Embracing Digital Tools and Open Science for Engineering Innovation

Gerard J. O'Reilly


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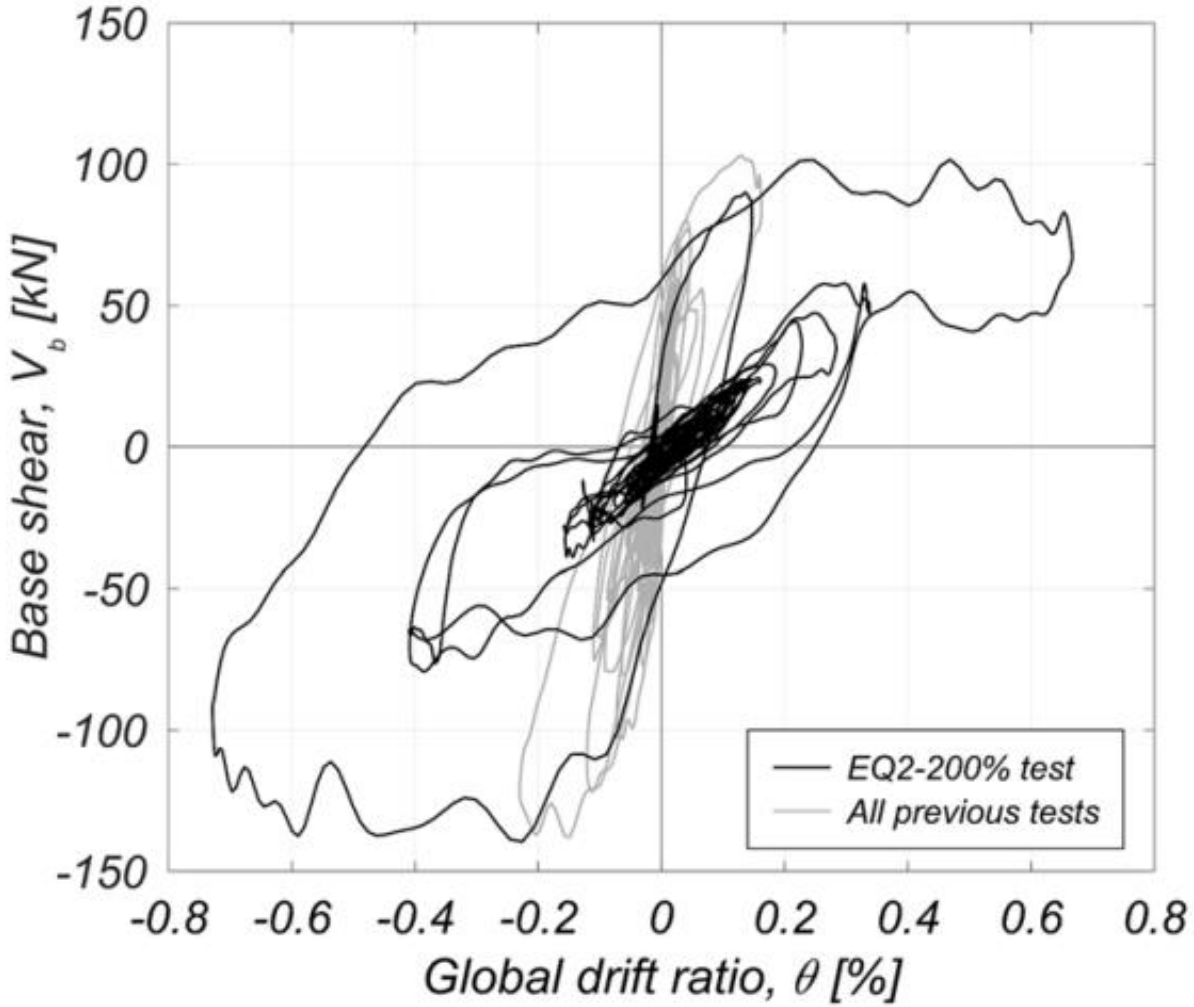
20-12-2018 16:39:37

Experimental results and observations



Bulletin of Earthquake Engineering (2019) 17:1521–1552
https://doi.org/10.1007/s10518-018-0495-5

ORIGINAL RESEARCH

Numerical assessment of the dynamic response of a URM terraced house exposed to induced seismicity

Stylianos Kallioras[1] · Francesco Graziotti[2,3] · Andrea Penna[2,3]

Received: 17 March 2018 / Accepted: 8 October 2018 / Published online: 10 October 2018

Abstract
This paper presents the results of a numerical study aimed at extending the utility of a shake-table test on an unreinforced masonry building prototype for the seismic assessment of terraced houses in the Groningen region of the Netherlands. The area, with no recorded tectonic activity to date, has recently experienced ground shakings induced by natural-gas production. Local buildings are mostly made of unreinforced masonry, often built with cavity walls, which were not specifically conceived for earthquake resilience; hence, they do not exhibit any seismic-resistant detailing. Numerical models were first generated and fine-tuned based on data obtained from incremental unidirectional dynamic tests on a full-scale building specimen, performed up to near-collapse conditions. The structure represented the end-unit of a typical Dutch terraced building with cavity walls and a flexible timber roof. Several issues concerning the numerical simulation of the dynamic response of unreinforced cavity-wall systems were addressed in the context of employing an equivalent-frame modelling approach. Analyses were conducted also considering the effect of the nonlinear out-of-plane response of walls. The calibrated single-unit model was then enlarged to numerically assess the effects of human-induced earthquakes on an entire row of terraced houses. A cloud method was selected to establish the probabilistic relationship between ground-motion intensity and nonlinear structural response, using a large suite of records characteristic of induced-seismicity earthquakes. The question of selecting an appropriate and comprehensive measure of shaking intensity for correlation with structural performance is also discussed.

Keywords Equivalent-frame macroelement models · Nonlinear dynamic analyses · URM cavity walls · Terraced houses · Induced seismicity · Fragility functions

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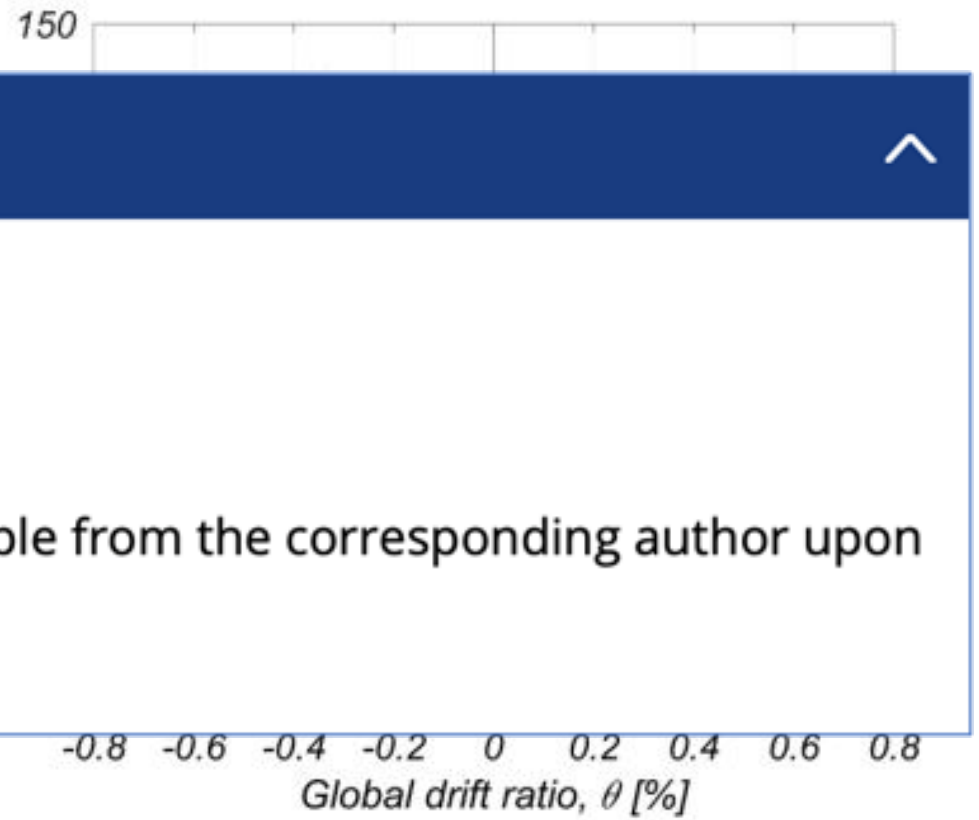
Kallioras et al. (2019) DOI: 10.1007/s10518-018-0495-5

