Analytical Report n8

Analytical Report 8: The Future of Open Data Portals

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Executive Summary

Portals are central points of access for datasets which allow data to be found easily. Their development is associated with the emergence of Open Data, and therefore they have largely been government led and funded initiatives for the purpose of opening appropriate government datasets – a supply-led approach. However, this drive by publishers, often to meet mandates, can only take portals so far. This report presents ten ways portals can organise for sustainability and added value by examining what is required on the other side of the equation – meeting and provoking demand. As users become an increasingly wider and more diverse group, these changes will increasingly be required.

These ten ways are:

- Organising for use of the datasets (rather than simply for publication);
- Learning from the techniques utilised by recently emerged commercial data marketplaces; promoting use via the sharing of knowledge, co-opting methods common in the open source software community;
- Investing in discoverability best practices, borrowing from e-commerce;
- Publishing good quality metadata, to enhance reuse;
- Adopting standards to ensure interoperability;
- Co-locating tools, so that a wider range of users and re-users can be engaged with;
- Linking datasets to enhance value;
- Being accessible by offering both options for big data, such as Application Programme Interfaces, and options for more manual processing, such as comma separated value files, thus ensuring a wide range of user needs are met;
- Co-locating documentation, so that users do not need to be domain experts in order to understand the data;
- Being measurable, as a way to assess how well they are meeting users' needs.

These ten ways are not simply an abstract list. It is hoped this list will be operationalised by portals by looking critically at their offering and taking an honest inventory; by addressing front end issues to meet user needs; by engaging with data providers not only to deliver the content in appropriate formats but also to share their domain knowledge; and finally, by engaging with other portals to solve joint challenges, primarily those of standards.

Contents

Introduction

Two decades after the emergence of *web* portals in the mid-1990s, there has been a rise in the number of *Open Data* portals, particularly amongst public institutions. Portals are central points of access for datasets. As of 2017. Liechtenstein was alone within the EU28+ countries in not having launched a national Open Data Portal[1]. So compelling has the portal model been that transnational portals have also emerged: the European Data Portal, offering access to Open Data from over 34 countries was launched in 2015.

Portals enable Open Data to be found easily – for example, if a user is looking for a dataset created by a given organisation, their data portal may be the first address to find that data. The portal of the data publisher would typically provide visitors with a search feature, as well as tools to browse through their entire collection of datasets, and understand the provenance, terms of use, scope and timeliness of the datasets. Occasionally, Open Data portals host data from multiple organisations. For those who release their data openly, such portals offer many useful services, from hosting reliable URLs to facilitating data discovery to metadata and version management. In addition, this second category of portals can assist data publishers in keeping track of how often their data is accessed, or understand demand[2] for and usage[3] of their data. Finally, it has even been suggested that governments increasingly use Open Data portals as primary tools to communicate with their citizens.[4]

Data is created, maintained and published by different parties. If every organisation offered their own tools to give others access to data, discovering relevant datasets would require a type of infrastructure similar to that which we have for Web search today. At the same time, organisations that release their data openly would have an even greater challenge to pinpoint where their highly distributed consumer base is located and what the impact of their Open Data efforts is –this would require stable identifiers as well as tracking and analysis tools that exist elsewhere (for example on the Web or on social media), but are simply not available for data today. Some communities, especially when they have a history and culture of open access (for instance, science), have in time developed their own technologies and guidelines to facilitate this, including DataCite[5] and the *FAIR principles* (listed below).[6] Others, including governmental data publishers, are by comparison less experienced and can make fewer assumptions about the scenarios in which their data will be reused and about the skills and background of their data users. In this case, having a single point of access with rich capabilities, including usage logs, can have benefits.

The Fair Principles

To be Findable

F1 (meta)data are assigned a globally unique and eternally persistent identifier
F2 data are described with rich metadata
F3 (meta)data are registered or indexed in a searchable resource
F4 metadata specify the data identifier

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 authorisation 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 have a plurality of accurate and relevant attributes
R1.1 (meta)data are released with a clear and accessible data usage licence
R1.2 (meta)data are associated with their provenance
R1.3 (meta)data meet domain-relevant community standards

However, independently of the Open Data maturity of one's organisation, simply publishing the data to a portal risks creating what has been called 'virtuous data dumps'.[7] As the use of open government data becomes more common, it is necessary to think about moving to the next stage in publishing, managing and using data. Central, aggregated portals were an early and necessary step in developing the Open Data narrative, but their aim cannot be to fulfil a mandate for publishing – ultimately, they are a means to facilitate broad use and generate impactful change. For the average citizen, it is what is done with the data that is important. For the data professional looking for the right source of data for their task, the challenge is mostly around finding and making sense of the data. Going forward, the focus should be on understanding these scenarios better and choosing the best tools, whether portals or others that deliver the capabilities and user experience people are asking for. In the end, it is very likely that this would benefit existing portal owners as well, as it will provide insight into how they could improve their offers and help publishers release better data over time.

In this paper, we take these ideas further. We present ten ways in which Open Data portals must evolve for sustainability and added value (*Figure 1*). They are the result of our own research around Open Data, human-data interfaces, and linked data; of interactions with data portals in several countries, their users, data publishers, and Open Data experts; and of the lessons we learned when publishing our own data on the Web. We reviewed the transcripts of three focus groups comprising Open Data

publishers, users, activists, entrepreneurs, journalists, facilitators and analysts, as well as seven recently published academic papers. Secondary sources included white papers by two European Open Data projects, three expert blogs and three independent reports for governments.[8]

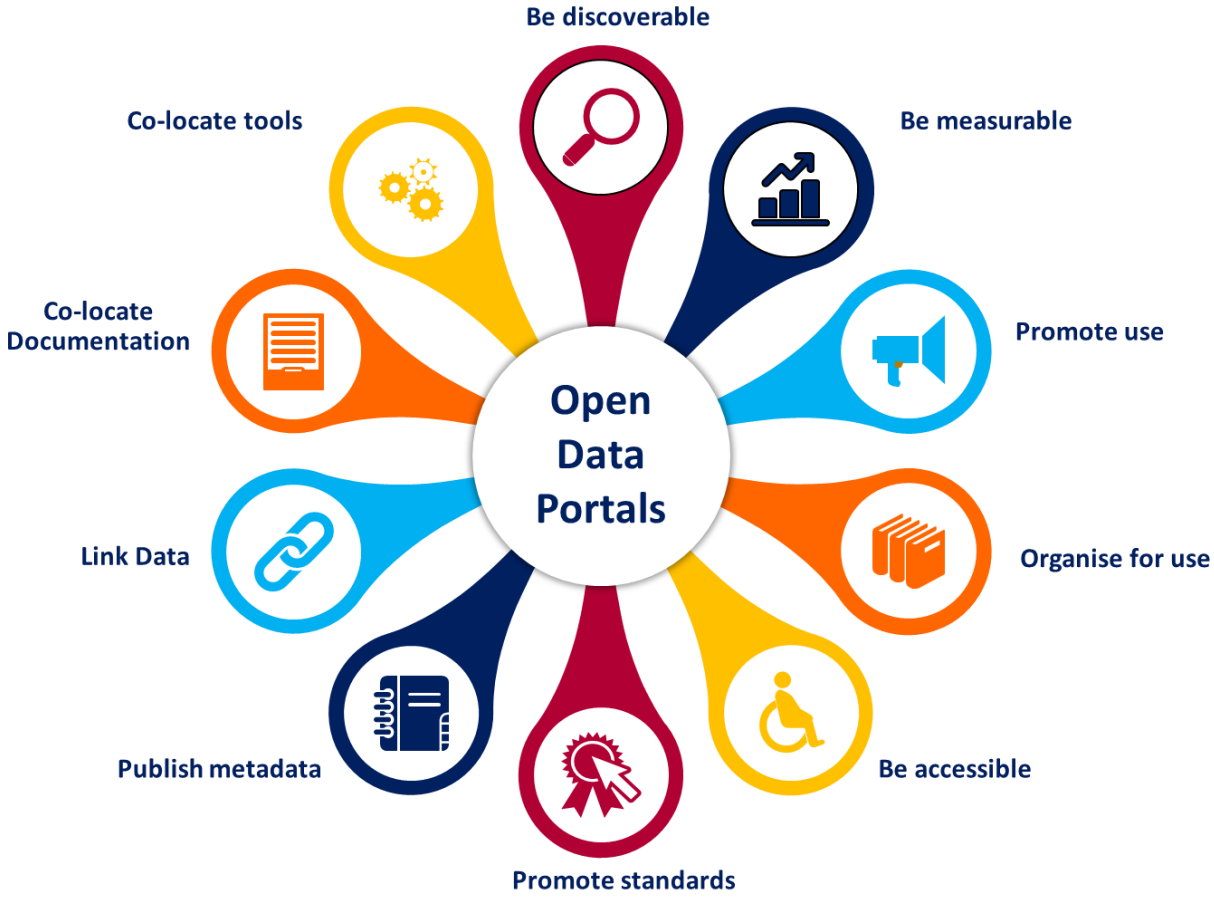


Figure 1 Ten ways to make your portal more sustainable

1. Organise for Use

Open Data is data that anyone can access, use or share.[9] To include 'anyone', it is necessary not only to serve advocates of Open Data or civil servants, but also to engage a range of potential users and understand their journeys – from journalists to business analysts to local communities to citizens. Portals have a vital role to play in improving the user data experience, inclusivity and reach. In theory, Open Data portals are supposed to help others use data, but they are often not organised with the user experience in mind, and reconciling this underlies future success.

