Culturally relevant relationships: publishing and connecting digital objects in collections of archives, libraries, and museums over the Web

Abstract
Cultural heritage institutions such as archives, libraries, and museums have the mission of curating and safeguarding societal memories. The patrimonialization and curatorial processes developed by such institutions are continuous value-adding activities. Such institutions are beginning to publish their collections as digital objects on the Web. The representation and publication of cultural heritage records as digital objects using LOD—linked open data—technologies is a new step in patrimonialization and curatorial practices. Many collections are thematically superimposed, complementary, and have synergy. These collections often present culturally relevant relationships between their objects, like a book about a painting or a draft or sketch of a famous painting, etc. This research aims at characterizing such culturally relevant relationships, compiling an inventory, and organizing them in a vocabulary. The implementation of semantic links using LOD technologies can achieve interoperability between digital collections and improve the usability of digital collections, thus empowering heritage institutions.

1. Introduction
This paper reports new results of ongoing research that was first communicated at the 14th International ISKO Conference in 2016. Cultural heritage institutions such as archives, libraries, and museums have the mission of curating and safeguarding societal memories, a continuous value-adding process resulting in cultural heritage objects that comprise different collections. Such institutions are now publishing their collections as digital objects over the Web. Archival, library, and museum collections are still dependent on catalog systems and technologies that do not allow full integration of their data with other resources available through the Web.

The representation and publication of cultural heritage records as digital objects using the facilities offered by LOD technologies is a whole new step in patrimonialization and curatorial practice. LOD technologies enable direct publication of digital collections and their integration into the mainstream Web. Many such collections are thematically superimposed and complementary, with the potential for as yet unexplored synergies to be developed. LOD technological resources enable such complementarity to be empowered for the benefit of heritage institutions, culture, and education.

Digital collections often present culturally relevant relationships between their objects, such as a book about a painting, a draft or sketch of a famous painting, a letter from an author commenting on a book or an artwork, or a contract to commission a sculpture or artwork, etc. This kind of synergy invites us to question what culturally
relevant relationships may exist between the digital objects of collections in archives, libraries, and museums, and how they can be discovered and identified. This, in turn, leads us to enquire how LOD technologies can be used to implement such relationships as semantic links, and how they could be useful for art, history, or culture curators to annotate digital heritage objects.

This paper seeks to discuss the questions raised above and characterize these culturally complementary relationships. The research thus involves compiling an inventory of such interrelations, organizing them in a vocabulary, and discussing how semantic links expressing them should be derived from the databases of catalog systems. The implementation of semantic links using LOD technologies can achieve interoperability between digital collections. This study also aims to improve the usability of digital collections in archives, libraries, and museums, thus empowering heritage institutions. The paper is organized as follows: after the introduction, section 2 describes the materials and methods used; section 3 describes the assumptions made concerning precise characterization of what objects we are linking and what their digital representations are; section 4 develops a framework for analysis of the relationships gathered; section 5 presents the relationships found; and section 6 provides final remarks and conclusions.

2. Material and methods

Bibliographic and document sources about the patrimonialization and curatorial processes developed by heritage institutions such as archives, libraries, and museums, were sought to supply definitions of archives, collections, items, records, and cultural heritage objects. Use cases or examples of relationships between objects suggested by curators of archives, libraries, and museums, or mentioned in literature, were collected and used as examples of possible relationships. Conceptual models such as the FRBR, the CIDOC CRM, the EDM, the RiC-CM were also examined as sources of possible relationships between objects.

A framework to analyze and organize the collected relationships was also developed, based on the top-level relationship schema between entities of Groups 1, 2, and 3 of the FRBR model. This choice is because the FRBR model is primarily object-oriented (it is concerned with relationships between objects in library collections), while the CIDOC CRM and EDM are mainly process-oriented. A deductive process based on this framework combined with an inductive process based on the cases collected were used to find the results.
3. Assumptions

It is important to define the precise nature of the objects in collections of archives, libraries and museum that we intend to link. According to Van Mensh (1992, 67), “The museum object is considered to be the basic unit of the museum working procedures”. We assume that archives and libraries wish to integrate their collections with heritage objects.

Web access to collections of heritage objects presupposes their representation in digital formats. The digital objects that are published and interlinked through the web using LOD technologies are indeed artefacts, even if the original object they are based on is a natural object (Marcondes et al. 2016). In this sense, they are social creations (Searle 1995), knowledge tools created based on archives, libraries, and museum methodologies and standards. They are complex digital objects, here called HOs – digital heritage objects – identified by a unique persistent identifier, along with metadata that provides context, access points, and enables their management in the digital environment. These metadata sets are associated with digital images or copies of the physical object. Such objects are of a priori cultural relevance, as they are the result of curation processes developed by heritage institutions.