Numerical model calibration



Open Research

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Kallioras et al. (2019) DOI: 10.1007/s10518-018-0495-5

Open science – early beginnings

~ 1.44 MB

~ 700 MB

Open science – online developments

Online Data Dumps

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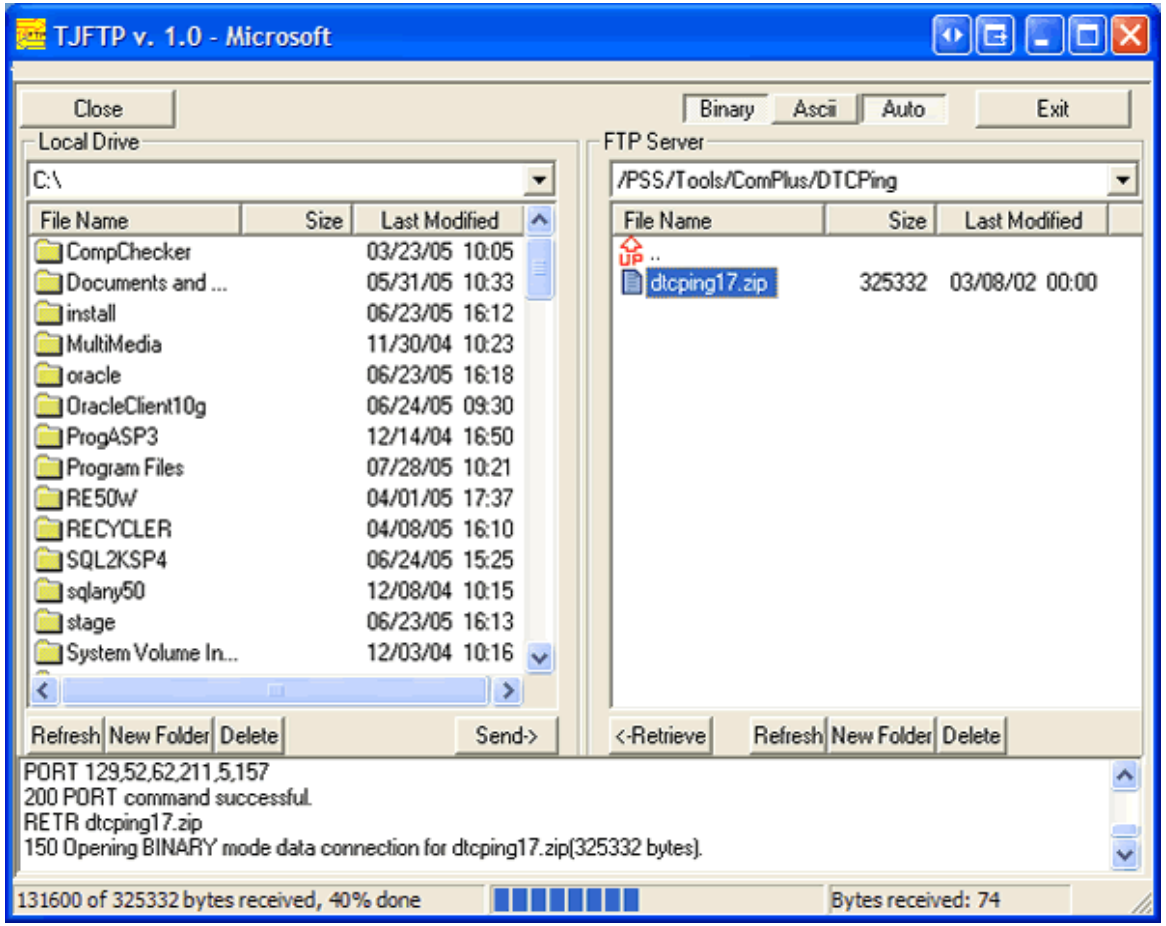
Cyclic Loading Test Data of Reinforced Concrete Bridge Piers

Appendix-A: Force
Appendix-B: Displacement

ID Number	Section	Section Size (mm)		Documents	Text Data Files	Excel Data Files
TP-001	Square	400×400	Six reinforced concrete specimens with same size and strength were loaded under different loading hystereses to evaluate the effect of loading hystereses.	Click	Click	Click
TP-002	Square	400×400			Click	Click
TP-003	Square	400×400			Click	Click
TP-004	Square	400×400			Click	Click
TP-005	Square	400×400			Click	Click
TP-006	Square	400×400			Click	Click
TP-007	Oval	400×900	Three reinforced concrete specimens with oval section for bridge columns were loaded to evaluate the confinement effect of interlocking hoops.	Click	Click	Click
TP-008	Oval	400×900			Click	Click
TP-009	Oval	400×900			Click	Click
TP-010	Square	400×400	Four reinforced concrete specimens were loaded to evaluate the effect of a longitudinal reinforcement diameter on a plastic hinge length.	Click	Click	Click
TP-011	Square	400×400			Click	Click
TP-012	Square	400×400			Click	Click
TP-013	Square	400×400			Click	Click
TP-014	Square	400×400	Four reinforced concrete specimens were loaded to evaluate the effect of unbonding of longitudinal reinforcements at plastic hinge region for enhancing ductility of reinforced concrete bridge columns.	Click	Click	Click
TP-015	Square	400×400			Click	Click
TP-016	Square	400×400			Click	Click
TP-017	Square	400×400			Click	Click
TP-018	Square	400×400	Three reinforced concrete specimens supported by high damping rubber bearings were loaded to evaluate a nonlinear interaction between an isolator and a column.	Click	Click	Click
TP-019	Square	400×400			Click	Click
TP-020	Square	400×400			Click	Click
TP-021	Circular	f400	Cyclic loading tests were conducted on six specimens. Two columns were tested under as-build condition and the other four columns were retrofitted with carbon fiber sheets in horizontal direction to enhance ductility.	Click	Click	Click
TP-022	Circular	f400			Click	Click
TP-023	Circular	f400			Click	Click
TP-024	Circular	f400			Click	Click
TP-025	Circular	f400			Click	Click
TP-026	Circular	f400			Click	Click
TP-027	Square	400×400	Four reinforced concrete specimens were loaded to evaluate the effect of aspect	Click	Click	Click
TP-028	Square	400×400			Click	Click

FTP File Transfer



Open science – online developments

Emailing

From: Kate Johnson kate.johnson@email.com
To: Bob Smith bob.smith@email.com
Date: Mon, 8 Sep 2025 10:14:32 -0400
Subject: Data Request

Hey Bob,
Nice work, can you share your data?

