One-to-one principle of the Dublin Core: application in Catalan university repositories of special and heritage collections

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Abstract

The One-to-One Principle of the Dublin Core Metadata Initiative aims to ensure distinct descriptions for conceptually different entities, such as originals and their digital versions. This study examines the application of the principle in five Catalan university repositories with special collections, analysing a random sample of 100 records across fields such as type, format, date, author, source, relation, and publisher. The results reveal frequent violations of the principle, mainly due to the blending of metadata for originals and digitised versions and inconsistencies in field usage. These findings underscore both the theoretical and practical challenges of applying Dublin Core correctly, and the need for clearer guidance and better metadata practices to support semantic clarity and interoperability.

Keywords

DCMI, Dublin Core Terms, One-to-one principle, Digital repositories, Metadata interoperability

1. Introduction

Although the DCMI was established in 1995 with the aim of describing electronic resources on the web [1], as a response to the rapid growth of the web defined by Tim Berners-Lee in 1993, various interested parties — particularly centres with digitised heritage collections — soon recognised its potential for representing collections on physical media as well. In 1997, the Research Libraries Group (RLG), in its *Guidelines for extending the use of Dublin Core elements...* [2], proposed extending the use of Dublin Core to describe analogue or digital resources not necessarily available online. To achieve this, it was necessary to determine whether the described document was the original and whether it was accessible via the Internet. The RLG's proposal focused on modifying the *date* and *publisher* elements to support the description of both original resources and their digital copies, and on using the *relation* element to connect both resources. This proposal became the foundation for the discussion that led to the formulation of the one-to-one principle at the DC-4 Workshop in Helsinki [3].

None of the various proposals and approaches put forward to address the one-to-one principle subsequently achieved general consensus. The option of duplicating records raised concerns about how to present information to users in a usable form, as well as the potential loss of information when metadata is shared in an interoperability context. The emergence of the RDF model, in which metadata statements and resources are established through the assignment of a URI [4], enabled DCMI to develop a more formal data model [5] and to explore a path towards achieving the objective set by the principle.

Currently, the DCMI Glossary defines the one-to-one principle as follows: "*The One-to-One Principle says that conceptually distinct entities, such as a painting and a digital image of the*

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painting, should be described by conceptually distinct descriptions. The principle was formulated in the early years of Dublin Core™ in order to draw attention to, and challenge, the widespread practice of creating metadata that pragmatically conflated elements descriptive of conceptually distinct resources into a single record.". Furthermore, it advocates the use of RDF as a data model to overcome 'flat' single-resource descriptions: "*Accepting RDF as the basis for metadata interoperability allowed Dublin Core™ descriptions both to respect the One-to-One Principle and to transcend the limitations of 'flat' single-resource descriptions*". [6].

Despite the progress outlined above, the application of the principle continues to face several challenges, including difficulties associated with a deep understanding of the principle, practical issues related to its implementation, and certain technological limitations linked to the software used for the management of digital collections in GLAM (Galleries, Libraries, Archives, and Museums) environments.

The aim of this study is to identify the current status of this principle in Catalonia, highlighting possible violations, approaches, or implemented solutions. To this end, five university repositories with special collections are taken as a reference. As a secondary objective, the study seeks to assess issues arising from the one-to-one principle in the context of interoperability between the university repositories analysed and the Catalònica aggregator.

2. Background

The literature published to date provides a clear account of the complexity associated with the understanding, use, and implementation of the one-to-one principle. Urban [5] highlights the tensions that the principle has generated since the 1990s — a situation that, in fact, already existed in more traditional cataloguing systems, which faced similar challenges (such as reproductions on microfilm or multiple editions of the same work). According to this author, despite the emergence of RDF, many institutions continue to violate the principle due to technical and practical limitations of repository management systems, or because of constraints associated with the OAI protocol. While the use of linked data and URIs could offer a solution, this alone does not appear to resolve the problem but rather shifts it to another technological domain (URIs). Urban refers to this as the "semantic web identity crisis", as a URI may also represent the work itself or a version of it.