Increasingly, many people thinking about this area are drawing inspiration from the world of e-commerce, identifying methods that have been developed over many years elsewhere in the online world that Open Data portals could benefit from. For example, Open Data portals could reimagine themselves as 'data retailers' and employ the same type of quantitative methods to log and analyse 'customer' behaviour, offer previews of the data for easier sense making, recommendations for related datasets, comprehensive 'product' descriptions (going beyond a collection of structured metadata), reviews and incentives. Another factor that will undoubtedly drive the requirement for this change is the rise of commercial data marketplaces such as Dawex[10] and qDatum.[11]

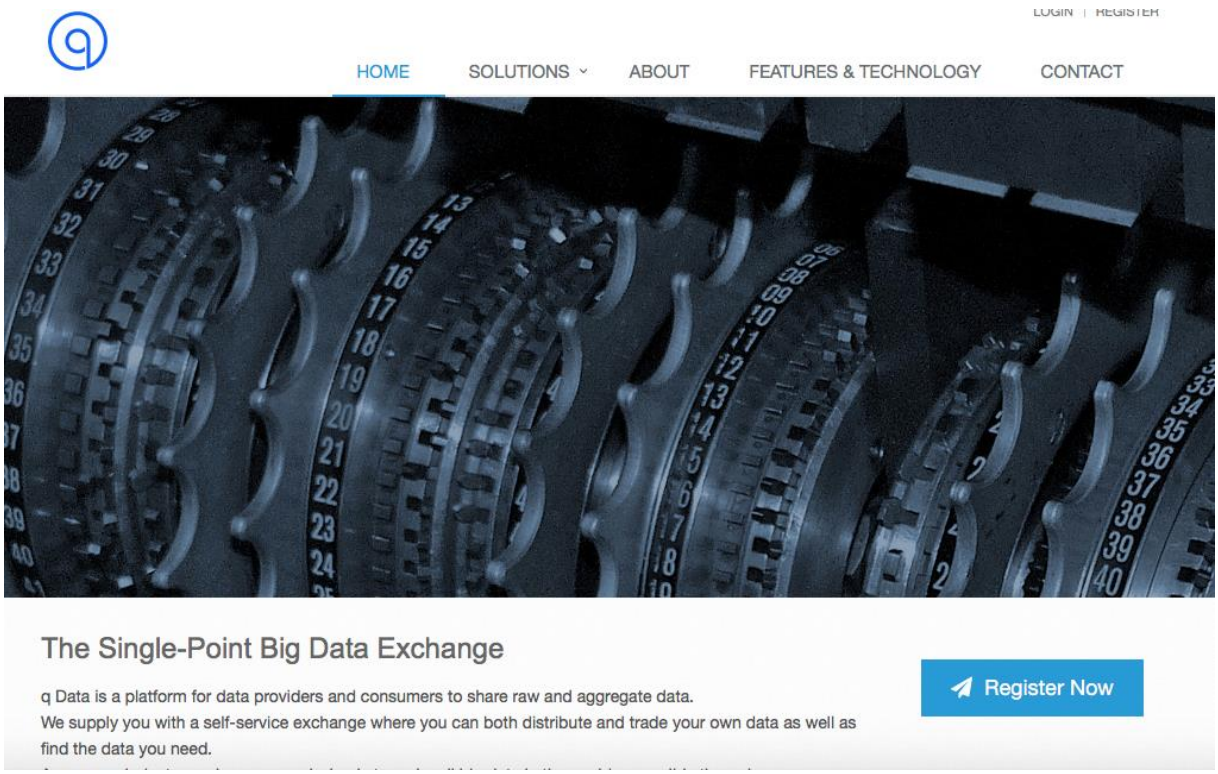
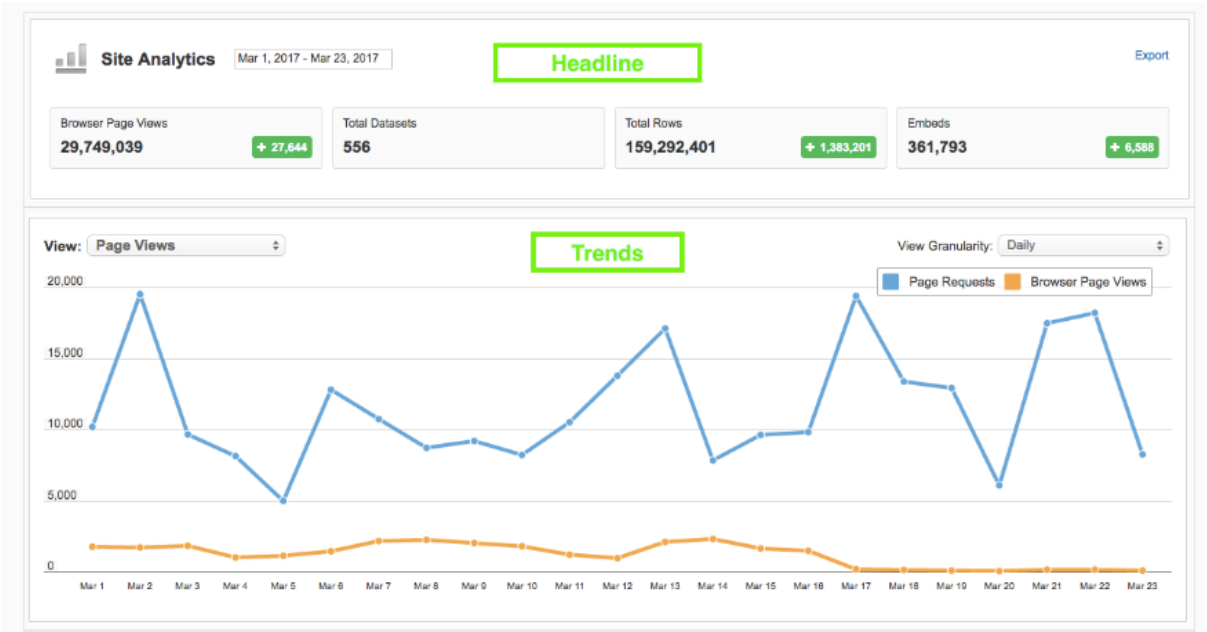


Figure 2 qDatum website

Analysing user behaviour is key in this context. Given the broad range of scenarios to which the data could be relevant, being able to adjust and test the design and capabilities of the data site in a data-driven, lean way is essential for understanding user needs and their evolution, and ensuring the portal meets them. Existing publishing software, for example Socrata (**Error! Reference source not found.***Figure 3*),[12] offer some support, though there is still a lot to be done to understand how the metrics and trends that are delivered by a dashboard translate into design and publishing practice.



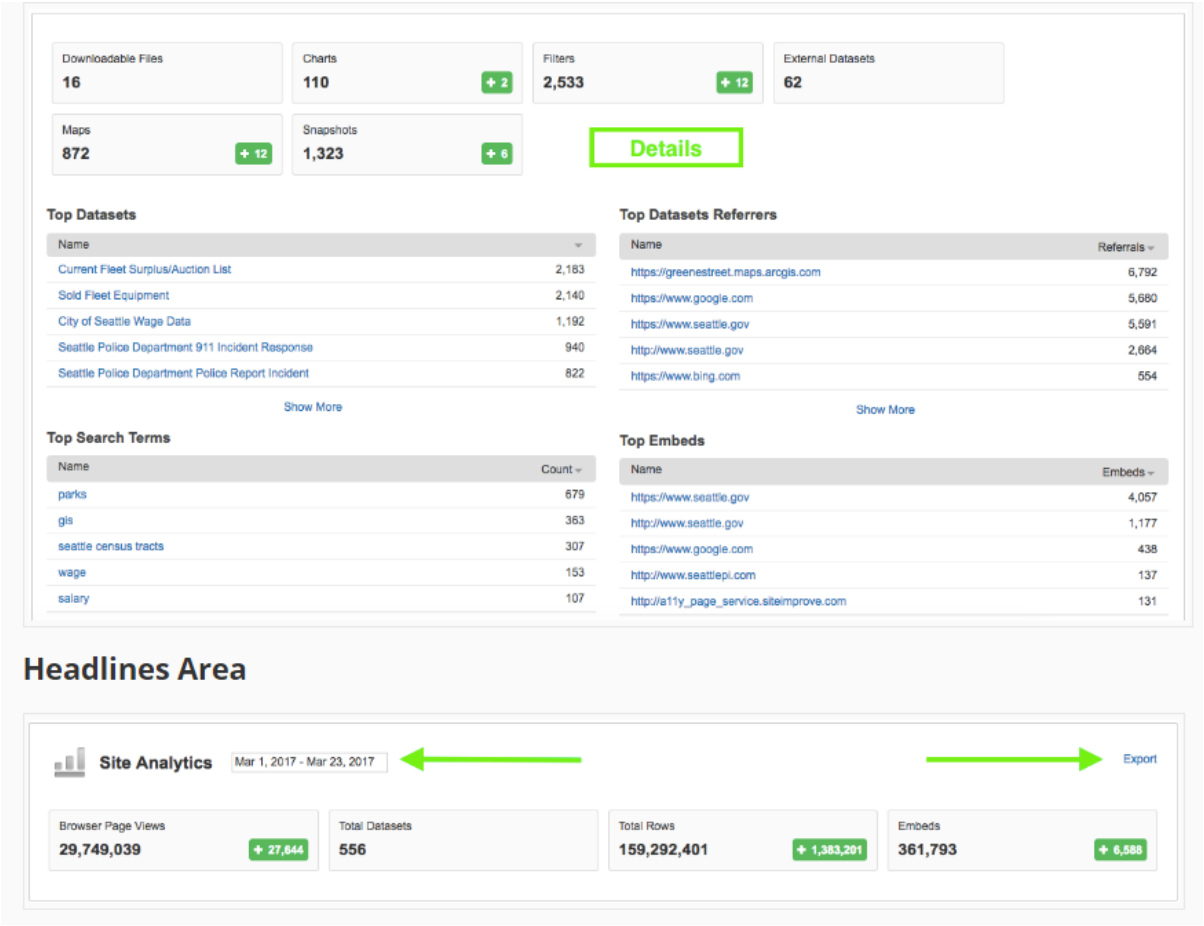


Figure 3 Socrata site analytics dashboard[13]

User experience (UX) methods, including focus groups, usability tests, A/B testing, eye-tracking and participatory design workshops are standards in many organisations today that are known for their user-centric approach – people expect a Web site or app to work seamlessly and Open Data portals cannot be an exception.

