Creating Digital Cultural Heritage with Open Data: From *FAIR* to *FAIR^5* Principles

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Abstract. The Art. 2 of the *EU Council Conclusions of 21 May 2014 on cultural heritage as a strategic resource for a sustainable Europe* (2014/C 183/08) states the existence of the new Digital Cultural Heritage (born digital and digitized). Starting from this assumption, we must rethink digitization, digitalization and digital transformation as recording and representing the processes of contemporary life cycles, no longer as simple tools to improve access to reality. So, we must define clear and homogeneous criteria to validate and certify what among contemporary digital magma we can identify as Digital Cultural Heritage (DCH). This paper outlines a proposal in such way starting from the extension of the *R: Reusable* requirement of *FAIR Principles* to R^5 adding the requirements: *Readable, Relevant, Reliable and Resilient*. These requirements should lead the design and creation of descriptive metadata in open format for indexing and managing digital cultural resources. The *Terra delle Gravine between sharing economy and experiential tourism* project was a case study for testing this proposal. Three digital libraries of the municipal libraries of Massafra, Mottola and Grottaglie were designed and implemented by creating an open data schema for indexing and describing the digital resources.

Keywords: Digital Cultural Heritage · Born digital · Digitization · R^5 · Reusable · Readable · Relevant · Reliable · Resilient · Metadati descrittivi

1 Introduction

The art. 2 of EU *Council Conclusions of 21 may 2014 on Cultural Heritage as a Strategic Resource for a Sustainable Europe (2014/C 183/08)* states:

> "*cultural heritage consists of the resources inherited from the past in all forms and aspects - tangible, intangible and digital (born digital and digitized), including monuments, sites, landscapes, skills, practices, knowledge and expressions of human creativity, as well as collections conserved and managed by public and private bodies such as museums, libraries and archive*".[1]

Starting by this assumption, we must necessarily change our approach to digital and digitalization starting to consider them representations that identify the digital transformation that characterizes the contemporary age. So, we need to identify and classify

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[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52014XG0614%2808%29.

among the massive digital resources we produce, either they are single computational artefact or complex digital libraries or 3D systems, those that we can recognize as the new Digital Cultural Heritage (DCH).

However, the current approach to digital creation does not concern the evolution of digitization, which today has become a complex process driven by defined and shared rules. The quality of the digital data is also completely undervalued in relegating their function to mere mediation tools for fostering the fruition of analogical artefact by their virtual representation. This instrumental use still negatively direct the creation of digital data and, above all, the structuring of metadata schemes for indexing digital artefacts and of their composition and descriptions of elements, that are formulated as merely codes for searching and retrieving data on the web. On the contrary, we should identify the digital data as records by recognizing the transformation of their function linked to their reuse over time, giving them some essential requirements for their sustainability.

Therefore, the metadata and descriptions associated with them needs to be focused with special care, since they are the only source that can record and represent in an intelligible way the digitization, digitalization and digital transformation processes that characterize the data life cycle, and to preserve the information necessary to know them and qualify them as digital resources with cultural functions for future generations.

The essential function of metadata for the management and use of digital data is the focus of the *FAIR Guiding Principles for Scientific Data Management and Steward-ship*[2], the guidelines for the management of scientific data published in 2016. This is one of the major topics interest in the wider debate on the possibility to apply *data science* methodologies to the creation and management of *data humanities*[3].

A workshop on the effectiveness of the *FAIR Principles* with regard both to the scenarios that digitization today poses, and that are already imminent was held at the CIDOC Conference 2018[4]. This paper summarizes some reflections matured by that fruitful comparison, related to the need to provide for an extension of the requirement *R*: *Reusable* of the *FAIR* to the requirements *R*[5]: *Reusable, Readable, Relevant, Reliable and Resilient*. This extension aims to facilitate the applicability of the *Principles* to data humanities and, consequently, to foster the identification and certification as Digital Cultural Heritage of the data meeting these requirements in the formless digital magma in which today we float.

2   From *FAIR* to *FAIR*[5]

The starting assumption of this reflection is that digital data are *records*, that is: *Digital data are dynamic and diachronic resources that record and preserve in their composition and descriptions the processes of their creation and the information about their life cycle.*

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[2] https://www.go-fair.org/fair-principles/.