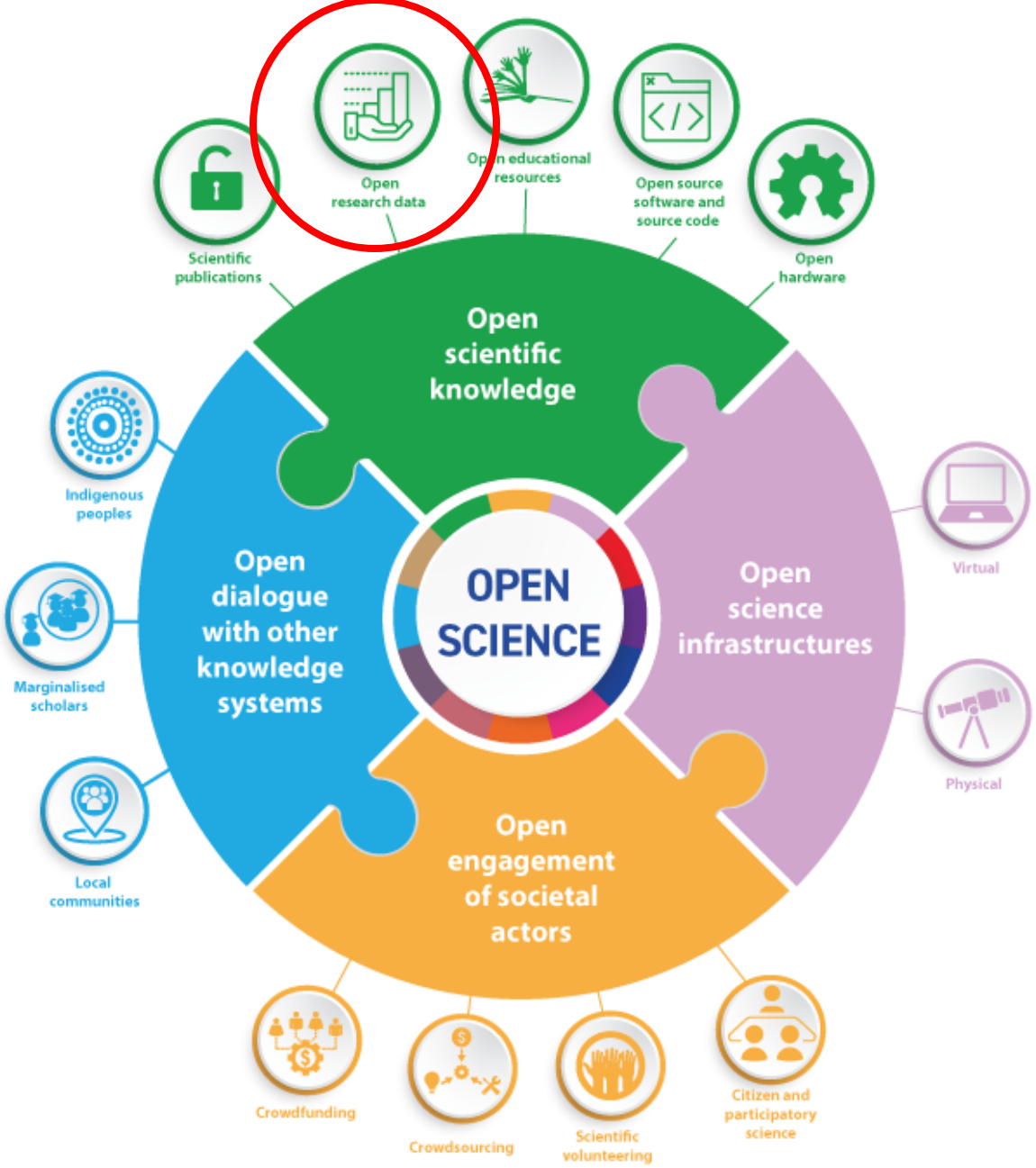
Thanks,
Kate

From: Bob Smith bob.smith@email.com
To: Kate Johnson kate.johnson@email.com
Date: Mon, 8 Sep 2025 10:27:09 -0400
Subject: Re: Data Request

Sure, here it is attached.

Cheers,
Bob

~20 MB



Open Research Data

Sharing raw data, datasets, and metadata to allow others to verify results and build new discoveries

Open Research

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Just as articles have a DOI, datasets can also have a DOI

DIGITAL OBJECT IDENTIFIER

SCIENTIFIC DATA | 3:160018 | DOI: 10.1038/sdata.2016.18

www.nature.com/scientificdata

SCIENTIFIC DATA

Amended: Addendum

OPEN

SUBJECT CATEGORIES
» Research data
» Publication characteristics

Received: 10 December 2015
Accepted: 12 February 2016
Published: 15 March 2016

Comment: The FAIR Guiding Principles for scientific data management and stewardship

Mark D. Wilkinson *et al.*#

There is an urgent need to improve the infrastructure supporting the reuse of scholarly data. A diverse set of stakeholders—representing academia, industry, funding agencies, and scholarly publishers—have come together to design and jointly endorse a concise and measureable set of principles that we refer to as the FAIR Data Principles. The intent is that these may act as a guideline for those wishing to enhance the reusability of their data holdings. Distinct from peer initiatives that focus on the human scholar, the FAIR Principles put specific emphasis on enhancing the ability of machines to automatically find and use the data, in addition to supporting its reuse by individuals. This Comment is the first formal publication of the FAIR Principles, and includes the rationale behind them, and some exemplar implementations in the community.

Supporting discovery through good data management

Good data management is not a goal in itself, but rather is the key conduit leading to knowledge discovery and innovation, and to subsequent data and knowledge integration and reuse by the community after the data publication process. Unfortunately, the existing digital ecosystem surrounding scholarly data publication prevents us from extracting maximum benefit from our research investments (e.g., ref. 1). Partially in response to this, science funders, publishers and governmental agencies are beginning to require data management and stewardship plans for data generated in publicly funded experiments. Beyond proper collection, annotation, and archival, data stewardship includes the notion of 'long-term care' of valuable digital assets, with the goal that they should be discovered and re-used for downstream investigations, either alone, or in combination with newly generated data. The outcomes from good data management and stewardship, therefore, are high quality digital publications that facilitate and simplify this ongoing process of discovery, evaluation, and reuse in downstream studies. What constitutes 'good data management' is, however, largely undefined, and is generally left as a decision for the data or repository owner. Therefore, bringing some clarity around the goals and desiderata of good data management and stewardship, and defining simple guideposts to inform those who publish and/or preserve scholarly data, would be of great utility.

This article describes four foundational principles—Findability, Accessibility, Interoperability, and Reusability—that serve to guide data producers and publishers as they navigate around these obstacles, thereby helping to maximize the added-value gained by contemporary, formal scholarly digital publishing. Importantly, it is our intent that the principles apply not only to 'data' in the conventional sense, but also to the algorithms, tools, and workflows that led to that data. All scholarly digital research objects[1]—from data to analytical pipelines—benefit from application of these principles, since all components of the research process must be available to ensure transparency, reproducibility, and reusability.

There are numerous and diverse stakeholders who stand to benefit from overcoming these obstacles: researchers wanting to share, get credit, and reuse each other's data and interpretations; professional data publishers offering their services; software and tool-builders providing data analysis and processing services such as reusable workflows; funding agencies (private and public) increasingly

Correspondence and requests for materials should be addressed to B.M. (email: barend.mons@dtls.nl).
#A full list of authors and their affiliations appears at the end of the paper.

Wilkinson et al. (2016) DOI: 10.1038/sdata.2016.18

Assigning a DOI to your data

Data Papers

SCIENTIFIC DATA

EARTHQUAKE SPECTRA

Data Repositories

zenodo

NSF NHERI DESIGNSAFE

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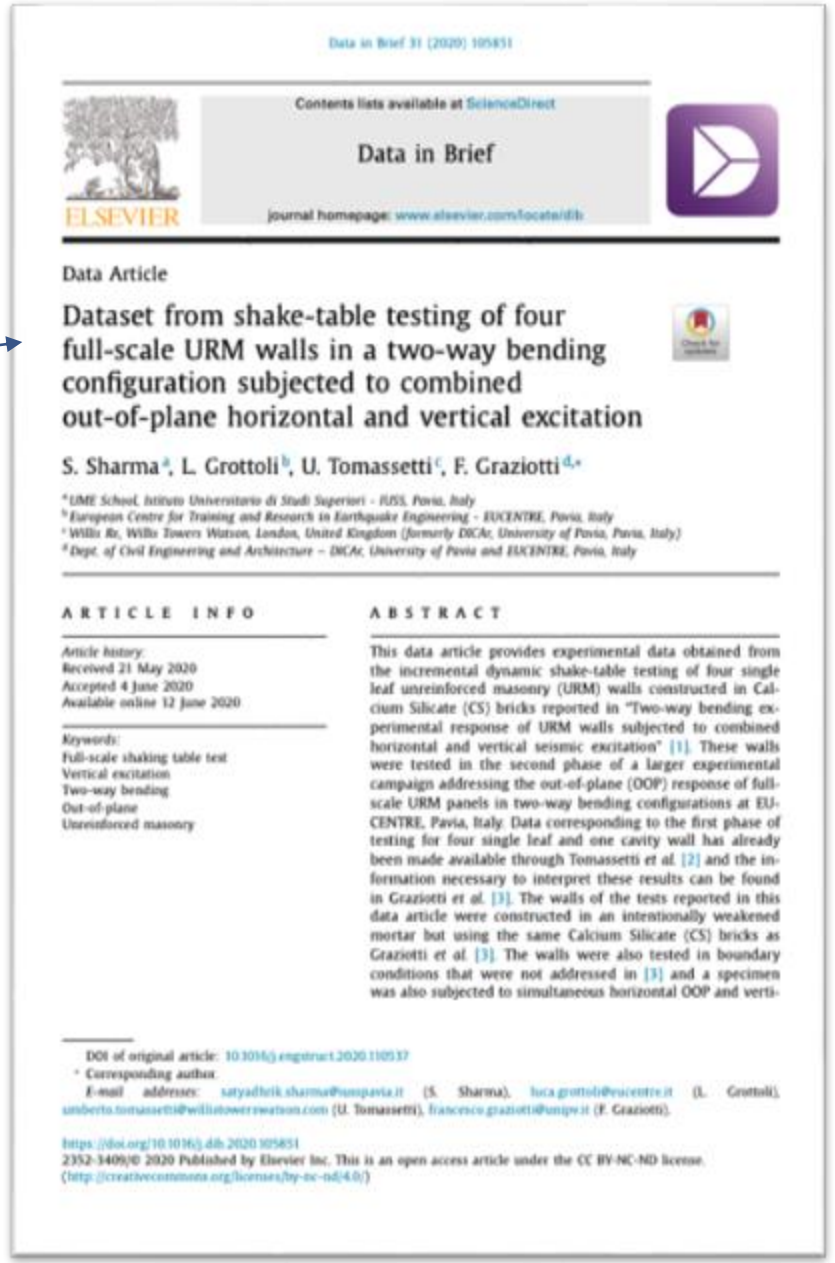
Data Papers