2. Promote Use

Impact stories and examples are often used in Open Data, but these are frequently aimed at encouraging data publishers rather than users. There are several approaches that can be taken towards increasing the sharing of skills and knowledge to develop wider use of data. The simplest of these is to facilitate the creation of curated lists of datasets, which are useful in a certain domain or context - both from within the portal and across other portals. Useful lists will attract maintenance from those who benefit from their utility.

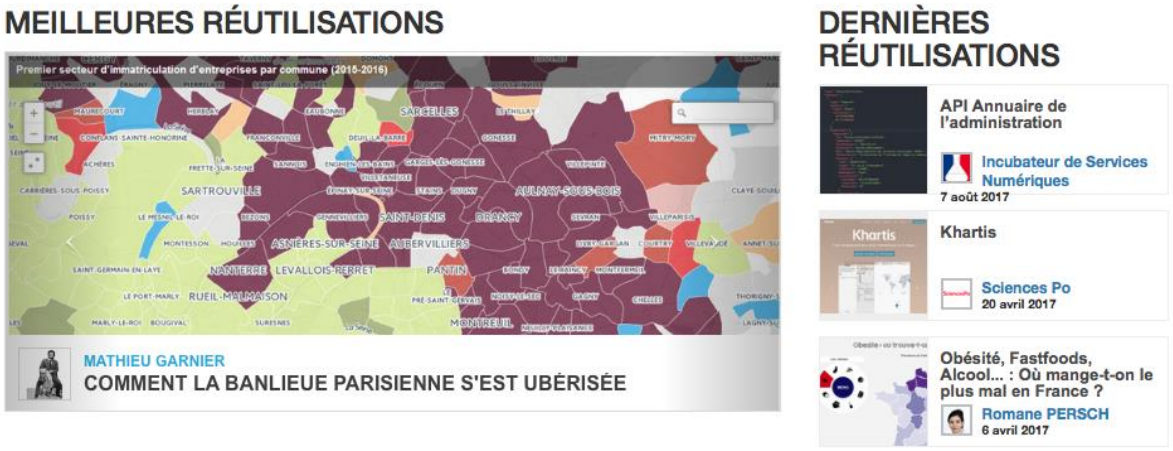


Figure 4 Data.gouv.fr's 'best reuse' feature

Another concept borrows from the open-source community, where it is common practice to store the files for a project in a repository where others can access and use them. Projects created during the many hackathons across Europe, of which many go no further than the prize-giving at the end of the weekend, could be shared in this way with the possibility of building on them in future. There is also an argument for the provision, alongside the data, of clear guides that demonstrate for users the process of a project, including the data, domain knowledge, skills and process required. One such example is that of *Data Campfire* (*Figure 5*), which enables users to share very detailed information about their creation of a data story, which not only promotes the data and its publisher, but crucially helps other understand what is needed to reuse that dataset or carry out similar analyses.

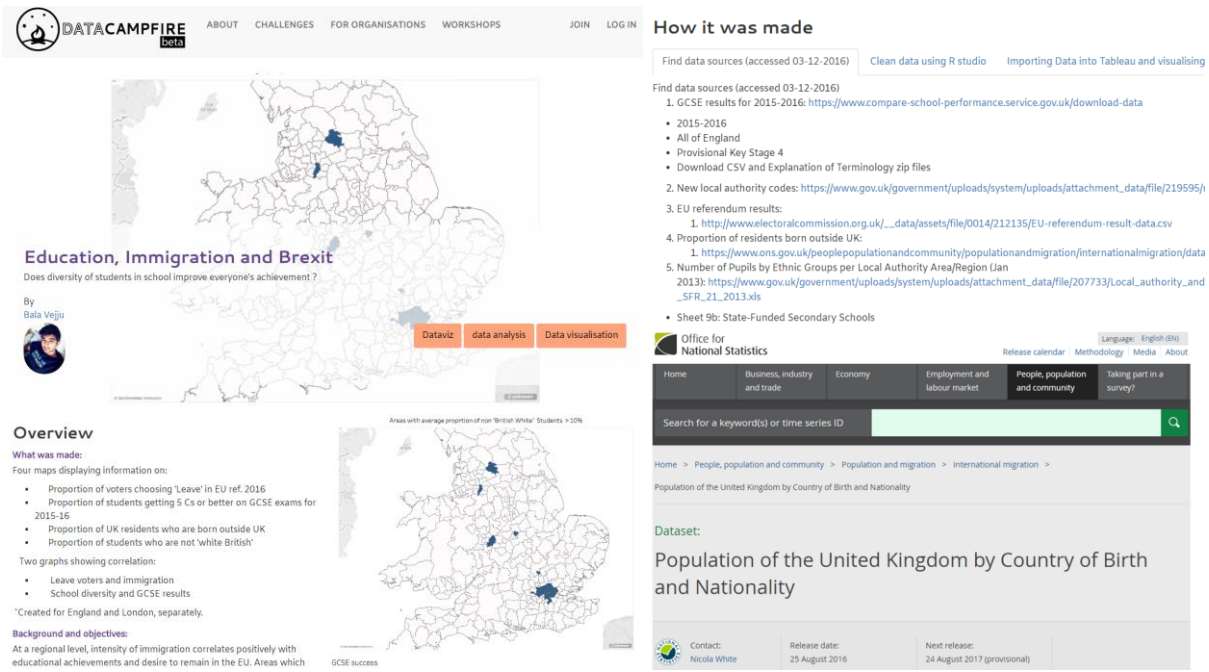


Figure 5 Data Campfire

In the software world, it is also common for the community to discuss issues around the use or future development of a piece of code, or ask and offer advice on known problems and workarounds. While Open Data portals sometimes support comments, the practice of promoting a community of practice

of data users and setting up discussion forums, Q&A capabilities, or other social channels is less established.

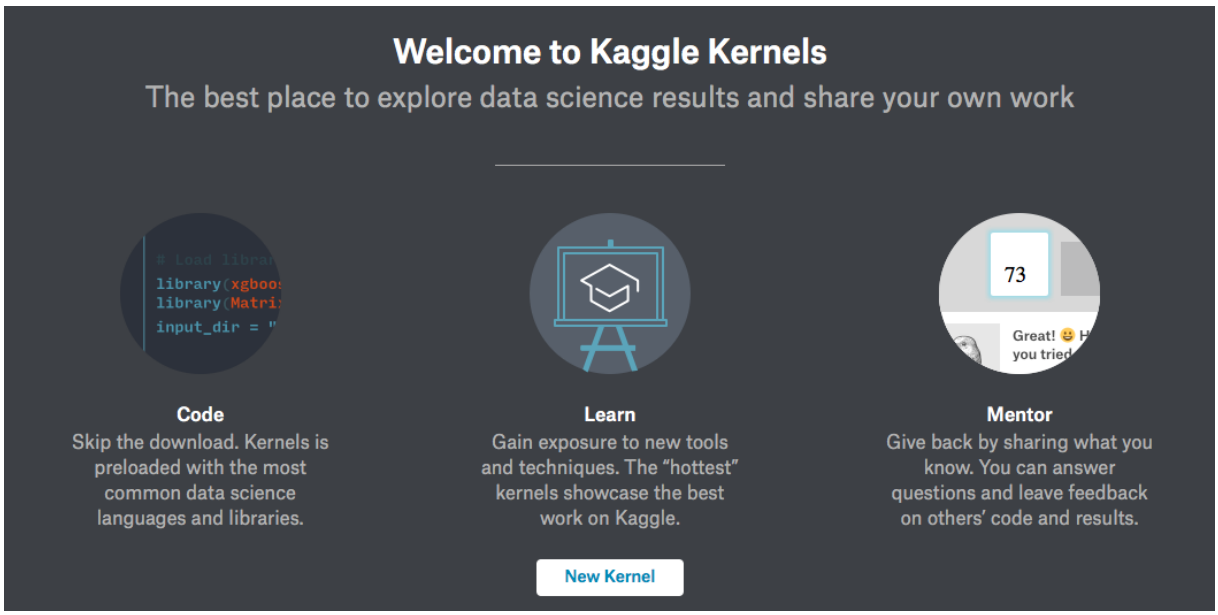


Figure 6 Data science competition Kaggle's sharing hub

Finally, and possibly most critically, datasets could be themed in potential usage (rather than publication) categories. Upvoting, badges or other rating and review techniques would work well in this context to incentivise the crowd-led development of themes, add more insight into how others use the data, and foster community development. There is little empirical evidence that people searching for datasets use sectors, or any of the high-level categories most portals support to navigate through a collection of datasets. If anything, research has shown that their queries rarely match the taxonomies used by publishers to group their datasets, and that they also mention aspects such as time and location, which are not part of the exploration experience offered by portals today.[14]

3. Be Discoverable

Counter-intuitively, it has been argued that portals can make data discovery harder. If a user is aware of the public institution which publishes the dataset they wish to peruse, but not of the appropriate Open Data portal, they may start by visiting the website of that institution and trying to identify where the data is located. However, often, an organisation's website and their data portal are designed and managed separately. The datasets hosted by the portal are not linked to the overall online presence of the institution. Reference data is published on departmental websites, while transactional data is published on portals. Data is not embedded in the user experience, which is fragmented and inconsistent across the different channels. A first step would be to achieve this integration, both from a functionality and an engagement point of view. A further step would then be to highlight other data portals that may be of use, and possibly share cross-portal facilities.