The main problem associated with the one-to-one principle concerns the risk of unnecessarily duplicating metadata, as well as the possibility of mixing data from different manifestations. However, Chen *et al.* [7] point out that if a one-to-many approach is adopted, the description of data related to rights, access control for each version, or even information concerning the digital preservation of each version, becomes significantly more complex.

The one-to-one principle has also been identified as a major limitation in contexts of interoperability and data aggregation [8], as well as in the mapping of metadata between systems when linking sources that use metadata element sets which do not comply with this principle. In this regard, the description, format, subject, and type elements — traditionally associated with multiple values — or the mapping of the MARC 260 field solely to the publisher field without a date, tend to be among the most common problems [9].

Some data models and standards, such as LRM and CDWA, address the one-to-one principle by describing resources at several related levels [10–14]. For example, the Library Reference

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Model (LRM), the data model established by IFLA in 2017 [15], addresses the one-to-one principle through hierarchically structured representations at four levels: work, expression, manifestation, and item. This approach resolves problems of information duplication when representing resources in multiple formats or versions (e.g., a printed book and its digital version) and establishes clear and explicit relationships between them. Another example is the Categories for the Description of Works of Art (CDWA), a standard that facilitates the implementation of the one-to-one principle by separating distinct entities into independent but related records (such as authorities, related documentation like images or photographs, or textual descriptions such as studies) [16].

The DCMI has acknowledged the challenges posed by tiered structures and is actively collaborating in the development of the openWEMI initiative, which establishes specific elements to connect resources based on the Library Reference Model (LRM) — Work, Expression, Manifestation, and Item. Nevertheless, its development for practical implementation in repositories remains at an embryonic stage [17].

Meanwhile, Chen [18] highlights the capacity of RDF to preserve the relationships embedded within source records, thereby enhancing semantic interoperability and mitigating the loss of contextual information. Addressing concerns over interoperability and potential data loss when mapping Dublin Core to other standards such as MARC, the OCLC CONTENTdm Metadata Working Group [19] recommends the use of qualified elements (e.g., *created*, *issued*) and the clear differentiation between attributes pertaining to the original and digital versions within metadata records.

Indeed, even aggregators such as Europeana have encountered difficulties in complying with the one-to-one principle [20]. As a result, its Europeana Data Model (EDM) introduced the need to differentiate between cultural objects (*edm:ProvidedCHO* — Provided Cultural Heritage Object) and their corresponding digital representations (*edm:WebResource*), through the use of specific EDM elements such as *edm:hasView*, *edm:isShownBy*, and *edm:isShownAt* [21]. EDM replaced the previous Europeana Semantic Elements (ESE) model, which conflated information about physical objects and their digital representations within a single record. Furthermore, EDM facilitates linking to semantic web ontologies and vocabularies such as CIDOC CRM, SKOS, DBpedia, and GeoNames, thereby improving interoperability and reducing redundancies [9].

According to Miller [22], there are several reasons why the one-to-one principle has not been fully adopted, including a lack of awareness of the principle and, by extension, the scope of some elements; limitations in metadata management systems; the need to simplify the management of digital collections; and the constraints of standards such as Dublin Core when exposing metadata via the OAI-PMH protocol, as discussed earlier. Participants in the interviews conducted by Shreeves et al. [23] expressed frustration with rigid adherence to the principle, feeling that describing only the digital manifestation was not helpful for users interested in the physical characteristics of the original object. This creates a tension between the principle and user needs, a concern also noted by Urban [24].

To ensure the sustainable maintenance of collections, it is essential to simplify the management of records. The proposal by Kurt *et al.* [25] centres on managing complex relationships between digital resources using a system of codes within a Dublin Core application profile. Specifically, it suggests the use of controlled vocabularies as shared identifiers, enabling users to find all versions of the same object, even when represented by

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different records. Instead of establishing manual relationships through the *dc:relation* element — which is difficult to maintain — this field contains an identifier (e.g. *<dc:relation xsi:type='kmoddl:Voigt1-ID'>C06</dc:relation>*) that links both the record describing an image of the object and a video about the same object. When another object references, but does not represent, the same object, the same identifier is used *(<dc:references xsi:type='kmoddl:Voigt1-ID'>C06</dc:references>*). This approach is further supported by the use of the same vocabulary in the *dc:subject* element *(<dc:subject xsi:type='kmoddl:Voigt1'>Slider Crank Mechanism</dc:subject>*). In this way, when a user retrieves a record, the system naturally displays all related objects.