[3] https://www.rd-alliance.org/open-consultation-fair-data-humanities-until-15th-july-2019; https://www.go-fair.org/implementation-networks/overview/co-operas/; https://operas.hypotheses.org/.

[4] http://www.cidoc2018.com/sites/default/files/CIDOC2018-BookOfAbstracts-Final-v-1-2.pdf.

Therefore, descriptive metadata become fundamental and inseparable for full identification and intelligibility of digital artefacts, since the accuracy and quality of their descriptions qualify them as *records* and make them digital resources designed and created for diachronic use and reuse by both contemporary and future users, and all of them should understand what the data represents.

We think that an approach to *data humanities* adopting the *FAIR Principles* in their state of the art has some issue. First of all, we are not entirely convinced that *Findability*, *Accessibility* (this one absolutely cannot be identified with *Open*) and *Interoperability* are suitable requirements to qualify metadata and data as *records* and digital resources.

A findable, accessible and interoperable data does not provide any guarantee of quality, completeness and reliability of the information that it contains. Moreover, the *findability* and, consequently, the *accessibility* and *interoperability* that originate by the one, mean when a data interests the users. The interest in a data is today strictly linked not to its function as access key to a simple or complex digital artefact, but to its role of cognitive and informational resource due to the correct quantity and quality of descriptive contents of metadata that it provides to users.

We think that the *FAIR* requirement that give meaning to first three, and by which those depend, is *Reusability*. The non-stop use and reuse of data are the requirements that guarantee their sustainability over time and, therefore, their survival, as *Reusability* is characterized by dynamism and diachrony which imply transformations of the functions of digital artefacts: to get an idea using an analogical paradigm, we have to think to Coliseum and to its life cycle.

The descriptive metadata become essential to guarantee quality and persistence of digital resources, when their contents are based on balanced quantitative/qualitative relation and respond to further requirements which, in our opinion, are just as essential as *Reusability*. In fact, this one does not constitute in itself a guarantee of the quality of data and of their value as information and cognitive resource. Indeed, the variability of data due to their reuse could become a cause for distortion and discrepancy of the contents, whose informative and cognitive value can therefore no longer be certified as *reliable*.

So, we propose to extend the *R* of *Reusable* into R^5 by adding the following requirements:

– *Readability*: this has not the semantic meaning of *legibility*, but the conceptual one of *intelligibility* of digital data for all the possible user targets who are interested in using them; this requirement is based on the well-balanced quantitative/qualitative relation among the descriptive metadata elements and formal, stylistic and linguistic accuracy of their content, and it is essential for giving metadata the informative and cognitive functions needed to qualify them as *records* and *cultural resource*;

– *Relevance*: this requirement is linked to users interest for the informational and cognitive contents recorded in the metadata; it is closely linked to reuse and to the functional transformations of data recorded in the descriptions over time; therefore, this requirement is indispensable so that we can recognize and identify the form and descriptive structure of data usually created with no cultural purposes even when their functions vary over time, evolving them into a source of knowledge about the processes recorded in descriptions and, therefore, in Digital Cultural resources;
– *Reliablility*: this requirement is related to the quality certification and validation of digital resources detected by their recorded descriptions throughout their life cycle, as related to all the functional transformations they can have; therefore, it is closely connected to recording and preserving in metadata descriptions the contents which can guarantee their informative and cognitive quality, also in the variation and evolution of their functions and forms over time;
– *Resilience*: this is a fundamental requisite for giving digital resources the new cultural dimension; stating the definition commonly used in information technology[5], it is "*the ability of a digital resource to adapt to use and reuse, to resist wear, to be flexible in case of transformation or evolution of its functions, in order to guarantee its cognitive and informative potential over time*"; therefore, it is indispensable to guarantee the sustainability and reuse of digital resources in the long term, providing to preserve both the information useful to know the processes of their creation, and those on their original function, and, finally, the recordings of functional transformation and evolution that characterized their life cycle.

The *Terra delle Gravine* project for creation of digital libraries in open data, below illustrated, has been the case study to test application of R^5 requirements in drafting descriptive metadata.