Keywords	Number of datasets returned
Dwelling stock	102
Housing stock	154

Dwelling supply	17
Housing supply	78

Figure 7 Study of 2015 on sensitivity of keywords when searching for data on 'housing stock' on data.gov.uk

Data searches are prone to be adversely affected by the subjectivity of choice of terms, as can be seen in *Figure 7*. The Web offers several search engines with well-honed algorithmic capabilities that have solved similar problems. Again, borrowing from e-commerce, data portals should be, if not optimised, certainly enabled for search engines. This is likely to be more effective than attempting to engage users with Boolean logic (or worse, technical formats such as SQL or SPARQL) to facilitate advanced search. At an individual data level, Schema.org offers a format for microdata mark-up to make pages discoverable by standard search engines. Extensions for dataset mark-up have recently attracted some interest.[15] As noted earlier, there are several communities that have embraced a culture of the open and developed a huge arsenal of best practices and tools to do just what Open Data portals are aiming to achieve: publishing data for others to use, describing data in a way that it can be identified and indexed effectively, making data management and use a community activity. Learning from their achievements and leveraging their solutions could give the emerging open government data ecosystem the confidence and bandwidth it needs to keep the momentum going and remain relevant and cutting-edge.

Open Data Portal Watch, a project whose key aim is to improve the quality of Open Data, crawls the Web to find portals – currently 260+ – whose dataset collections would otherwise remain hidden to regular users (*Figure 8).*

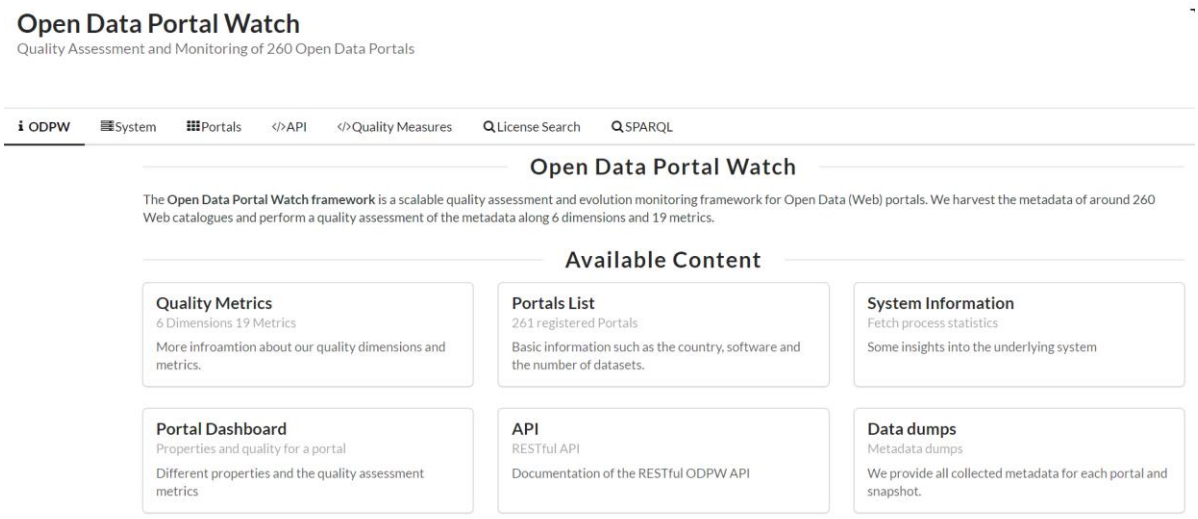


Figure 8 Open Data portal watch: keeping track of Open Data portals online

However, there are other visibility measures that could be taken without having to invest in a fully-fledged crawler infrastructure. Portal owners should also consider publishing a list of datasets which are known to exist, but are not currently available. This would limit the time wasted on abortive searches, while showing visitors that the publisher is monitoring demand and is aware of areas that they need to improve. Identifying a dataset as existing but not available would also offer greater transparency and could help initiate focused discussions between users and publishers, on top of existing request tools (*Figure 9*, *Figure 10*, *Figure 11*).

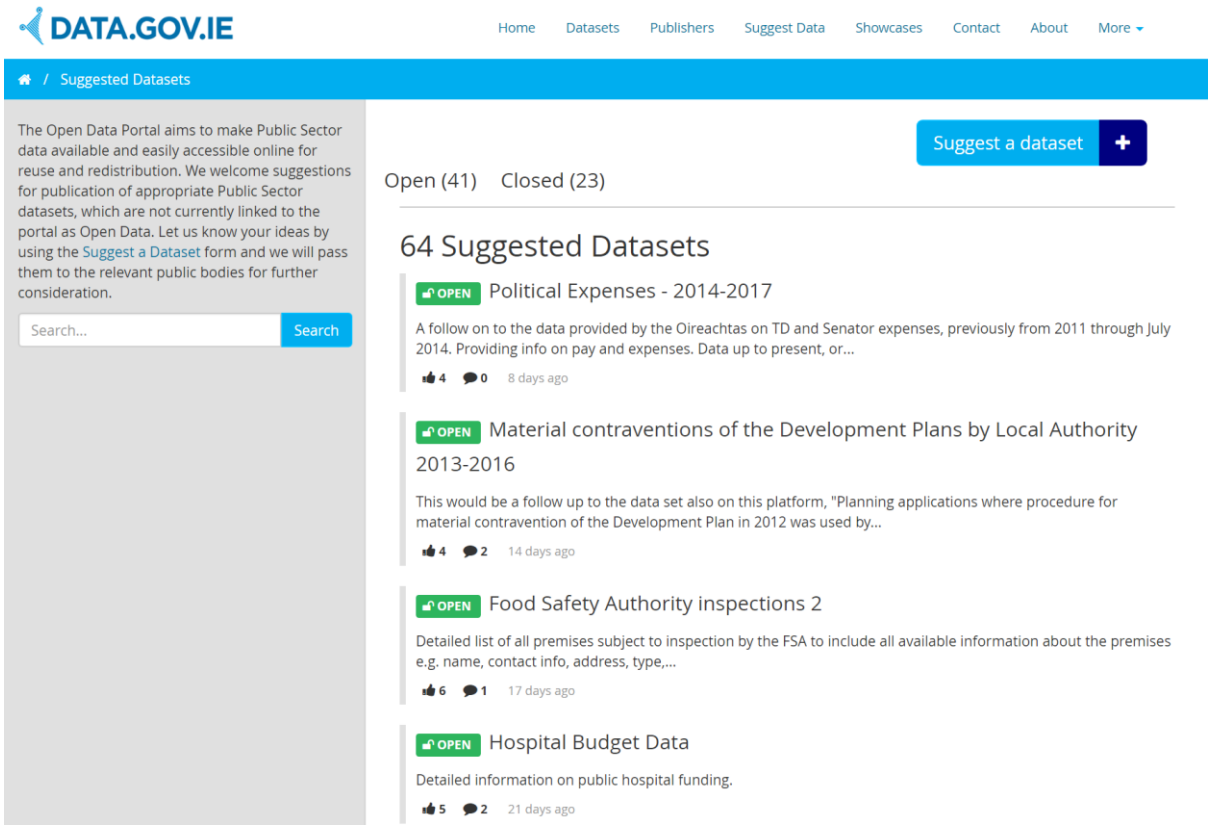


Figure 9 Data request form of the Irish Open Data portal, including open and closed issues, as well as votes & comments

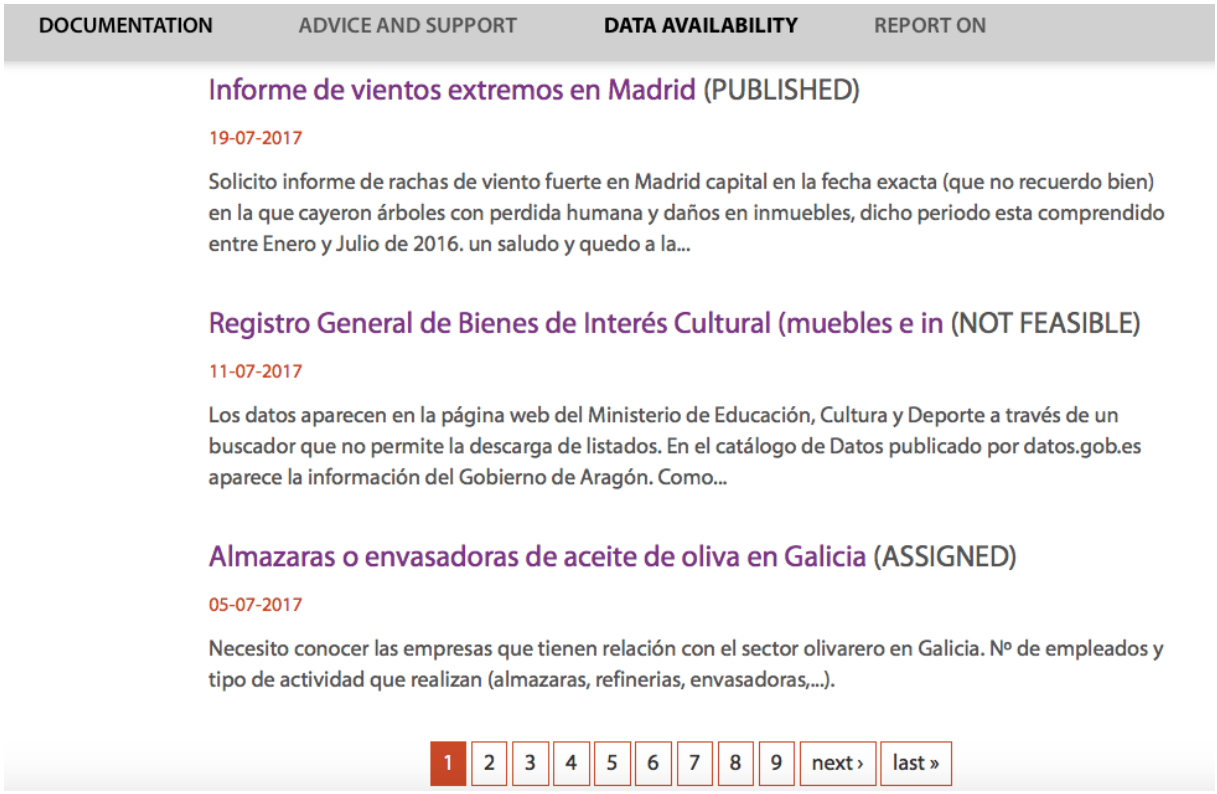


Figure 10 Request responses from datos.gob.es, showing an example of where it has not been possible to release a data set