Data in Brief 31 (2020) 105851

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

Dataset from shake-table testing of four full-scale URM walls in a two-way bending configuration subjected to combined out-of-plane horizontal and vertical excitation

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[b] European Centre for Training and Research in Earthquake Engineering - EUCENTRE, Pavia, Italy
[c] Willis Re, Willis Towers Watson, London, United Kingdom (formerly DICAr, University of Pavia, Pavia, Italy)
[d] Dept. of Civil Engineering and Architecture – DICAr, University of Pavia and EUCENTRE, Pavia, Italy

ARTICLE INFO

Article history:
Received 21 May 2020
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Keywords:
Full-scale shaking table test
Vertical excitation
Two-way bending
Out-of-plane
Unreinforced masonry

ABSTRACT

This data article provides experimental data obtained from the incremental dynamic shake-table testing of four single leaf unreinforced masonry (URM) walls constructed in Calcium Silicate (CS) bricks reported in "Two-way bending experimental response of URM walls subjected to combined horizontal and vertical seismic excitation" [1]. These walls were tested in the second phase of a larger experimental campaign addressing the out-of-plane (OOP) response of full-scale URM panels in two-way bending configurations at EUCENTRE, Pavia, Italy. Data corresponding to the first phase of testing for four single leaf and one cavity wall has already been made available through Tomassetti *et al.* [2] and the information necessary to interpret these results can be found in Graziotti *et al.* [3]. The walls of the tests reported in this data article were constructed in an intentionally weakened mortar but using the same Calcium Silicate (CS) bricks as Graziotti *et al.* [3]. The walls were also tested in boundary conditions that were not addressed in [3] and a specimen was also subjected to simultaneous horizontal OOP and verti-

DOI of original article: 10.1016/j.engstruct.2020.110537
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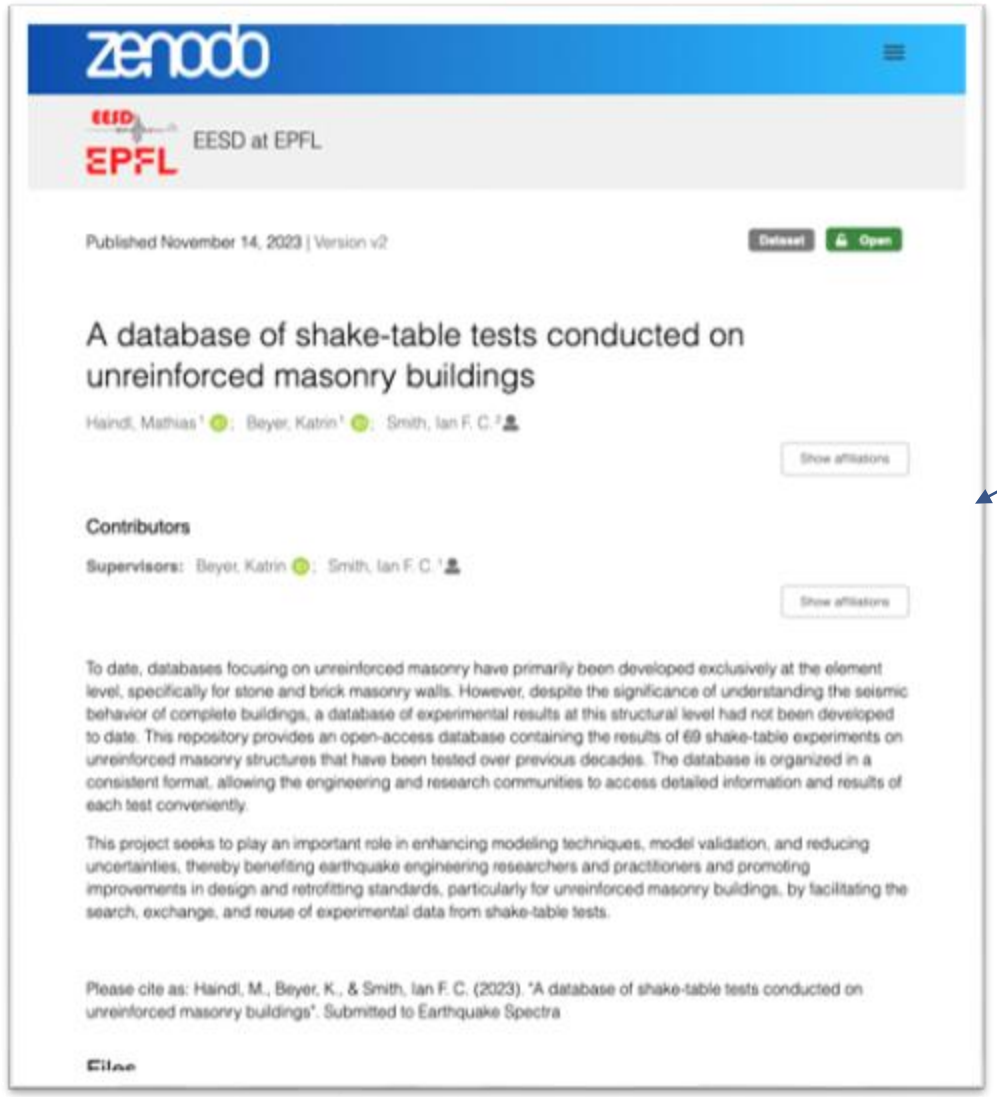
https://doi.org/10.1016/j.dib.2020.105851

DOI: 10.1016/j.dib.2020.105851

Data available as supplemental file on journal website

Time required ~ 1 year

Assigning a DOI to your data



Data Repositories

zenodo

DOI

DOI 10.5281/zenodo.11093882

Data hosted on a browsable repository

https://zenodo.org/records/11093882

Is having a DOI good enough?

Open Research Data

Sharing raw data, datasets, and metadata to allow others to verify results and build new discoveries