4. A framework to analyze relationships between cultural heritage objects

A framework to analyze the suggested relationships was developed. It consists of a table cross-relating entities according to the type of heritage institution: archives, libraries and museum heritage objects. To these HOs “monuments” were also added, as there are several suggested use cases that include relationships between archives, libraries, and museum objects with monuments. Such entities are related to other entities, namely Agents (FRBR Group 2 Entities), Concepts, Processes, Time and Place (FRBR Group 3 Entities). The table is shown below. Due to space limitations, the relationships between HOs and Agents, Concepts, Processes, Time and Place, and a classification schema are not included in this paper.

Table 1: Relationships between heritage objects

<table>
<thead>
<tr>
<th></th>
<th>aHO</th>
<th>lHO</th>
<th>mHO</th>
<th>monHO</th>
<th>Agents</th>
<th>Concepts</th>
<th>Events</th>
<th>Time</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>aHO</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>lHO</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td>mHO</td>
<td>31</td>
<td>32</td>
<td>33</td>
<td>34</td>
<td>35</td>
<td>36</td>
<td>37</td>
<td>38</td>
<td>39</td>
</tr>
<tr>
<td>monHO</td>
<td>41</td>
<td>42</td>
<td>43</td>
<td>44</td>
<td>45</td>
<td>46</td>
<td>47</td>
<td>48</td>
<td>49</td>
</tr>
<tr>
<td>Agents</td>
<td>51</td>
<td>52</td>
<td>53</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concepts</td>
<td>61</td>
<td>62</td>
<td>63</td>
<td>64</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Events</td>
<td>71</td>
<td>72</td>
<td>73</td>
<td>74</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>81</td>
<td>82</td>
<td>83</td>
<td>84</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place</td>
<td>91</td>
<td>92</td>
<td>93</td>
<td>94</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Each table cell may contain a direct relationship from the entity represented by the specific line to the entity represented by the specific column, i.e., a semantic link. The entity in the cell line is the *domain*, and the entity in the column is the *range* of the relationship. For example, cell 22 represents the FRBR Group 1 work-work, work-expression, work-manifestation, and work-item relationships. Since we asked for heritage institution curators to suggest cases of relationships between objects in collections of different heritage institutions, the framework developed reflects relationships where domain and range are objects in archives, libraries, and museum collections. Archives, libraries, and museum objects may be further characterized into different types of objects as is usual in archive, library, and museum collection management. All relationships are also types of *associative relationship*, largely used in thesaurus theory and construction.

“Dependence” is a fundamental criterion to analyze and classify relationships. Are there several types of dependence? Following Guarino and Welty (2000, 2009) on “existential dependence” and IFLA (1998, 66) on “referential” and “autonomous” relationships, we question if any of the relata in the relationships found are existentially dependent on each other, or whether any of them are dependent on one another in any other sense. Searle (1995, 8) discusses “subjective judgments,” “observer-relative features” of reality, and features that are “ontologically subjective”. This then leads us to ask whether both relata are independent, or whether any relata depend on a subjective judgment from their creator or from a third-party agent, such as a curator or a literary critic. Hessen (2000) notes that knowledge is always knowledge of something; it is a relation between an agent and an object, whereby the agent is *intended for* the object. Within Dahlberg’s (1992, 67) concept theory, among the formal relationships, there are intersections of relationships such as those linking objects that share at least one property.

To analyze and evaluate possible relationships provided by use cases or collected in literature, each relationship is assigned a label and described, while examples are given and the following questions are asked: Do any of the relata existentially depend on each other? Is there an inverse relationship? Are there other types of relationships between the two types of objects? Are there similar relationships in other conceptual models, vocabularies, or ontologies?

**5. Main results**

For the purposes of this work, culturally relevant relationships are seen as those conceptual relationships that contextualize and enhance the cultural comprehension of a heritage object. They may be direct relationships, such as between a book and a painting inspired by it (e.g., the work *Don Quijote de La Mancha* and the aquatint by
Picasso portraying Don Quijote and Sancho Panza\(^1\), or indirect ones, such as between a book or a painting and its author or subject (the FRBR Group 1 relationships to Group 2 and 3 entities).

Such relationships may be directly derived from records in catalogs, for instance between two works with common properties, such as the title in the previous example of Don Quijote, or between a work and its author. Yet they can also be *authorial*: different cultural experts and curators, such as art and literary critics, historians, educators, journalists, scholars, etc., discover, illuminate, evaluate, relate to, interpret, and show different points of view about historical facts or processes, historical characters, and artefacts, etc. While doing their job, these experts may find or propose authorial relationships between such entities not previously perceived by anyone else.