Figure 11 Netherlands Open Data Portal showing 75 unavailable datasets

4. Publish Metadata

The requirement for enlightening, consistent, usable metadata - data about data - is not new. But neither has this issue been resolved. Accurate metadata is vital not only for findability but also cataloguing - poor metadata can undermine the portal itself. A study by Koesten et al. explored the data search and sense making needs of 20 data professionals,[16] including aspects that are directly relevant when deciding whether a dataset is relevant or not. They distinguish between three dimensions: relevance (is this the data I need?); usability (can I use it in practice?) and quality (how good is the data and how easy is it going to be do use it?). Data should be accompanied by descriptions of these aspects, either as structured metadata, but also in the form of comments, case studies, experience reports, examples of use, etc. (*Figure 12*).

Assess	Information needed about
Relevance	Context, coverage, original purpose, granularity, summary, time frame
Usability	Labeling, documentation, licence, access, machine-readability, language used, format, schema, ability to share
Quality	Collection methods, provenance, consistency of formatting/labeling, completeness, what has been excluded

Figure 12 Table from Koesten et al showing the metadata users consider useful to make sense of data

The European Data Portal for example has a Metadata Quality Assistant, that analyses metadata quality of associated portals on a weekly basis. The review is based on three criteria: the accessibility of distributions, their machine readability and their compliance with the DCAT-AP specification, which is discussed further in section 6.

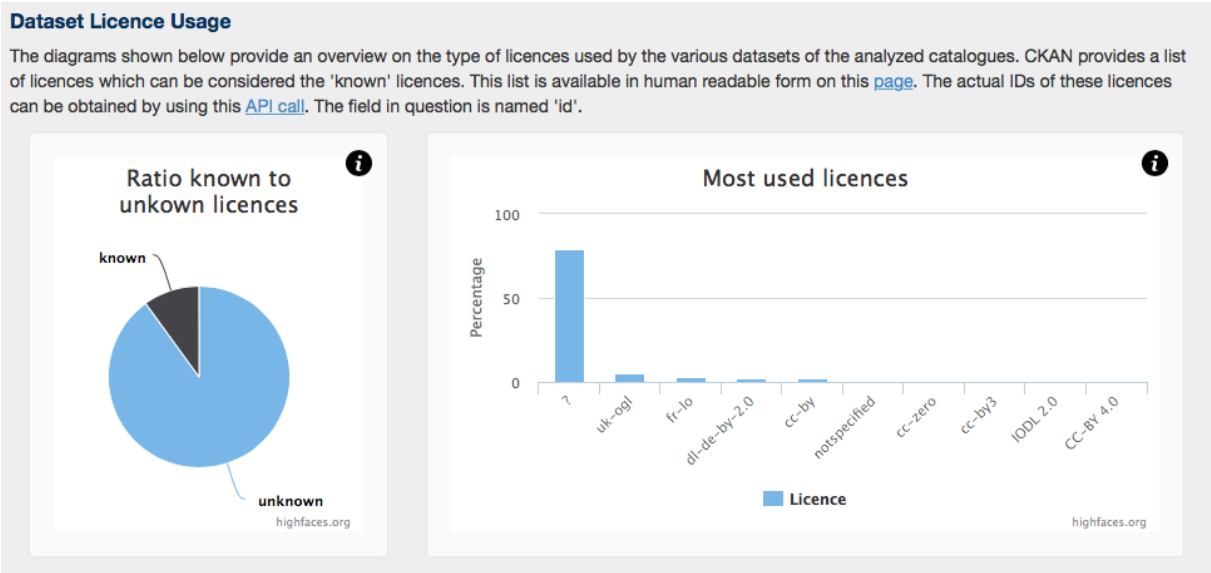


Figure 13 The European Data Portal Metadata Quality Dashboard, showing dataset licence usage

Although metadata is a well-researched area and much is known about the value good metadata adds to data, there is still great potential for more methods and systems for the production, measurement and analysis of metadata, which in itself has the potential to enhance reuse. One such area that is relevant to both sections 3 and 4 is the use of metadata for making associations and relationships between datasets.

5. Promote Standards

A standard is an agreed way of doing something. Well-defined common standards enable parties to have a shared understanding of the subject under discussion. For data, this means that the concepts that are relevant in the data domain, the way they are named, their attributes and connections to other concepts are defined and agreed within a community of practice. The Open Data Institute's Open Data Certificates are one such way to assess and certify data portals that meet standards for publishing sustainable and reusable data (*Figure 14*).[17] These are based on the 5 stars scheme for Linked Data.[18] For example, a 'Platinum' standard portal not only has machine-readable provenance and uses unique identifiers – thus satisfying technical demands – but also has a communications team supporting use.

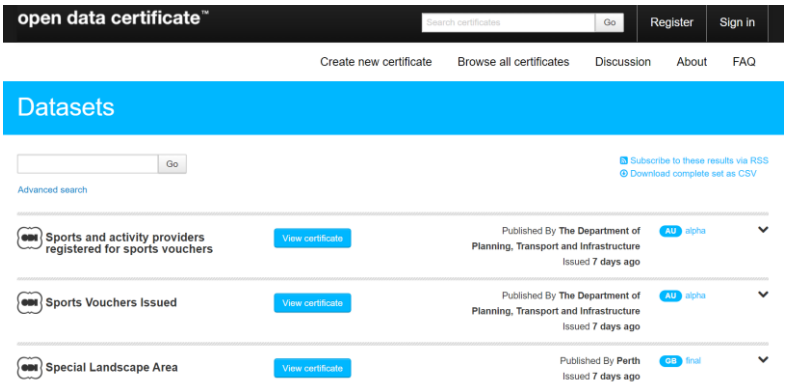


Figure 14 List of certified Open Data sets and portals

However, a second function of standards is that of compatibility – this includes aspects such as interoperability, being able to take someone's data and use it in combination with other data describing similar types of things; endurance; quality; granularity; and licensing. At least 8 different licences are associated with datasets published on dati.gov.it.

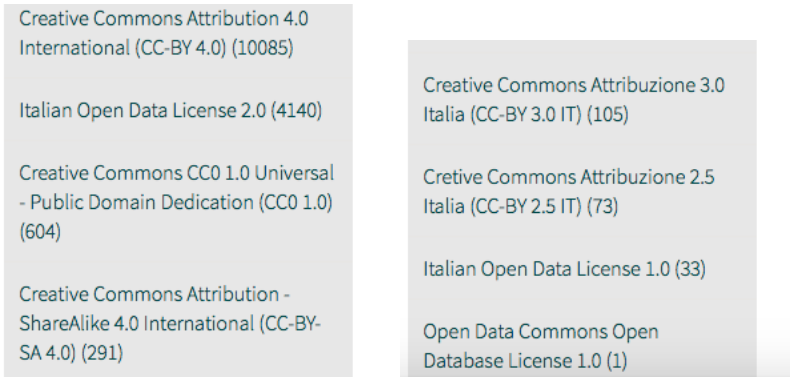


Figure 15 Dati.gov.it

The DCAT Application Profile for data portals in Europe[19] (DCAT-AP) is a specification for describing public sector datasets in Europe based on W3C's Data Catalogue vocabulary (DCAT). At the implementation level, the solution is a thin layer of common metadata standards (see Section 5) applied across multiple data portals. Its basic use case is to enable a cross-data portal search for data sets.

If portals are to become a commodity, they need to define and promote standards for all these different aspects. Based on their experience in publishing thousands of datasets and working together with hundreds of publishers, they are ideally placed to lead standards development, which would facilitate the creation of more useful and usable data via an infrastructure of interconnected repositories. Currently, this is not always the case – while some publishers and portal owners are involved, for example, in the definition of standard vocabularies in certain domains, key standards such as CSV on the Web, all DCAT-related activities, and many others require stronger ties to Open Data government practitioners.

6. Co-locate Documentation

Frequently, even if supporting documentation is present, its length and technicality can render it almost useless, especially if presented in a PDF format. Supporting documentation should be accessed immediately from within the dataset and should be context-sensitive so that users can directly access information about a specific item of concern. This eliminates the need to search the documentation and speeds up access to the relevant material. Users can work with portal owners as a trusted conduit to data publishers to improve documentation, similar to open-source software projects. For these activities to be sustainable, open government data publishers and portal hosts must re-think their ownership models as well, to allow for a broader community to contribute and be acknowledged in secondary data publishing and management such as documentation.