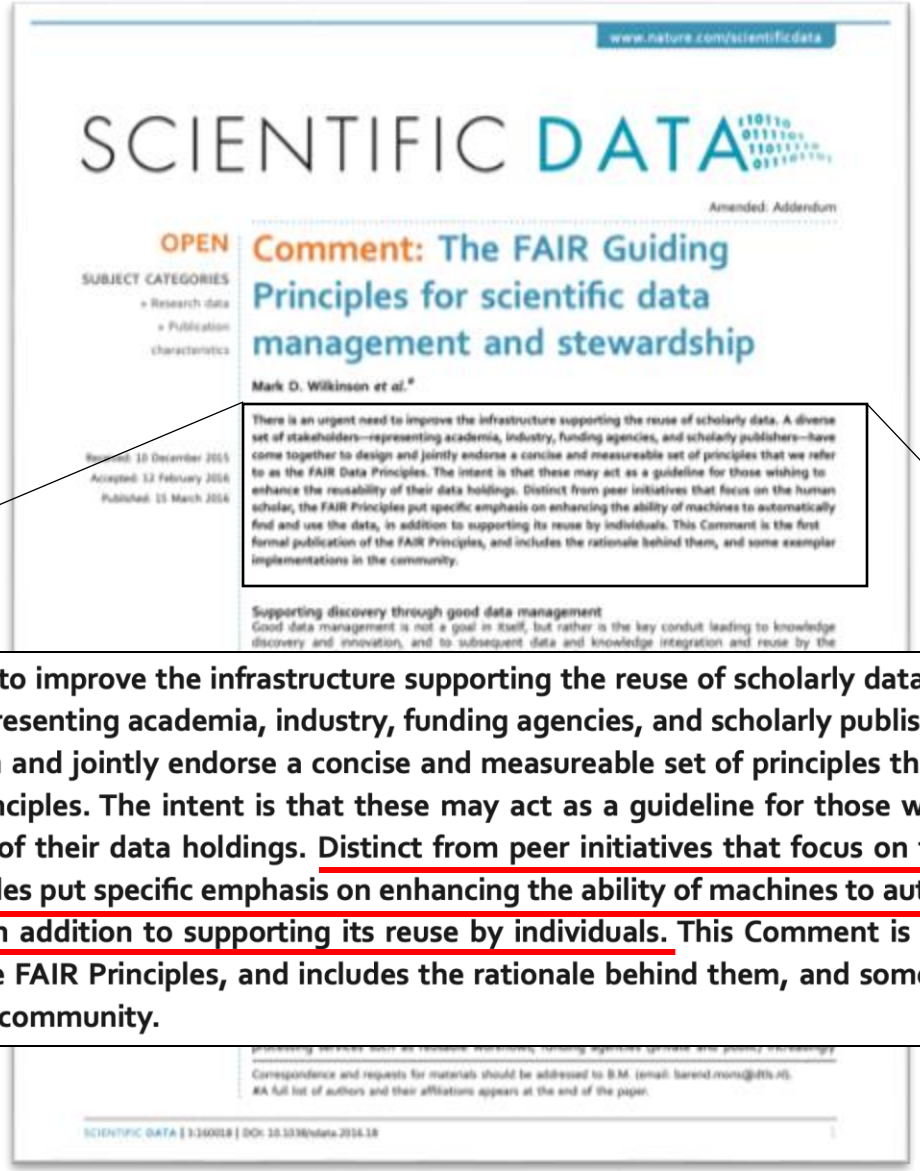
Findable

Accessible

Interoperable

Reusable

https://www.go-fair.org/fair-principles/



SCIENTIFIC DATA

Amended: Addendum

OPEN

SUBJECT CATEGORIES

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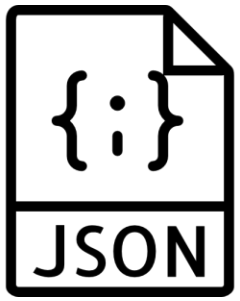
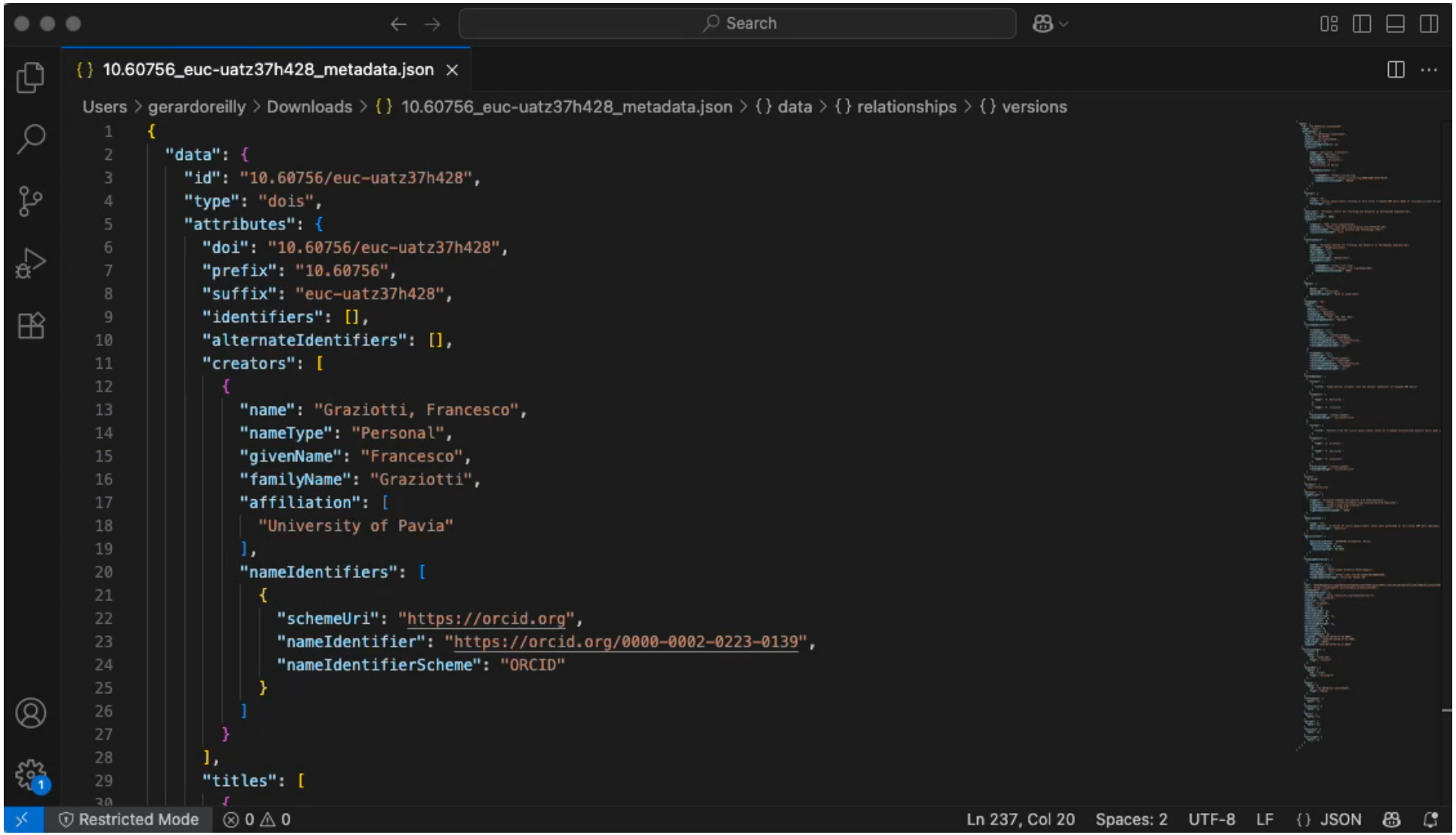
Wilkinson et al. (2016) DOI: 10.1038/sdata.2016.18

What is metadata?





Findable

Data must be registered or indexed in a searchable resource

Accessible

Metadata and data should be readable by humans and by machines, and it must reside in a trusted repository

Interoperable

Data must share a common structure, and metadata must use recognized, formal technologies for description

Reusable

Must have clear usage licences and clear provenance, and meet target community standards for the domain

To be Findable:
F1. (meta)data are assigned a globally unique and persistent identifier
F2. data are described with rich metadata (defined by R1 below)
F3. metadata clearly and explicitly include the identifier of the data it describes
F4. (meta)data are registered or indexed in a searchable resource

Having a DOI only gets you this far!

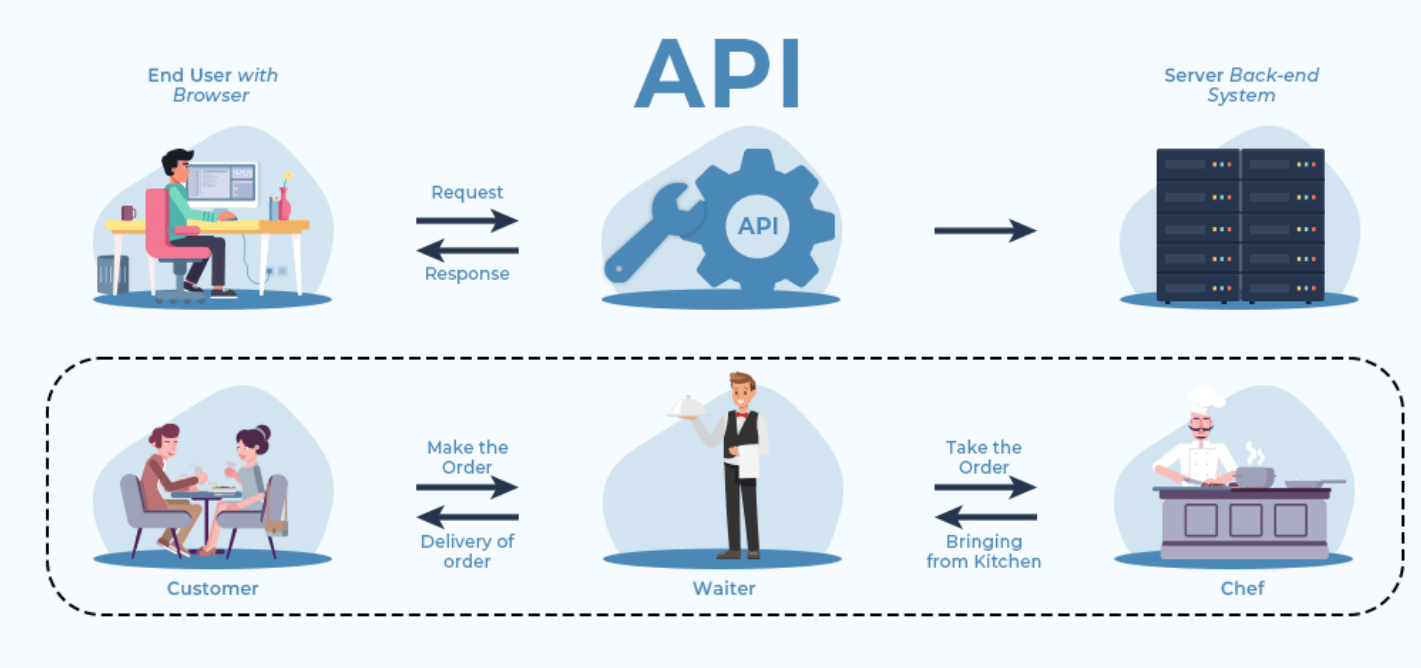
To be Accessible:
A1. (meta)data are retrievable by their identifier using a standardized communications protocol
A1.1 the protocol is open, free, and universally implementable
A1.2 the protocol allows for an authentication and authorization procedure, where necessary
A2. metadata are accessible, even when the data are no longer available