5.1. Criteria for analyzing relationships

From the theoretical bases used and from this inventory of relationships, an initial set of criteria was developed for organization of the relationships found. Such criteria are something like what Guarino and Welty (2000) call “meta-properties”.

- **Cultural association (CA):** when there is a relationship between two HOs established not by the creator of any of them, but by a third-party agent, for example, by a curator, a literary or art critic. Cultural association means that the two HOs are existentially independent.

- **Cultural dependence (CD):** when two HOs have a relationship established by the creator of one of them; the creator of one HO *intended for* the other HO; the two HOs are both artefacts.

- **Cultural independence (CI):** when two HOs have a relationship established by the creator of one of them, the creator of one HO *intended for* the other HO, but only one of the HOs is an artefact, whereas the other one is originally a natural object.

- **Existential independence (EI):** when the two HOs exist independently of each other.

- **Intersection (IS):** both HOs share at least one common property.

Another criterion that seems to define the way two HOs are related is the type of expression form, or how each object is expressed or manifested. In this sense and according to previous research (Marcondes *et al*. 2016), the following types of expression forms exist:

- (originally) natural objects
- artifacts

\(^1\) See https://www.moma.org/collection/works/68157.
– image
  • iconographic (paintings, drawings, etchings, photographs)
  • moving image
– textual
  – one-copy textual (documents, letters, deeds)
  – various-copy textual (books, manuscripts or print copies)
– sound
– objects (three-dimensional objects).

5.2. Relationships identified
A based_on relationship between different types of HOs presupposes an original, previous work and another work on which it is based. It encompasses all kinds of pragmatic replicas or artistic copies, re-creations, revisits, and re-readings of a work; it is concerned directly with works in the FRBR model sense. A work is based on another if the based-on work carries at least one property of the base work: -a book (IHO) which is based_on another (IHO): cell 22; -an artwork (mHO) which is the base for another mHO): cell 33; -a monument (monHO) which is the base for another (monHO): cell 44.

– Example: many literary works are based_on Shakespeare Hamlet², such as Hamlet for Kids (Shakespeare Can Be Fun!) by Lois Burdett; the design of the Federal Hall in New York City is based_on the design of the Parthenon in Athens³; the different based_on versions of Da Vinci’s Mona Lisa by artists such as Dali, Botero, Andy Warhol, etc.
– Criteria: CD, IS; both HO share the same expression form.
– Do any of the objects depend on the other? Existentially, neither objects depends on the other but (we suggest), from a cultural standpoint, the based_on works would not have existed if the original work did not exist.
– Inverse relationship? Yes, the Base_for relationship.
– Are there any other types of relationships between the two types of objects? The Design_or_Procedure_for relationship.
– Are there similar relationships? crm:P15 was influenced by (influenced) and frbr:is a transformation of, has adaptation, has an imitation relationships.

Design_or_Procedure_for relationships: -between architectural plans (aHO) and a monument (monHO): cell 14; -between an artwork (mHO) and their preparatory sketches (mHO): cell 33.

³ See https://en.wikipedia.org/wiki/Federal_Hall.
Criteria: CD.

Example: the architectural plans of MAC Niterói and the monument itself; the preparatory sketches and *Guernica* by Pablo Picasso; the preparatory sketches and the “War and Peace” panels by Brazilian artist Candido Portinari at the United Nations headquarters in New York.

Inverse relationship? Yes, the *Design_or_Procedure* relationship: cells 11 and 33.

Similar relationships? The *crm: E29 Design or procedure entity*, used with the *crm: P69 has association with* relationship.

Other types of relationships between the two types of objects? No.

*Documents* relationship between a field notebook (aHO) and the objects it documents (mHO): cell 13.

Example: Darwin’s Beagle’s expedition field notebook⁴ and the species collected by him.

Criteria: CI; the range HO has the form expression *textual*.

Inverse relationship? The species in a museum *is_Documented_by* a field notebook: cell 31.

Are there other types of relationships between the two types of objects? No.

*Has_as_Subject* relationships: -between a painting or drawing (domain mHO) whose subject is a book (range lHO): cell 32; -between a book (lHO) whose subject is letters (aHO): cell 21; -between a book (lHO) whose subject is a book (domain (lHO); -between a book (lHO) whose subject is a monument (monHO) cell 24; -between a letter (domain aHO) commenting on or describing a book and the book itself (range lHO): cell 12; -between a letter (domain aHO) commenting or describing an artwork and the artwork itself (range mHO): cell 13.

Criteria: CD; the range HO has the form expression textual.

