases use community standards to varying degrees, such as library, academic, and cultural heritage standards, mostly represented by vocabularies, authority files, and specific archiving methods. For example, `basis wien`'s database grows with each archived material; the calendar is archived after the event has taken place; and DoME has selected art-historically significant catalogs, preserving the original structure as much as possible, and making them easily accessible to humanities scholars for quantitative research.

5.4.3. Compatibility for quantitative research

The most well-documented database is the project of DoME. It contains only exhibitions of a particular period, and the collection of data is already completed; nevertheless, it provides a good example for preparing data for research purposes by preserving the historical data in a structured format. Although only a few semantic web principles were used (linking to Wikidata and AAT) and no other Linked-Data-compatible data preparation methods (ontologies), it is still the most suitable for

quantitative research purposes, thanks to its advanced filter functions and spreadsheet download option.

The data of basis wien requires the help of the archivists to get access to data, but it has reliable data on exhibitions and participants, even if it doesn't allow for drawing conclusions about the nationality, gender, or the role of participants in the exhibition.

The database of eSeL is in beta version and doesn't provide trustworthy data due to incorrect assignments. Currently, it is also the most challenging to get access to it. Even though they collected useful data on locations, etc., it is not possible for now to easily harvest it or get access to it through Europeana, and there are no filters to create customized datasets for research purposes. This demonstrates how difficult it is to remodel a large amount of data in a short period of time with limited financial and technical resources.

All three databases should be treated with caution as they may contain biases regarding events for various reasons, such as decisions made during data entry, missing or subjectively interpreted information, and the choice of whether to include data in a structured or unstructured format. DoME and basis wien provide trustworthy data for research purposes, which could be used to answer various research questions concerning networks of artists, the art institutional landscape, and changing trends. The platform eSeL contains a great deal of event-related information, but reliable data and a user-friendly interface would be essential preconditions for usability.

The basic metadata on exhibitions is very similar across databases. Whether an exhibition is historical or contemporary does not seem to influence the basic metadata categories of an exhibition record, for example: ID, title, location, date, organizer, and artists/agents' location. However, the descriptive metadata for additional information, such as assigned types and the defined roles of participants, could differ. Therefore, it is useful to use thesauri to define terms instead of describing them individually. Certain additional information (archival materials, objects, and tags) is mainly influenced by the purpose of data archiving and publishing endeavors. In addition to the scope of the databases (temporal and spatial), this supplementary information and the reliability of the data could be used to select datasets for research initiatives. The latter can be examined using data visualization methods, by consulting the databases' documentation, and by contacting the developers.

6. Conclusion

In my master's thesis, I aimed to prove that exhibitions provide a fruitful source for art historical research. Although exhibition history and curatorial studies have been established, there is no widely accepted definition for exhibitions, which could be a precondition for modeling exhibition data. It is challenging to document them in their entirety to reconstruct the experience of visitors. Still, thorough documentation provides useful insights into the canonization processes in art history, the network of artists and curators, the stylistic influences, the art market, and the underrepresented perspectives (regions, genders, styles). Publishing reliable databases on exhibitions enables historians to use quantitative research methods to prove or disprove qualitative research results, investigate the temporal and geographical patterns of the art market and artist networks on a large scale, and to give voice to forgotten artists.

After investigating the available standards and comparing the three databases, my research questions can be answered as follows:

- *Is it possible to develop a single solution to describe and model both early 20th-century exhibitions and contemporary events?*

Although historical and contemporary exhibitions could differ in scope and in the variety of actor roles, they could be modelled by the same ontology, such as the one suggested by Nicola Carboni. The curatorial concepts didn't exist in today's form at the beginning of the 20th century. So the model of Garcia et al. is less compatible with a selection of exhibitions over a longer timespan. Contemporary mega events can be represented by the models of both Carboni and Garcia et al. CIDOC CRM is suitable for modelling the temporal, spatial, mereological, contingent, participatorial, and spatio-temporal aspects of an exhibition and can include archival materials, but it has some shortcomings in regard to missing direct links between artists and exhibitions and modelling of the discursive and contextual characteristics of an exhibition.