3   The *Terra delle Gravine* Project

Terra delle Gravine tra sharing economy e turismo esperienziale[6] is a project for creation of digital libraries of different kind of cultural heritage carried out in 2018 by a consortium of twelve municipalities in land of Taranto, Puglia, thanks to a grant from the Regione Puglia.

As project activities, D.A.BI.MUS. Ltd. and the Department of Humanities – DISUM of University of Bari Aldo Moro carried out the design and implementation of three digital libraries in open data for enhancement of book collection preserved in the libraries of the Municipalities of Massafra, Mottola and Grottaglie.

The metadata schema and datasets were designed referring to national standard of ICCU and ICCD and according to the schema defined for the national project *dati.gov*.

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it[7] and by the Regione Puglia for its *Puglia Digital Library*[8]. The project engaged the students of some high schools of the three Municipalities in creation of contents related to the original resources treated to fill descriptive metadata elements.

Previously, students were trained on:

– methods and techniques for cataloguing and for digital description of books;
– open data ontologies and metadata standards used by ICCD[9] and ICCU[10] for their digitization projects;
– methods and techniques for structuring metadata schema using open data.

Then, the students were engaged in the creation of metadata schema for description of both original books and of the digital objects produced by their scanning.

The activities included the following phases:

1. transferring to students know-how for creation of metadata schema in open data;
2. supporting the students for design and creation of their metadata schema in open data following rules and standards used at national and regional level;
3. creating cataloguing contents and inserting descriptions within metadata elements;
4. editing digital libraries on CKAN platform.

The monitoring of project progress and interaction with student teams was achieved by activating specific groups through *Telegram* messaging app, that is fast, secure, simple and free.

The digital libraries with their open data and descriptions are currently published on the regional platform *Terra delle Gravine*[11] and on the national platform *dati.gov*[12].

4   Designing Digital Libraries in Open Data for Creation of DCH

The open data schema used for indexing the digital resources was developed integrating and rationalizing elements extracted by ICCU and ICCD metadata standards. The descriptive contents were elaborated according to R^5 requirements with the aim to create digital resources that can be identified as DCH.

To this goal, we preferred to distinguish the descriptive metadata relating to the digital objects from cataloguing descriptions of the books reproduced in the images carried out by the scanning.

We used elements of Dublin Core[13] standard for descriptive section both of the books reproduced and of the digital objects, integrated with elements taken from other

[7] https://www.dati.gov.it/.

[8] http://www.dataset.puglia.it/.

[9] http://dati.beniculturali.it/altre-ontologie-utilizzate/.

[10] http://dati.culturaitalia.it/.

[11] http://www.terradellegravine.eu:3389/dataset.

[12] https://www.dati.gov.it/dataset/digital-library-biblioteca-comunale-comune-massafra; https://www.dati.gov.it/dataset/digital-library-biblioteca-comune-mottola; https://www.dati.gov.it/dataset/digital-library-biblioteca-comunale-comune-grottaglie.

[13] https://www.dublincore.org/resources/glossary/application_profile/.

standards, in particular as reported in the rules defined by the ICCU for *Cultura Italia* project. Some other elements were taken from the ontologies of the ICCD Linked Open Data project, in order to create a schema that represents both the full process of creation and the life cycle of each digital resource integrating the R^5 requirements necessary to validate them as digital cultural entities.

The sequence of elements was organized focusing on the goal to provide information as intelligible as possible to both user operators in charge of entering descriptions in each element, and to any future users who, accessing to the metadata, will look for information on the creation process and on the life cycle of the digital resource they managed.

As an example of the solution used for the three digital libraries, the DL layout of the Municipality of Massafra is reported as Table 1.

The correct format in XLS or CSV can be viewed online at the *URL* indicated in the above note to the text.

The project is currently undergoing and open data sustainability is constantly monitoring to define, by this way, if digital resources can effectively maintain the requirements that allow their identification as Digital Cultural Heritage in their diachronic evolution.