The correct application of the one-to-one principle is hindered by the difficulty in understanding a standard that, although presented as a simple solution applicable to a wide range of contexts, presents significant barriers, particularly among students [26–27], and also among professionals who do not always implement or fully understand it [24, 28]. This is largely due to the lack of familiarity with the abstract models to which metadata must conform, as well as the difficulty in grasping the intricacies of these models [28]. Some of the most problematic elements in this regard include *date* and *coverage*, *source* and *relation*, *format* and *description*, *type*, *description* and *subject*, and *creator*, *publisher* and *contributor* [12]. These issues stem primarily from the ambiguity of their definitions, certain semantic overlaps between elements, and their broad, simple, and interdisciplinary nature [26]. This ambiguity is directly transferred to the one-to-one principle, generating doubts concerning authorship (whether the original creator or the person responsible for digitisation), and edition (whether the original publisher or the publisher of the digital version). Particularly significant are cases involving the *date*, *type*, and *format* elements, where multiple repositories mix values from the original work and the digital resource, complicating subsequent interoperability [14].

Park and Childress [29] offer various perspectives on this matter, some of which advocate for the addition of new elements to the set in order to more clearly differentiate between representations, while avoiding the complexity of other vocabularies such as VRA Core. Similarly, Han *et al.* [14] emphasise that when multiple manifestations must be included in the same record, specific strategies must be employed to prevent interoperability issues. Sustainability appears to be the main drawback of strictly adhering to the one-to-one principle. Consequently, some authors suggest adhering to it only when practical, or opting for one of the following three approaches: a) 'intellectual content and entry page', which entails providing general descriptions focused on the content of the resource rather than its physical medium. This approach is straightforward and easy to maintain, but aggregators will encounter difficulties in accessing the created pages, and filtering by format will be problematic. b) 'The linking approach', which involves using the *relation* element to connect each record with its versions and reproductions. This method is the least ambiguous and therefore most compatible with interoperability processes; however, it is the most complex to maintain. c) Incorporating the characteristics of the physical object into the digital version. Similar to the first approach and easy to maintain, it is more ambiguous, particularly when multiple carriers are described and users need detailed information about them [30].

Differentiating the intellectual content of each manifestation is likely the most accurate approach when striving to adhere to the one-to-one principle, as the intellectual content remains consistent regardless of the form in which it materialises [31]. Including a "note" element could also be useful for providing additional information, especially in contexts where

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entities managing digital collections are not primarily focused on maintaining a catalogue of physical objects, even though these may be of interest to end-users [31]. This may also be related to the fact that many institutions have separate management systems specifically for works or items in their physical collections. Paterson [28] suggests that, to maintain a clear, consistent, and reusable description in interoperability contexts, it is more appropriate to describe the *dc:type* element with the *Collection* value from the DCMIType vocabulary, rather than using *PhysicalObject*. Finally, an incorrect implementation of the one-to-one principle may lead to difficulties in navigating and discovering related resources [32].

Finally, some repository management systems such as Omeka Classic and Omeka S allow Dublin Core metadata to be managed both at the record level and linked to the different digital files (media). This can be a solution to avoid having to duplicate records to comply with the one-to-one principle. In addition, these systems allow configuring their search engines to retrieve information at either level. However, this solution is not without its challenges and drawbacks. Firstly, the relationship between the item and its files is structurally formalised (one contains the other), but not semantically formalised, so it is necessary to use some DC elements in both directions (e.g. *dcterms:hasFormat* / *dcterms:isFormatOf*). In this sense, existing DC elements may be insufficient to represent more complex relationships such as those proposed by FRBR or IFLA LRM. Another drawback of this approach from the software is found when exposing data through OAI-PMH, since Omeka, by default, only exposes the metadata of the items and not those of the files linked to them. Another drawback is that, even if the record is not strictly duplicated, in practice, to follow the DC philosophy — although no element is mandatory — each record should have a complete and autonomous description. Therefore, describing only specific elements such as *dc:format*, *dc:rights*, *dcterms:created*, etc., would not be entirely accurate. It would be necessary to provide data equivalent to that of a complete record, including its own title, author (entity or person responsible for digitisation), date of creation, format, description, rights, etc. In practice, this would require creating multiple descriptions with a significant volume of data. Additionally, certain elements, such as *rights*, which would apply to the digital manifestation, could cause confusion, as they would only be available at the file level and might go unnoticed by users.