- *Is it possible to develop a common solution for diverse domains such as archives, event calendars, and academia?*

Even though the three databases are from diverse domains (research project, archive, and archived calendar), they all have the purpose of documenting and collecting data in relational databases. They describe exhibitions in similar gravity, but as metadata is never neutral, they introduce certain metadata categories

specific to their aims. DoME was established for quantitative research purposes and provides calculated data on the exhibited objects and artists. The platform eSeL includes subjective categories to enable the user to filter upcoming events of interest, while *basis wien* archive documents events and the actors of the contemporary art field, and provides metadata categories on publications. For linking data in various databases, Linked Data provides great opportunities. The example of eSeL shows the demand to share interoperable data on exhibitions, but it is challenging to convert a great amount of data in a relational database into a triple structure while avoiding semantic data loss. Nevertheless, certain tools, such as Karma and WissKI can provide aid for data mapping.

- *Does the source of exhibition data influence the description of it?*

In each database, not only the purpose, but also the source of data influences the metadata categories used for description. DoME aims to preserve the information from the catalogs as detailed as possible. The platform eSeL gains information from press releases and invitations to exhibitions, which provide factual data on events accompanied by short descriptions. In the *basis wien* archive more sources are available on one event, but they only add the basic information to the exhibition profiles and refer to the more detailed sources.

- *Are there shared and widely accepted standards in Austria that all three databases use?*

Austrian associations provide recommendations for museums, archives, and libraries. For the purpose of the investigated databases, the recommendations for museums seem to be the most suitable. The older the database, the less compatible it is with the requirements of the FAIR principles regarding interoperability. The institutions take the first steps by using common thesauri (with or without URIs). The databases share some of the controlled vocabularies of the Getty Research Institute (AAT, TGN). The platform eSeL, and DoME link to Wikidata identifiers, while *basis wien* and DoME use GND. They collect data in relational databases, but for modelling data, they don't share the same structure. For defining metadata categories, *basis wien* relies on Dublin Core, eSeL on Linked Art, and DoME introduces a project-specific guideline based on the information of the catalogs to preserve the consistency of data entries.

From the case studies, we can conclude that the reliability and accessibility of data are essential for data use. DoME provides the easiest access to its data through download options, and eSeL needs to improve the quality and accessibility of its database. It is beneficial to contact the data keepers to gain more insights into the meaning of data categories, to be able to draw the right conclusion when answering specific research questions. Documentation about data entry decisions could support both archivists and researchers in interpreting data and preserving its consistency.

To produce interoperable data, certain standards and principles can provide aid. Often, a combination of more metadata standards, thesauri, and entities from diverse ontologies is required to represent complex concepts, such as exhibitions. Nevertheless, unique identifiers for exhibitions, venues, and several contemporary artists are still missing, which would be essential for linking open data. In the cultural heritage field, there is still a relatively small amount of data published in the LOD data cloud, which does not allow for the use of the full potential of this knowledge network. Linked Open Data initiatives could offer a great opportunity to link different exhibition databases and encourage cooperation between institutions. Although linking and standardization go together with compromises, it is a worthy effort for the sake of knowledge sharing.

Appendix

Excerpts of the interview in German with Andrea Neidhöfer, archivist in the basis wien archive

Place: basis wien, Fünfhausgasse 5, A-1150 Vienna

Datum: 11.11.2024, 15:00-17:45 Uhr

Translations from German to English made with the aid of deepl.com

Ausschnitt 1/Excerpt 1:

00:00:46 Andrea Neidhöfer (original)

Lioba Redekker hat einfach sehr viele Materialien von Künstlerinnen bekommen: Portfolios, Lebensläufe, aber auch Ausstellungseinladungen, Publikationen, Anträge natürlich. Wir nehmen auch an, es gab schon Vorgänger, Robert Fleck zum Beispiel, der schon Materialien angesammelt hat und eine kleine Bibliothek hatte. Sie hatte also schon einen Grundstock, den sie übernommen hat, und das war quasi dann die Entstehung des basis wien-Archivs. Sie hatte dann eben die Idee, das an einer zentralen Stelle zu sammeln und auch öffentlich zugänglich zu machen und hatte dann gleich auch die entsprechende Vision – Das war dann quasi die zweite Hälfte der 90er Jahre, wo das Internet auch von Bibliotheken immer mehr verwendet wurde – eine Onlinedatenbank programmieren zu lassen, also in die Offlinedatenbank einzuarbeiten und dann das Ganze auch über das Internet online zu stellen.

Das ging dann auch relativ rasch. 1999 ging die erste Version der Datenbank online und im Grunde hat sich seitdem strukturell an der Datenbank kaum was geändert. Sie hat sie tatsächlich so für die Bedürfnisse der basis wien programmieren lassen und wir arbeiten immer noch damit.