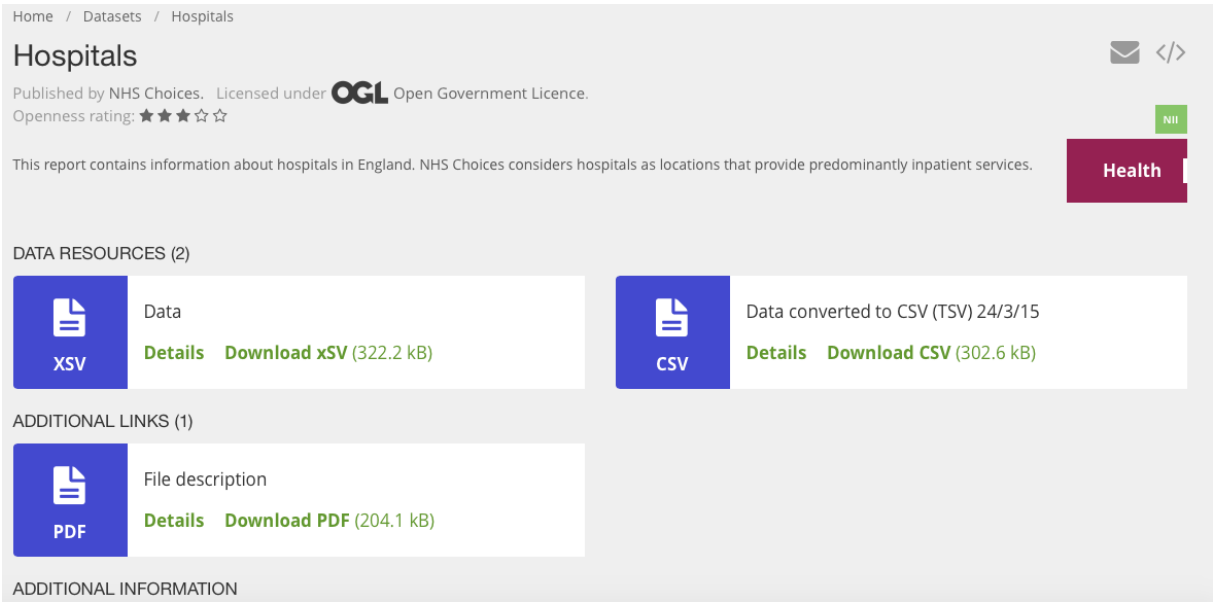


Figure 16 Data published alongside documentation on data.gov.uk

The data campfire model (as illustrated in section 3*),* while focusing on data use, is a good model to follow. The more detailed the information that accompanies a dataset, the easier it will be for data practitioners to decide whether said data is relevant for their tasks. To keep the effort associated with linking and finding these additional details manageable, existing metadata standards need to be extensible to allow apps and services to define their own vocabularies and functionality on top of them.

7. Link Data

Previous research by the European Data Portal has revealed that datasets are often used with each other, with the most popular combination being that of population statistics, environmental datasets and regions and cities data.[20]

Successful exploitation of datasets should be effected by the ability within portals to link to core reference data, such as classifications of common entities (e.g., types of places, organisations, products, assets), open address data and open geospatial data (mapping), units of measurement, temporal information etc. This will allow the cross-referencing and analysis of multiple datasets that are currently siloed or not interoperable on a non-personal basis. Links could also be used to point to previous versions of the same dataset, external datasets not hosted on the portal or recommendations based on content or user features (collaborative filtering).

Creating links between datasets can be achieved in several ways: using a native approach such as Linked Data, which relies on universal Web URIs and domain vocabularies expressed in formal languages; or heuristic algorithms that calculate similarities among datasets based on a pre-defined set of features such as domain, publisher or other metadata categories. Linked Data enables each entry in a dataset to be connected to other datasets, internal or external – datasets are collections of identifiable objects, organised in a graph, just like documents and links on the Web. Links are created by the owner of the data or by third parties and can be accessed in the same way as the data itself. When links denote similarities between entire datasets, they tend to be determined by the portal and need to be updated as new datasets are added to the portal.

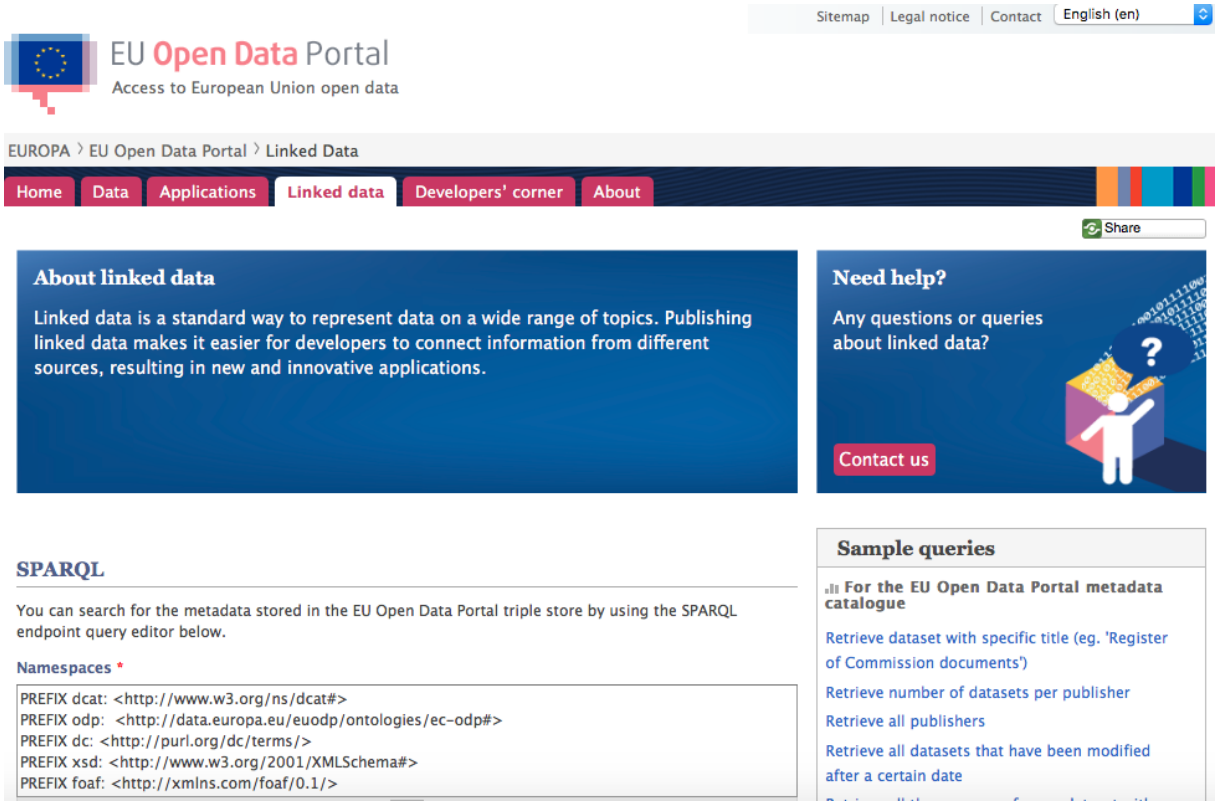


Figure 17 EU Open Data Portal showing SPARQL search

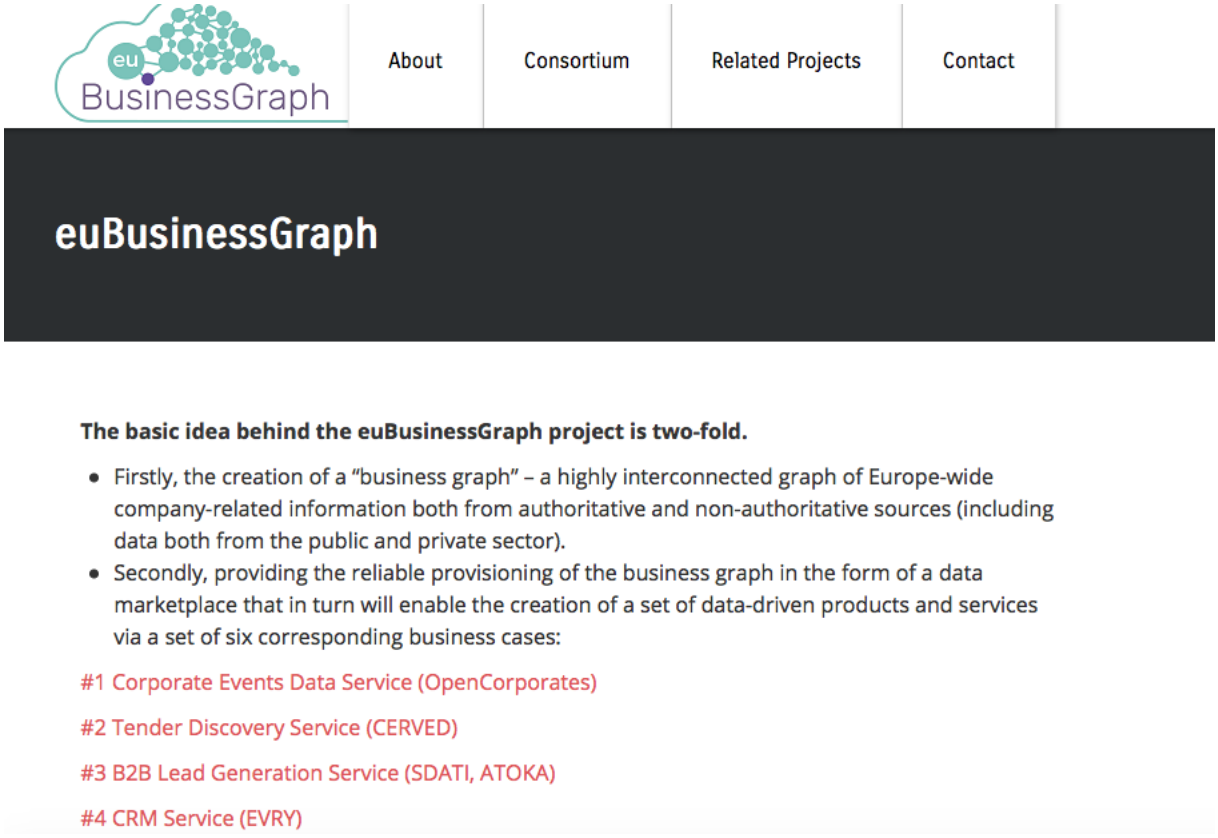


Figure 18 The EU Business Graph creates links between separate datasets around corporate entities

As national governments and the EU encourage the use of higher-starred Open Data (3 stars or more) and Google starts indexing some types of Open Data, there will be demand for professional specialist

services that can carry out the interlinking of repositories and repository collections both accurately and at scale. At the same time, there is a need to understand that linking is as core to Open Data as support for a variety of formats (see Section 11) or defining identifiers.