3. Methodology

The methodology consisted of the following steps. First, a literature review was conducted to identify the most problematic DC elements, the most common associated issues, and the most frequent solutions. Second, five repositories with special collections from the main Catalan public universities in the Catalònica aggregator, managed by the Biblioteca de Catalunya, were selected. The chosen professional environment allowed for the use of a case study familiar to the authors, in which the distinction between digital and analogue copies is clearly defined, and involved professional teams from the library sector. The selected repositories were:

- Universitat de Barcelona. Biblioteca Patrimonial Digital (CONTENTdm 7.0.77.0)
- Universitat de Lleida. Repositori Fons Especials (DSpace 5.10)
- Universitat Politècnica de Catalunya. UPCommons - Fons patrimonials (DSpace 6.4)
- DDD de la Universitat Autònoma de Barcelona. Fons patrimonial (Invenio 1.1.6)
- DUGiFonsespecials (DSpace 5.6)

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A random sample of 20 records was selected from each repository, analysed in the original repository, and compared with the version collected by Catalònica. The fields analysed were *dc:type*, *dc:format*, *dc:date*, *dc:author*, *dc:source*, *dc:relation*, and *dc:publisher*.

4. Results and discussion

Below is an analysis of the results by repository.

In the case of BiPaDi from the University of Barcelona, several violations of the one-to-one principle were observed. While the *dc:format* element is used to transcribe the physical description of the analogue resource, the same record uses the *dcterms:medium* element to indicate the format of the digitised version (image/jpeg). Regarding dates, the same record records both the creation date of the analogue original, inconsistently using the *dcterms:created* element (55% of cases) and *dcterms:issued* (45% of cases), as well as the date of the digitised resource using *dcterms:available*. The imprint of the analogue resource (place of publication and publisher) is recorded, in the case of published materials (10%), using the *dcterms:isFormatOf* element. The publisher of the content (*dc:publisher*) is the Universitat de Barcelona in all local records. Finally, the *dc:relation* element is used to link the DC record of the repository to the MARC record of the institution's catalogue. Catalònica does not typically use DCTerms, causing the BiPaDi records to lose expressiveness. This results in the use of *dc:date* for both the date of the analogue resources and their digitised version, *dc:format* for the physical description of the original and the MIME type of the digital file, and the mapping of the imprint from the *dcterms:isFormatOf* element to *dc:relation*.

In the case of the Dipòsit Digital de Documents de la Universitat Autònoma de Barcelona, certain violations of the one-to-one principle are also observed. Specifically, the same record contains values associated with both the analogue original and its digitisation. This occurs in the *dc:date* element, which records the creation dates of the originals, while the *dc:format* field records the MIME type of the digital format (application/pdf). In this case, the selected resources are press clippings, and the source — i.e., the medium in which they were published — is inconsistently recorded using the *dc:description* element in most cases (90%) and, to a lesser extent, the *dc:relation* element (10%). In contrast to the previous case, the mapping between DDD and Catalònica is exact.

The DUGiFonsEspecials records correspond to the Ferrater Mora collection at the Universitat de Girona and consist of a set of letters containing correspondence between Josep Ferrater Mora and José R. Echeverría. The original records in the local repository are based on DCTERMS and are accompanied by an application profile that modifies various fields, such as the use of the *dc:description.nomscitats* elements to collect the names of other authors cited in the letters, or *dc:relation.references* to connect the record with works cited, although not through URIs in either case. Data entry is very uniform across the records analysed. However, the one-to-one principle is violated because, as in the case of DDD, while the creation date in *dcterms:created* corresponds to that of the analogue original, the format refers to the MIME type of the digitised file via the *dc.format.mimetype* element. In the same context, the *dc:publisher* element records not an entity related to the letter, but the person responsible for the digitised resource (Universitat de Girona. Càtedra Ferrater Mora). By not using DCTERMS, the records collected in Catalònica map the elements *dcterms:created* to *dc:date*, *dc:description.nomscitats* to *dc:description*, *dc:relation.references* to *dc:relation*, and *dc.format.mimetype* and *dc.format.extent*

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to *dc:format*. Finally, the source repository mixes English and Catalan in the values, which causes some fields, such as *dc:type*, to be transferred in English, generating a language inconsistency in Catalònica. The language policy of either the source repository or Catalònica should be reviewed.