Translation:

Lioba Redekker simply received a lot of material from female artists: Portfolios, CVs, but also exhibition invitations, publications, and applications, of course. We also

assume that there were predecessors, Robert Fleck, for example, who had already collected materials and had a small library. She already had a basis that she took over, and that was the genesis of the basis wien archive, so to speak. She then had the idea of collecting it in a central location and making it accessible to the public, and then also had the vision - that was basically the second half of the 1990s. The Internet was also being used more and more by libraries - to have an online database programmed right away, i.e. to incorporate it into the offline database and then put the whole thing online via the Internet.

This went relatively quickly. The first version of the database went online in 1999, and basically hardly anything has changed structurally in the database since then. She actually had it programmed for the needs of basis wien and we are still working with it.

Ausschnitt 2/Excerpt 2:

00:02:45 Andrea Neidhöfer (original)

Also der Hintergrund des vektor-Projektes war, dass die Bibliotheken traditionell sehr stark vernetzt waren und mit Standardisierungen gearbeitet haben, mit Ansetzungsregeln etc.

Institutionen wie wir – die sich zwar Archiv nennen, aber im Grunde kein klassisches, traditionelles, aktensammelndes Archiv sind – und die ganz vielen kleineren und unabhängigen Institutionen, die im Bereich bildender Kunst dokumentarisch arbeiten, die ganz unterschiedliche Bestände haben und sehr heterogen sind, hatten keinerlei Regelwerke und zu dem Zeitpunkt noch wenig Austausch. Das war die Idee mit dem vektor, sich da zusammenzusetzen. Ich glaube es war auch mal die Idee eine Datenbank zu entwickeln, da wurde aber schnell realisiert, dass es im Rahmen des Projektes nicht möglich ist.

Man hat sich dann eher verständigt Leitlinien zu entwickeln, also gemeinsame Standards. Zu diesem Zweck hat man sich zum Beispiel mit Dublin Core auseinandergesetzt. Es war dann auch noch die Idee, einen gemeinsamen Thesaurus zu entwickeln, auch so ähnlich wie der AAT oder angelehnt an den AAT. Es konnte aber eigentlich nicht realisiert werden. Also das Ergebnis dieser Bemühungen war das Handbuch.

Translation:

So, the background to the vektor project was that the libraries were traditionally very strongly connected and worked with standardization, with rules etc.

Institutions like us, which call themselves an archive, but are basically not a classical, traditional archive that collects files, and the many smaller, independent institutions that work documentarily in the field of visual arts, which have very different holdings and are very heterogeneous, had no rules and, at that time, still little exchange. That was the idea with the vektor, to get together. I think there was also the idea of developing a database, but it was quickly realized that it wasn't possible within the scope of the project.

It was then agreed to develop guidelines, i.e. common standards. Dublin Core, for example, was discussed. There was also the idea of developing a common thesaurus. Also similar to the AAT or based on the AAT. However, it could not actually be realized. So, the result of those efforts was the handbook.

Ausschnitt 3/Excerpt 3:

00:04:47 Andrea Neidhöfer (original)

Unsere Datenbank ist eine Microsoft-Access-Datenbank, also eine relationale Datenbank, die mit Tabellenstruktur arbeitet. Und auch wenn das jetzt nicht unbedingt der neueste technische Stand ist, funktioniert es einfach sehr gut, weil einerseits alles in einer Ebene beschrieben wird und andererseits auch miteinander verlinkt werden kann. Wir können Publikationen, Archivalien, Ereignisse, Personen und Institutionen, miteinander verbinden. Da gibt es eigentlich keine Hierarchien und es funktioniert in die unterschiedlichsten Richtungen. Das heißt, wir können extrem viel damit abdecken, was wir gut dokumentieren können.

Was für mein Verständnis für Datenbanken sehr wichtig ist: Es gibt sehr klare Feldbezeichnungen, also es ist immer klar, was macht dieses Feld und was für einen Inhalt das hat. Ist das ein Zahlenfeld? Ist das ein Freitextfeld? Ist das ein Dropdown? Das ist ziemlich ausgeklügelt.

Aus dem vektor herausgehend hat sich eben ein Netzwerk, das European-art.net, entwickelt.