To be Interoperable:
I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.
I2. (meta)data use vocabularies that follow FAIR principles
I3. (meta)data include qualified references to other (meta)data

To be Reusable:
R1. meta(data) are richly described with a plurality of accurate and relevant attributes
R1.1. (meta)data are released with a clear and accessible data usage license
R1.2. (meta)data are associated with detailed provenance
R1.3. (meta)data meet domain-relevant community standards

Application Programming Interface (API)

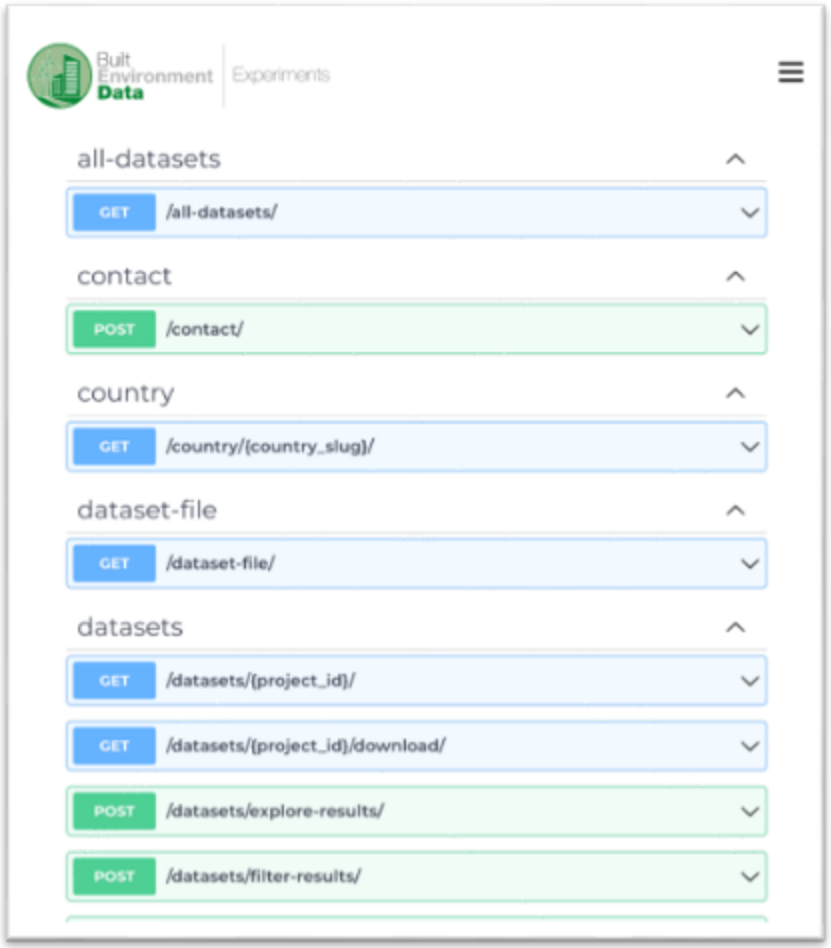
APIs are a well-established concept in everyday tools

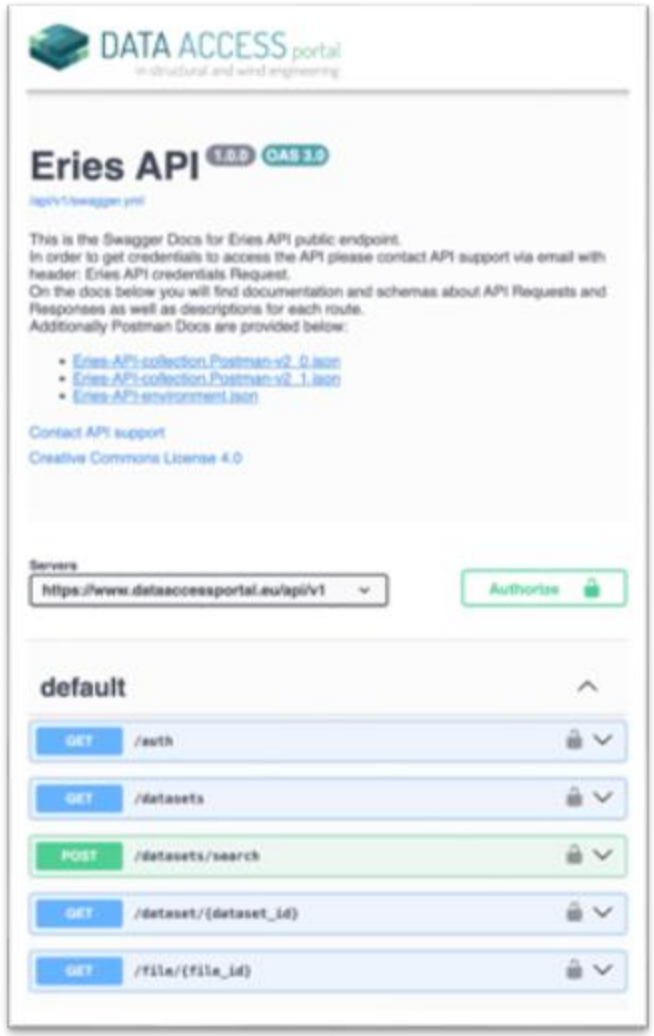


They follow a set structure or “schema” that people can interact with an build upon

Application Programming Interface (API)