Table 1. Digital Library Biblioteca Comunale di Massafra – Open Data schema

Titolo della risorsa digitale	Identificativo risorsa digitale	Genere risorsa digitale	Livello di descrizione	Soggetto responsabile della digitalizzazione	Stato della digitalizzazione	Progetto di digitalizzazione	Descrizione risorsa digitale	Genere_1	Argomento_1	Argomento_2	Argomento_3
P. Catucci, Massafra sue epigrafi, Tecnografica 1986	TA0012_M_00001	Text	Monografia	Biblioteca Comunale di Massafra	In corso	Terra delle Gravine		DigitalObject	Storia e monumenti		
F. Ladiana, La pietra della fame, Stampa Sud 1984	TA0012_M_00002	Text	Monografia	Biblioteca Comunale di Massafra	In corso	Terra delle Gravine		DigitalObject	Massafra - stroria 1901-1922		
C. D. Fonseca, comprensorio civiltà rupestre, Stampa Sud (1985?!)	TA0012_M_00003	Text	Monografia	Biblioteca Comunale di Massafra	In corso	Terra delle Gravine		DigitalObject	Massafra - cultura e storia		
P. Ladiana, Uomini, fatti e cose della vecchia Massafra,Tipolitografia B.M. s.n.c. - Massafra 1995	TA0012_M_00004	Text	Monografia	Biblioteca Comunale di Massafra	In corso	Terra delle Gravine		DigitalObject	Massafra - cultura e storia		

Categoria_1	Categoria_2	Titolo della risorsa analogica rappresentata	Autore	Contributore_1	Contributore_2	Contributore_3
Libro a stampa	Libro moderno	Massafra e le sue epigrafi – fra cronaca e storia -	Paolo Catucci			
Libro a stampa	Libro moderno	La pietra della fame - Massafra/ borghesia e popolo tra ottocento e novecento	Fernando Ladiana			
Libro a stampa	Libro moderno	Il comprensorio della civiltà rupestre	Cosimo Damiano Fonseca			
Libro a stampa	Libro moderno	Uomini, fatti e cose della vecchia Massafra	Paolo Ladiana	Vito Serio		

(continued)

Table 1. *(continued)*

Data	Editore e Luogo di edizione	Descrizione fisica	Soggetto_1	Soggetto_2	Soggetto_3	Note	Genere risorsa analogica	Materiale	Localizzazione logica della risorsa analogica
1986	Tecnografica, Massafra	247 pag ; 25 cm	Storia-Monumenti-Massafra	Storia-Personaggi Illustri-Massafra		In calce al front.: Amministrazione Comunale di Massafra, Assessorato alla Cultura	PhysicalObject	Carta	Biblioteca Massafra CRSEC TA/50 I B 16
1984	STAMPASUD Posa, Mottola	219 pag. ill ; 26 cm	Massafra	Storia		In calce al front.: Regione Puglia Assessorato alla Cultura C.S.P.C.R. Massafra	PhysicalObject	Carta	Biblioteca Massafra CRSEC TA/50 I B 09
1985 (?!)	STAMPASUD Posa, Mottola	91 pag. ill ; 29 cm	Massafra	Insediamenti rupresti - Massafra		In calce al front.: Regione Puglia Assessorato alla Cultura C. S. P. C. R. Massafra	PhysicalObject	Carta	Biblioteca Massafra XV 4 21
1995	Tipolitografia B.M. s.n.c., Massafra	241 pag. ill ; 24 cm	Massafra	Monumenti e personaggi			PhysicalObject	Carta	Biblioteca Massafra XVII B 6