8. Be Measurable

Data portals require at least two kinds of metrics: usage (for publishers) and quality (for users). The most common usage metric is that of downloads (*Figure 19Figure 19*), which is a very poor metric when trying to understand what Open Data is being used for. Increased use of digital object identifiers may assist in this case, to inform users on which data might be considered high value.

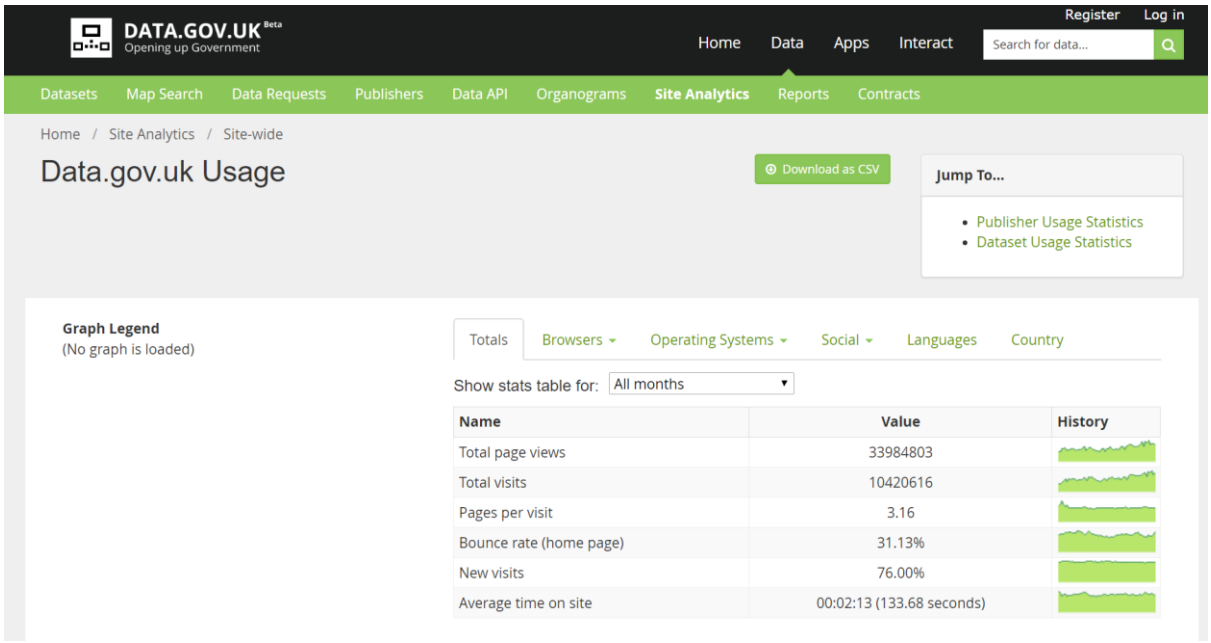


Figure 19 Usage statistics of the Open Data portal in the UK

There is no common standard definition for data quality, but most proposals tend to distinguish between absolute criteria such as completeness (e.g., does the dataset contains all schools in England or does it miss any?); correctness (i.e., is the information factually correct); timeliness (i.e., when it was last updated); and relative ones, most prominently *fitness of use*. Absolute metrics could be used to point people to areas in a dataset that require improvement, whereas fitness of use could increase the confidence in a dataset and perhaps act as a differentiator when one has to choose between different, comparable datasets. Alternatively, portals could consider user reviews – for this to be sustainable, it would require a separate, independent platform (for example the EDP as gateway to the open government data of the EU Member States,) and a realistic incentive model to encourage people and organisations to create reviews. Many well-known examples from ecommerce illustrate how powerful reviews can be in driving improvements in customer experience and sales (in this case, users of datasets).

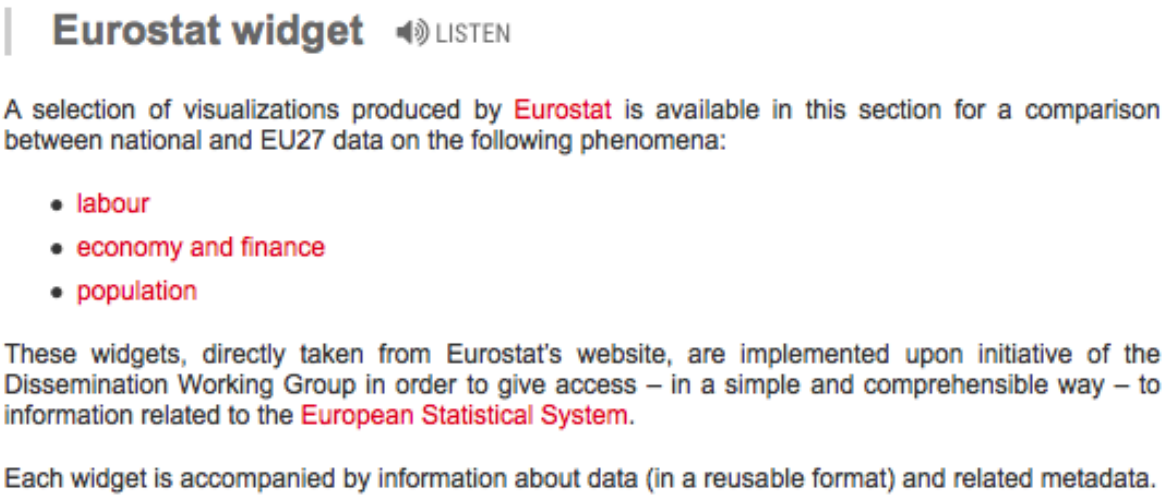
Quality is sometimes understood in the sense of 'having the quality of'. This enables users to match datasets effectively. For instance, hourly data on road traffic might be preferably matched with hourly air quality data, rather than daily or weekly. Data about areas at, for instance, a lower super output area level, may not be effectively combined with data about the same area which also combines other areas. This can improve use decisions, but does not aim to change the data itself.

A key issue for portals is to remain aware of different user groups' prioritisation of the attributes of data, and not to impose a 'one form of data quality fits all' regime. Examples of this include de-emphasising certain datasets because their timeliness is low - this may not matter in certain scenarios.

9. Co-locate Tools

There is a plethora of tools for data manipulation available, but while some tools are household names to the Open Data evangelist, others, including basic mapping and visualisation tools, are unknown to most potential users. The standard process that currently exists is for a user to select datasets from a portal, and then appropriate tools – often ones that have significant financial and knowledge barriers – from a separate location. As Nicholas Terpolilli writes, "The modern way to manage data is to give tools to the average person. And they don't want to scrap HTML tables, look at a CSV file, nor do they want to learn SPARQL."[21] In other words, the barriers to use are orders of magnitude larger than the benefits of use for most people. However, it is exactly these audiences that will ultimately make Open Data and the portals hosting them a household name in many professions and civic projects. For these audiences, what counts is the ability to either be able to inspect or answer queries from the data on site, or have a downloadable package that installs locally to do the same job.

The careful curation and provision of tools in simple categories linked to datasets and their uses can have a huge impact on an individual's ability to explore a dataset and decide on its relevance. One example is EuroStat's visualisation tools, covering many themes including demographics, economics and key themes and also provides a tool for easily creating 'widgets'[22] (as depicted by *Figure 18* and *Figure 20* below).



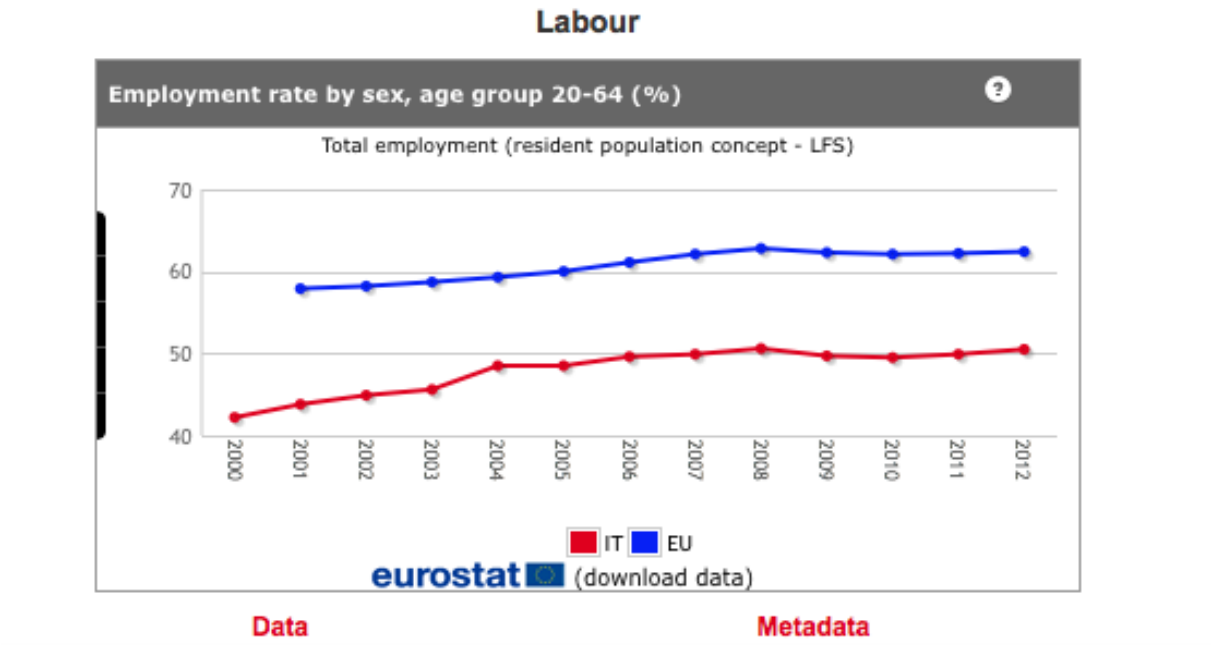


Figure 20 The Eurostat widgets in use on the Italian National Statistics (ISTAT) site. Note the links back to the data and metadata at the bottom.