Databases offer these APIs for metadata



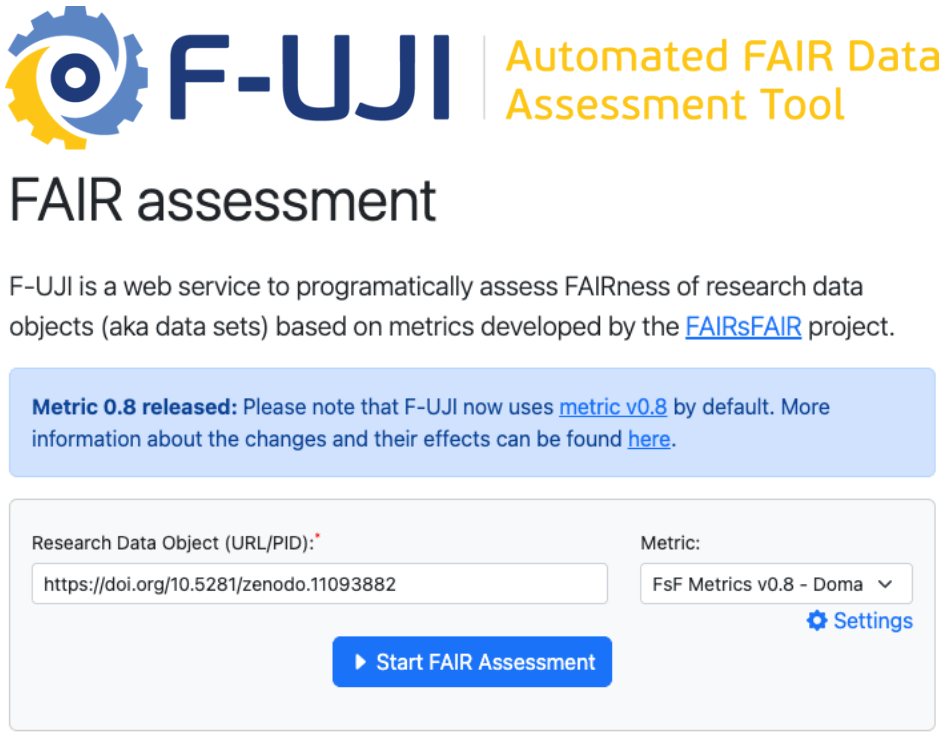


We should strive towards developing schemas for data too

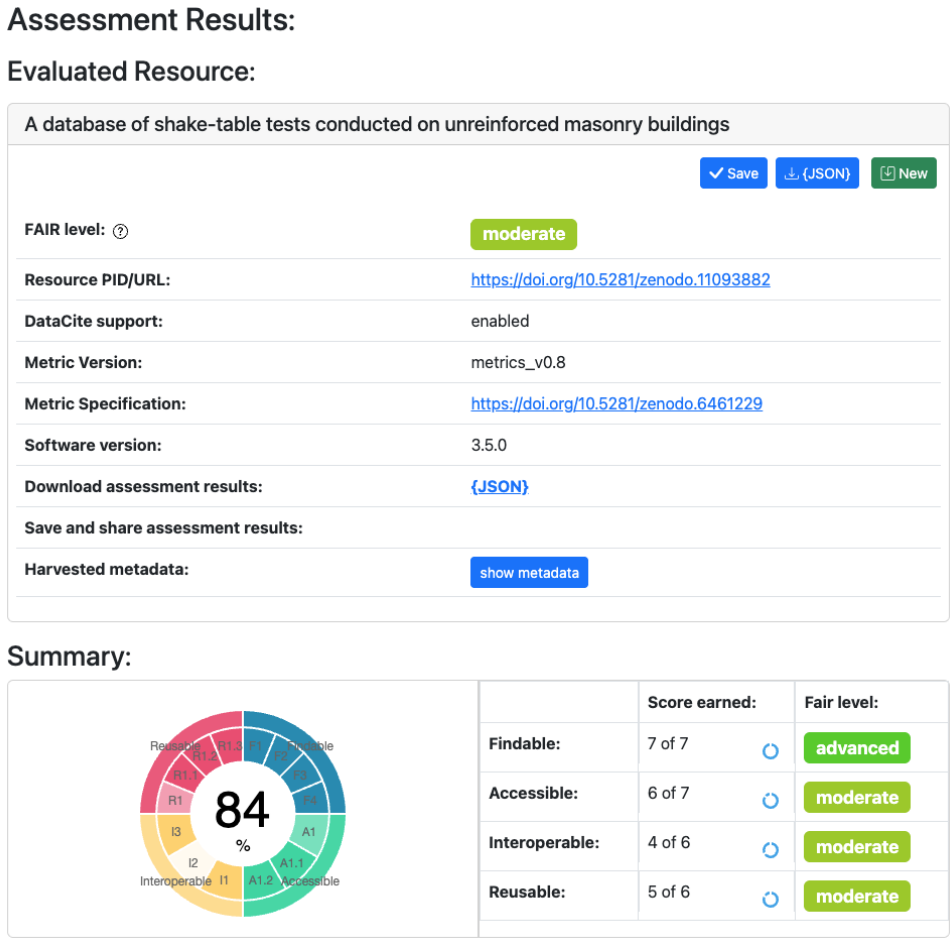
This will make the data interactable and machine-readible

Measure how FAIR your datasets are

Web-service where you can insert a DOI a get a score on how FAIR your data it



https://www.f-uji.net/



It mainly depends on the quality of the metadata you provide and storage repository you use

Why bother?

- **Accelerates discovery:** Data and code sharing enables collaborative, data-intensive research (the "fourth paradigm") and helps solve complex scientific and technical problems

Baker et al. (2024) DOI: 10.1177/87552930241259 39

Why bother?

- **Accelerates discovery:** Data and code sharing enables collaborative, data-intensive research (the "fourth paradigm") and helps solve complex scientific and technical problems
- **Supports major initiatives:** Open data and software (e.g., GEM, OpenSees, DesignSafe) provide essential infrastructure for earthquake hazard and risk research, becoming foundational resources for the community

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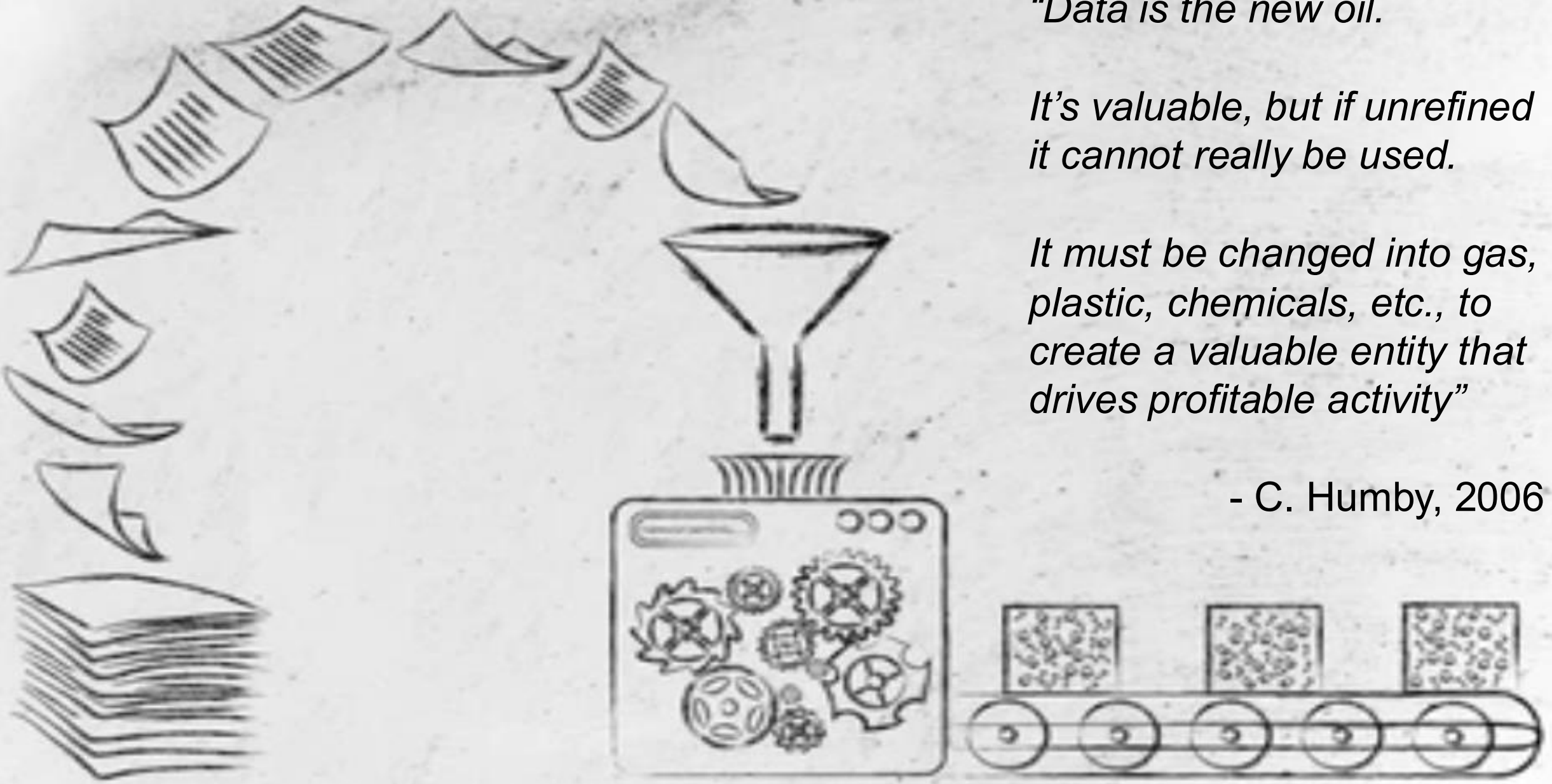
- **Provides feedback and error correction:** External users help identify bugs or issues, leading to improved reliability
- **Demonstrates impact and credit:** Usage tracking, DOIs, and citations provide recognition and evidence of contribution value to funders and peers