Thesaurus PICO 4.3_1	Thesaurus PICO 4.3_2	Descrizione del contenuto	Lingua	Ambito cronologico	Soggetto conservatore
http://www.culturaitalia.it/pico/thesaurus/4.3/thesaurus_4.3.0.skos.xml#http://culturaitalia.it/pico/thesaurus/4.2#libri		Testimonianze degli avvenimenti che le epigrafi ricordano: un richiamo alla conservazione della memoria storica, di cui gli studiosi locali, come l'autore, sono con la loro opera diligente e appassionata, i vigili custodi.	Ita	decennio 1980 - 1986	Biblioteca comunale-Paolo Catucci-Massafra
http://www.culturaitalia.it/pico/thesaurus/4.3/thesaurus_4.3.0.skos.xml#http://culturaitalia.it/pico/thesaurus/4.2#libri		Il volume racconta la drammatica realtà vissuta della popolazione massafrese negli anni a cavallo tra i due secoli (dalla fine dell' Ottocento all'avvento del Fascismo) , quando la fame, la miseria e l'incertezza occupazionale erano dominanti. Addirittura c'era chi, durante un breve intervallo di lavoro nei campi non aveva non un tozzo di pane per colazione e si appartava per la vergogna, nascondendo nel suo fazzoletto una pietra per camuffare il desco : La pietra della fame	Ita	decennio 1980 - 1984	Biblioteca comunale - Paolo Catucci - Massafra
http://www.culturaitalia.it/pico/thesaurus/4.3/thesaurus_4.3.0.skos.xml#http://culturaitalia.it/pico/thesaurus/4.2#libri		Tra gli aspetti specifici e per tanti versi apparisccenti che definiscono l'identità categoriale della "Pugliesità" e senza alcun dubbio quella della " Vita in Grotte", ormai entrata in pieno titolo nella letteratura storica, dopo gli studi del prof. Cosimo Damiano Fonseca, con il suggestivo nome di "Civiltà Rupestre". Infatti l'elemento di continuità che lega dalla preistoria all'età moderna la vita delle popolazioni pugliesi è la pietra: dal Gargano allo Ionico, dalla Linea Ofantina sino al Salento, pur con differenti tipologie, l'escavazione degli invasi grottali si ripete con una impressionante seriazione.	Ita		Biblioteca comunale - Paolo Catucci - Massafra
http://www.culturaitalia.it/pico/thesaurus/4.3/thesaurus_4.3.0.skos.xml#http://culturaitalia.it/pico/thesaurus/4.2#libri		Raccolta del materiale dove vede protagonisti monumenti e personaggi della vecchia Massafra, distretto diocesano con i suoi vescovi e con il suo clero e le chiese.	Ita	1500-1950	Biblioteca comunale - Paolo Catucci - Massafra

Regione	Provincia	Comune	Indirizzo	Latitudine	Longitudine	Formato della risorsa digitale pubblicata	Data e ora di creazione della risorsa digitale	Dimensioni della risorsa digitale	Profilo ICC	Profondità di colore	Livello qualitativo	MIME Type
Puglia	Taranto	Massafra	Via Lopizzo n.38	40.58711	17.11152							
Puglia	Taranto	Massafra	Via Lopizzo n.38	40.58711	17.11152							
Puglia	Taranto	Massafra	Via Lopizzo n.38	40.58711	17.11152							
Puglia	Taranto	Massafra	Via Lopizzo n.38	40.58711	17.11152							

Accessibilità	Direzione di lettura	Numero di immagini	Sequenza delle pagine	Versione SW di produzione	Detentore dei diritti della risorsa digitale	Licenza per la risorsa digitale	Collezione digitale	Identificativo collezione digitale	Scheda Puglia Digital Library
Uso pubblico	Sinistra - Destra	1	Da 1 a 247						
Uso pubblico	Sinistra - Destra	76	Da 1 a 219						
Uso pubblico	Sinistra - Destra		Da 1 a 91						
Uso pubblico	Sinistra - Destra	30	Da 6 a 249						

5 Conclusions

The adoption of the *FAIR Principles* requirements with the extended R in R^5 is an indispensable prerequisite for the creation of digital resources and their metadata, to characterize them as the new DCH by making them sustainable, permanent, reliable, resilient sources of knowledge about process and transformations that characterize their evolution over time.

Not the data itself, in fact, but the interest of present and future users in the data as informative and cognitive resources must become the assumption on which we have to base the entire process of design, creation, publication and preservation of digital cultural entities. Therefore, we must focus on the application of the R^5 requirements already from the analysis and design phase of both digitization and of creation of metadata schema for indexing and managing digital objects.

By this way, the identification of DCH among the massive data that today overlaps in the web can start in the medium term and, at the same time, homogeneous and shared guidelines for the creation of digital resources can be defined having clear from the beginning how we can give them the value of cultural entities.

We think this is the way to create and recognize over few years the DCH as defined by the 2014 EU *Conclusions*. Otherwise, we will continue to consider digitization, digitalization and digital transformation only as different and captivating instruments for enjoy the tangible and intangible heritage, losing sight that all of them are already today the humus that, at different levels, identifies the contemporary Digital Age.

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