In the case of the Fons Especials repository of the University of Lleida, a practice more aligned with the one-to-one principle is observed with regard to the description of the resource, focusing on the analogue document. Thus, the *dc:format.extent* element reports the length of the document and does not include information on the digital format, with the exception of one record that, conversely, only indicates the format of the digital image (image/jpeg) and not that of the analogue photograph. In this same record, two dates are included: the creation date of the analogue image with *dc.date.issued* and that of the digitised version with *dc.date.created*. As in previous cases, the one-to-one principle is violated in this repository when the name of the university is indicated by the *dc:publisher* element. Again, in Catalònica, these qualified elements are unified by a *dc:date*, making them more difficult to distinguish. As a point of interest, the records in this repository are duplicated in Catalònica, as, although they share URIs, they are available in what appear to be two different DSpace instances.[1]

Finally, in the case of UPCommons - Fons Patrimonials of the Universitat Politècnica de Catalunya, the *dc:format* elements refers in all cases to the format of the digitisation through its corresponding MIME type. However, it is a violation of the one-to-one principle to include the date of the original document in the *dc.date.issued* element. Another issue arises with the authorship of the document, as both the authorship related to the creator of the original document is included in the *dc.contributor.author* element and the authorship of the entity (faculty or service of the UPC) responsible for its digitisation, which is included in the *dc.contributor.other* element. These last two elements are mapped to *dc:creator* and *dc:contributor*, respectively, in Catalònica, while the date loses its qualifier and is stored in a *dc:date* element.

5. Conclusion

The limitations of Dublin Core for the correct application of the one-to-one principle are both theoretical and practical. The Dublin Core data model, lacking clear hierarchical relationships between potential linked entities, inevitably leads to the duplication of information when resources are represented in different versions or formats, causing confusion for the end user. Furthermore, there is very little information on the principle available on the DCMI website itself (only two 145-word paragraphs), which undoubtedly complicates the cataloguing process. This makes it difficult for cataloguers to correctly apply critical fields for the one-to-one principle, such as type, format, date, publisher, creator, relation, and their qualifiers. Therefore, more comprehensive and detailed documentation is needed to guide users in the proper use of existing elements to accurately and clearly represent and relate different entities (originals and digitisations).

Some authors propose the addition of new elements to facilitate the distinction between manifestations, although this may contradict the simplicity philosophy of Dublin Core. Others

[1] https://repositori.udl.cat/items/54542f2b-e443-4e75-9afb-7dc16fb1b428 and https://fonsespecials.udl.cat/handle/10459.2/19

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argue that the correct application of the one-to-one principle with the current Dublin Core data model is theoretically possible, thanks to the adoption of the RDF model. However, the lack of a semantic hierarchy between entities, combined with the simplicity of the standard, generates ambiguities in the representation of different versions of the same resource. This leads to descriptions with duplicate information that hinder interoperability and confuse users.

The experience of other models, such as IFLA LRM and CDWA, demonstrates that a hierarchical data model better represents the relationships between work, expression, manifestation, and item, facilitating the adherence to the one-to-one principle without duplicating information. In this regard, we must await the integration of openWEMI into DCMI metadata terms to assess how it can be applied in specific repositories and their national and international aggregations.

Finally, aggregators such as Catalònica must ensure that the semantic nuances and relationships of the original records are preserved. This requires full support for qualified elements rather than "flattening" records, as well as the adoption of an RDF-based aggregation model. Additionally, more technical documentation is needed, including shared application profiles and the development of specific guidelines for the most popular repository management systems (e.g., DSpace, CONTENTdm, Omeka).

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