Baker et al. (2024) DOI: 10.1177/87552930241259 39



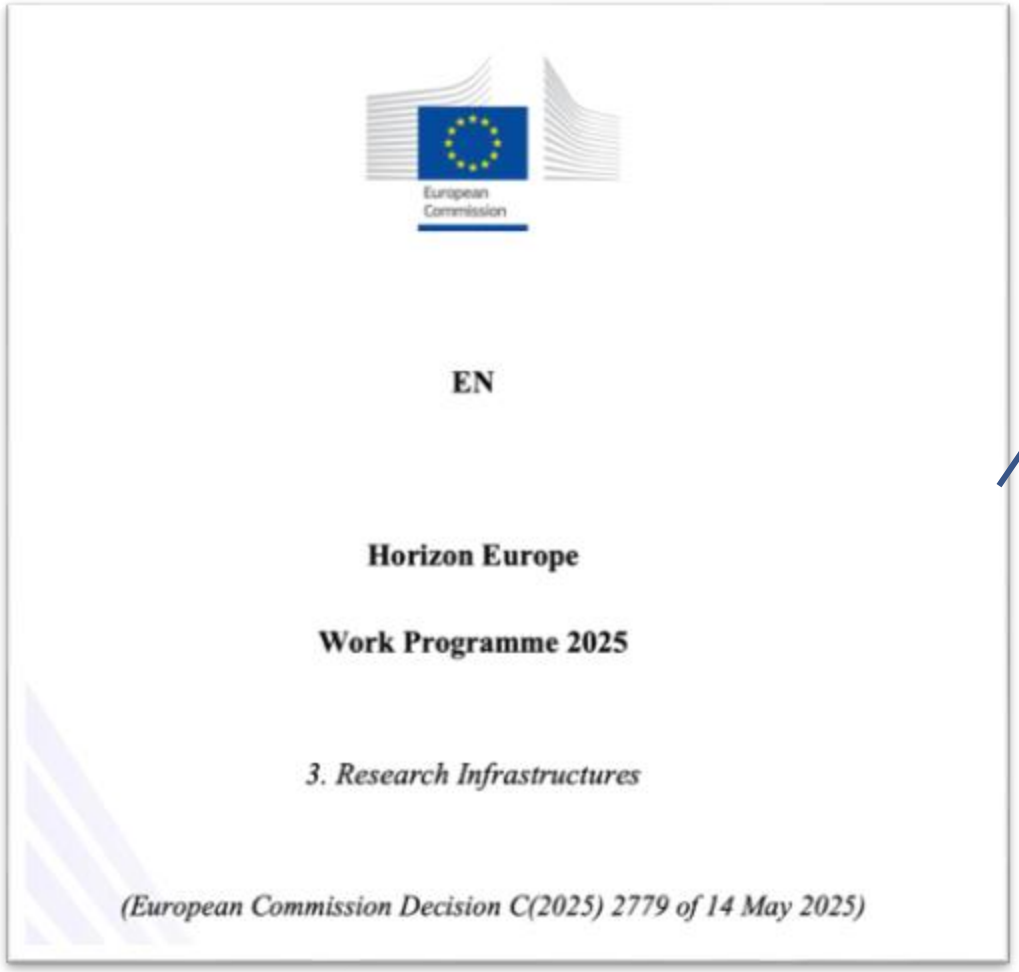
“Data is the new oil.

It’s valuable, but if unrefined it cannot really be used.

It must be changed into gas, plastic, chemicals, etc., to create a valuable entity that drives profitable activity”

- C. Humby, 2006

ERIES ENGINEERING RESEARCH INFRASTRUCTURES FOR EUROPEAN SYNERGIES 2.0?



European Commission

EN

Horizon Europe

Work Programme 2025

3. Research Infrastructures

(European Commission Decision C(2025) 2779 of 14 May 2025)

In line with the Strategic R&I Agenda of the 2021-2030 European Open Science Cloud (EOSC) co-programmed European Partnership , the programme aims at ensuring that Open Science policies, practices and skills become the norm across the ERA and that the EOSC federation is enlarged through connecting existing research infrastructures in Europe and providing additional value added services based on user needs, also with the view of enabling the European contribution to a web of FAIR data and services.

HORIZON-INFRA-2025-01-SERV-03: Research infrastructure services advancing frontier knowledge

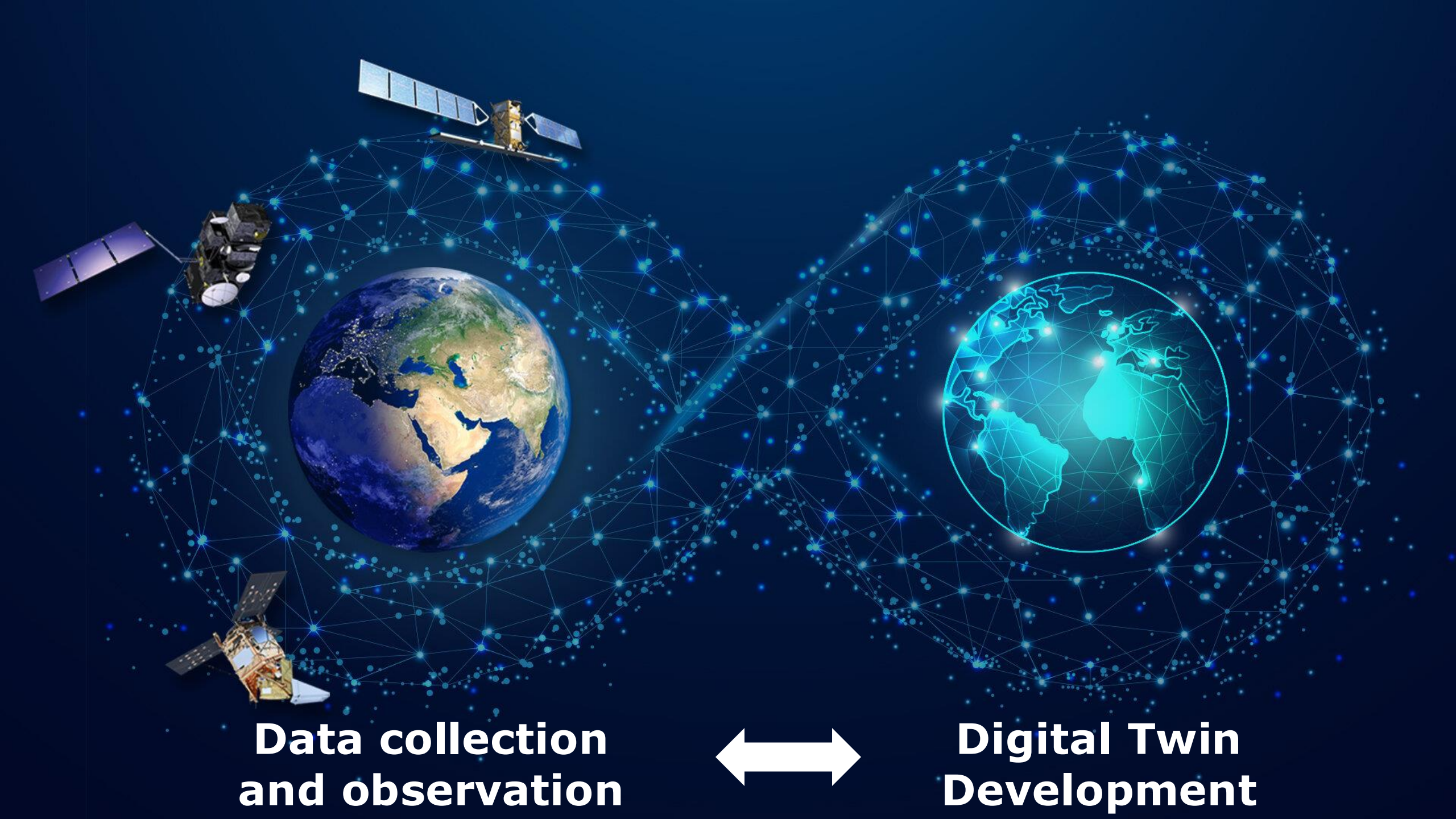
Expected Outcome: Project results are expected to contribute to all the following expected outcomes:

- Better management, including implementing FAIR data principle, of the continuous flow of data collected or produced by research infrastructures.

DestinE Platform

Funded by
the European Union

Allocated **over €315 million** from the EU's Digital Europe Programme


Data collection
and observation
Digital Twin
Development

Currently focused on:

- **Urban heat / heatwaves**
- **Sea ice & polar hazards**
- **Flood**
- **Weather-induced extremes**

Why not also other hazards?

EPOS
EUROPEANPLATEOBSERVINGSYSTEM

Built Environment Data