Translation:

Our database is a Microsoft Access database, i.e. a relational database that works with a table structure. And even if this is not necessarily the latest technology, it works very well because everything is described on one level and can also be linked. We can link publications, archives, events, people, and institutions with each other. There are actually no hierarchies, and it works in many different directions. This means that we can cover an extremely wide range of things that we can document well.

What is very important for my understanding of databases is that there are very clear field designations, so it is always clear what this field does and what its content is. Is it a number field? Is it a free text field? Is it a dropdown? It's pretty sophisticated. A network, European-art.net, has developed from the vektor.

Ausschnitt 4/Excerpt 4:**00:06:49 Andrea Neidhöfer (original)**

Und wie gesagt diese Felder kann man miteinander in Verbindung setzen. Und diese Verbindungen kann man dann noch genauer definieren, zum Beispiel durch Rollen. Also die Person ist beteiligt in der Ausstellung oder die Person hat die Ausstellung kuratiert, die Person hat die Rede gehalten und das funktioniert eigentlich nach wie vor sehr, sehr gut.

Translation:

And as I said, these fields can be linked to each other. And these connections can then be defined even more precisely, for example, through roles. So, the person is involved in the exhibition, or the person curated the exhibition, the person gave the speech, and that actually still works very, very well.

Ausschnitt 5/Excerpt 5:

00:11:47 Andrea Neidhöfer (original)

Die Idee war, wir gehen eigentlich immer vom Objekt aus, ein gutes Beispiel ist eine Einladungskarte, die bekommen wir zugeschickt und auf der Einladungskarte sind eigentlich – und das hat die Lioba auch erkannt – ganz viele nützliche Informationen. Der Titel der Ausstellung, der Ausstellungsort, die Laufzeit, die beteiligten Personen und teilweise noch Zusatzinformationen was sie machen, also Kuratorium, Kurator oder Person, die die Rede hält.

Und ausgehend von dem Objekt wird dann quasi ein Ausstellungsdatensatz angelegt. Es werden die Personen verknüpft, die zum Beispiel schon in der Datenbank sind. Sind sie noch nicht in der Datenbank, werden sie neu angelegt, genauso verfahren wir mit der Institution.

Translation:

The idea was that we actually always start with the object. A good example is an invitation card that we get sent to us, and on the invitation card, there is, and Lioba also recognized this, lots of useful information. The title of the exhibition, its location, its duration, the people who are involved, and sometimes additional information about what they are doing, i.e., the board of trustees, curator, or person giving the speech.

And based on the object, an exhibition data record is then created, so to speak. The people who are already in the database, for example, are linked. If they are not yet in the database, they are newly created, as is the institution.

Ausschnitt 6/Excerpt 6:

00:24:11 Andrea Neidhöfer (original)

Wir berücksichtigen Fremdressourcen, Vokabulare, Thesauri, also Standards, zum Beispiel GND (Gemeinsame Normdatei) mit. Für Personen und Körperschaften war das Vokabular früher noch getrennt, denn die Verschlagwortung richtet sich nach dem AAT (Art and Architecture Thesaurus) vom Getty Institut auch unsere Ortsbezeichnungen richten sich nach dem TGN, nach dem Getty Thesaurus of Geographic Names. Die Struktur der Datenbank berücksichtigt Dublin Core.

Translation:

We consider external resources, vocabularies, thesauri, i.e., standards, for example, GND (Gemeinsame Normdatei). The vocabularies for persons and corporate bodies used to be separate, but the indexing is based on the AAT (Art and Architecture Thesaurus) from the Getty Institute, and our place names are also based on the TGN, the Getty Thesaurus of Geographic Names. The structure of the database takes Dublin Core into account.

Ausschnitt 7/ Excerpt 7:**00:26:28 Andrea Neidhöfer (original)**

Wir erfassen alle Ausstellungen im Bereich bildender zeitgenössischer Kunst. Wir suchen so gut wie möglich alle Personen, die da beteiligt sind. Das sind natürlich oft Personen, die noch nicht so etabliert oder bekannt sind, dass sie schon eine Nummer im Thesaurus haben. Das wird nie zu hundert Prozent alles abdecken aber in ULAN waren lange Zeit einfach nur die herausragenden, bekannten Namen für Österreich enthalten.

Translation:

We record all exhibitions in the field of contemporary visual art. We try to find as many people as possible who are involved. Of course, these are often people who are not yet so established or well-known that they already have a number in the thesaurus. It will never cover everything one hundred percent. ULAN, for a long time, had simply contained the outstanding, well-known names for Austria.

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