Example: *La Joconde : essai scientifique / sous la direction de Christian Lahanier*⁵, like many other books, has as its subject, or describes, or analyses, Da Vinci’s *Mona Lisa*; a letter from Brazilian writer Machado de Assis to his colleague Joaquim Nabuco commenting on the idea for a future book, *Memorial de Ayres* (Jackson, 2009, 18); the book *Brunelleschi’s Dome: The Story of the Great Cathedral in Florence* (Ross 2008) has as its subject the construction of Brunelleschi’s Dome of Santa Maria del Fiori church;

Inverse relationship? The *Is_Subject_of* relationship between a painting or drawing (mHO) whose subject is a book (domain lHO): cell 32; or between a monument (monHO) which is the subject of a book (lHO): cell 42.

Similar relationships? The “is the” relationship *frbr:has_as_subject*, or *edm:P120*
Influenced relationship: -between a work which influenced the creation of another work according to someone.
- Example: according to several literary critics, the work *Don Quijote* by Cervantes Saavedra influences many others; any of the two HO is intended for the other.
- Criteria: CA, EI.
- Inverse relationship? The *Influenced_by* relationship.
- Similar relationships? The *dbpedia: influenced* relationship.

Inspired: Relationship -between a book (domain lHO) which inspired a painting or drawing (range mHO): cell 23; -between an artwork (domain mHO) and a book (range lHO): cell 32.
- Example: the previously mentioned book *Don Quijote de La Mancha* by Cervantes Saavedra and an aquatint by Picasso portraying Don Quijote and Sancho Panza; or the romance *Iracema* by the Brazilian writer José de Alencar and a painting with the same title by José Maria Medeiros⁶; or the Da Vinci’s *Mona Lisa* and the novel *Mona Lisa Overdrive* by William Gibson⁷, among many others.
- Criteria: CD; the two HOs have different expression forms.
- Inverse relationship? The *Inspired_by* relationship.
- Other types of relationships between the two types of objects? The *Has_as_Subject* relationship between a book (domain IHO) whose subject is a painting or drawing (mHO) or the *Is_Illustrated_by* relationship between a book (domain IHO) which is illustrated by a painting or drawing (mHO, of type iconography).
- Similar relationships? The relationship *wikim: inspired*.

Is_Illustrated_by relationship: -between a book (domain IHO) that is illustrated by a painting or drawing, (range mHO, of type iconography): cell 23.
- Example: Aristophane’s *Lysistrata* edited by the Limited Editions Club, which is illustrated by six signed etchings by Pablo Picasso; James Joyce’s *Ulysses* 1935 edition illustrated by Henri Matisse’s rare etchings.
- Do any of the objects depend on the other? In this case, it seems to apply the FRBR (IFLA, 1998, 66) *referential* relationship. Matisse’s etchings are components of the Ulysses edition and they would not have existed if the edition did not exist.
- Criteria: CD, domain IHO has the expression form textual, range mHO has the expression form iconographic.
- Inverse relationship? The *Illustrates* relationship.

Other types of relationships? The frbr:Has_as_Subject relationship between a book (domain lHO) whose subject is a painting or drawing (mHO); the Inspired relationship between a book (domain lHO) which inspired a painting or drawing (range mHO).

Similar relationships? crm: P65 shows visual item or crm: P46 is composed of (forms part of).

Portray refers to a relationship between an artwork (domain mHO) of type iconography and a monument it portrays (range monHO): cell 24.

Example: several paintings made by French Impressionist artist Monet portraying the Rouen Cathedral.⁸

Criteria: CD; range mHO has the expression form iconographic.

Inverse relationship? The Is_Portrayed_by relationship: cell 43.

Other types of relationships? No.

Similar relationships? The crm: P62 depicts (is depicted by).

Apart from the relationships between objects belonging to collections of heritage institutions, there are also external relationships, that is, those between HOs and external entities such as Agents, Concepts, Processes, Time and Place. Relationships of this kind, provided in the FRBR model, such as, the relationships between a painting by Claude Monet and the concept Impressionism art movement or between a work and its author, will be analyzed in a future paper.

6. Concluding remarks

The publishing of digital collections over the web opens up new opportunities for heritage institutions. It enhances access, enables reuse, and achieves full integration of collections to the mainstream Web, thus enlarging their reach and synergies. This synergy can be exploited by implementing LOD links to establish culturally relevant relationships between the digital objects in these collections. The interlinking of resources from different institutions provides rich contexts not available through OPAC technologies (Sanderson et al., 2017). The reciprocal implementation of LOD links between heterogeneous and distributed digital collections requires cooperation, coordination and curation activities on a new level. It can also achieve interoperability, improve synergies and usability between collections, thus empowering and reshaping heritage institutions.

---

References