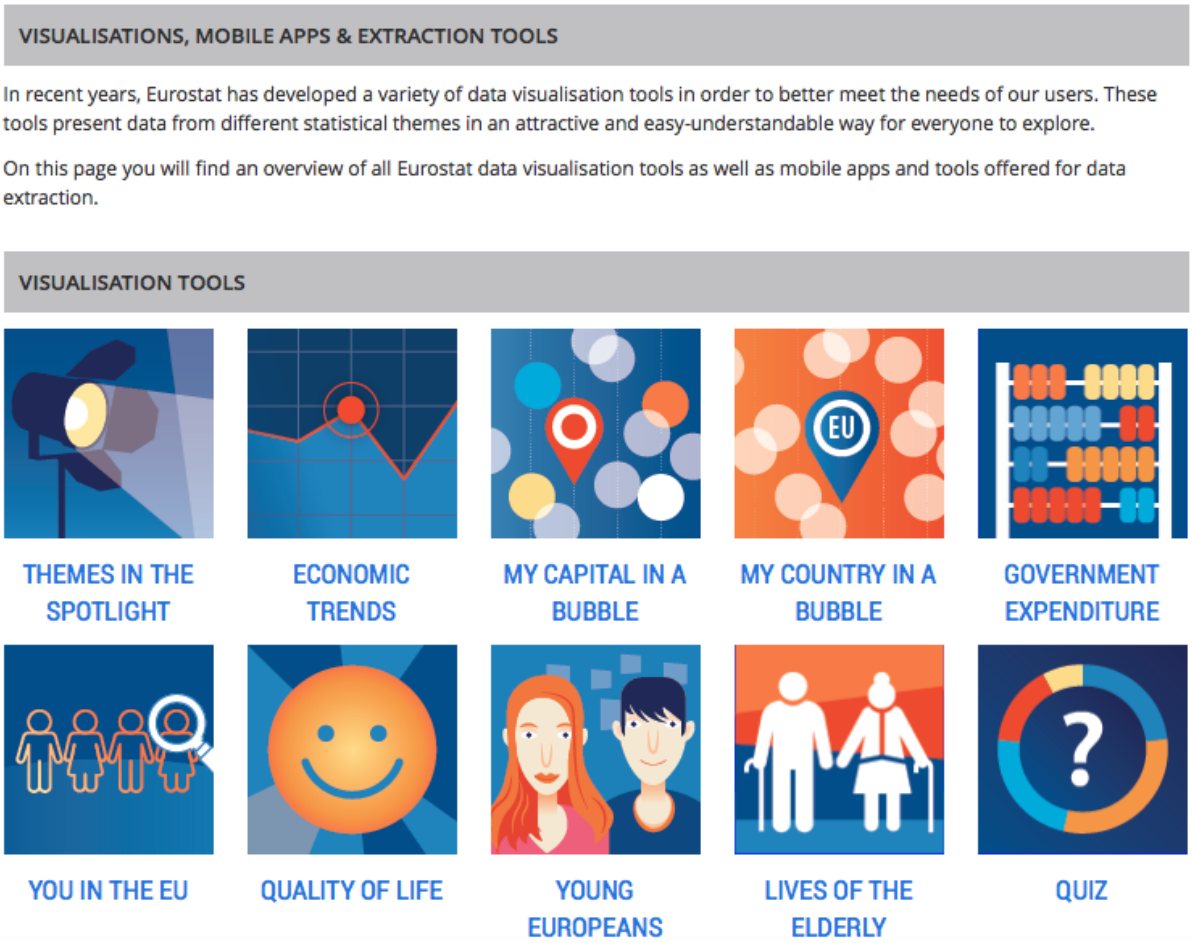


Figure 21 Eurostat's visualisation tools

Another, more in depth tool, is Geo-Explore, created by a team from the University of Southampton. This tool eliminates the need for the use of geographic information systems software to utilise UK Inspire geodata.[23] This means that geodata – possibly the most valuable data in terms of potential for reuse in the world – is opened up to a vastly larger range of use opportunities (*Figure 22)*.

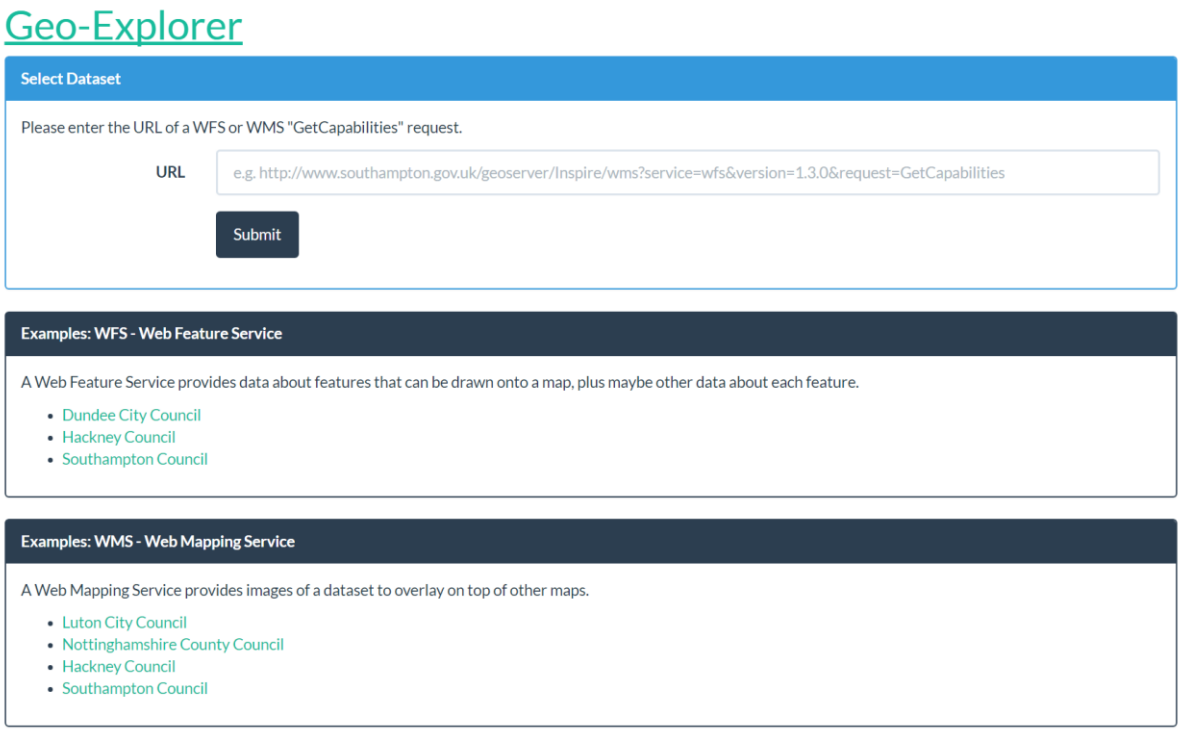


Figure 22 Co-locating tools with geodata

Data.gouv.fr links to easily available and accessible tools, including those found on many desktops, in its 'Reuse' section, with short but clear instructions as to how to use them, with examples of how the results might look.

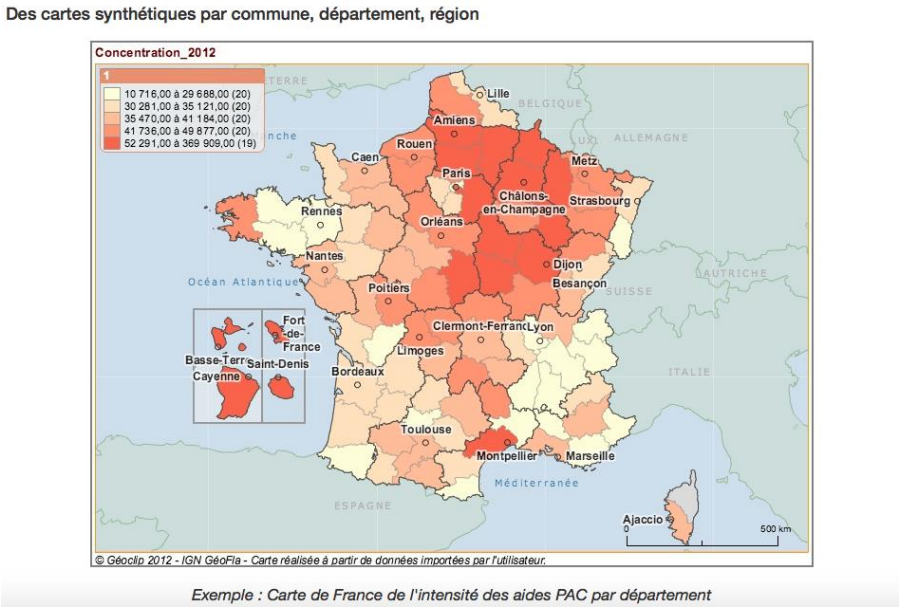


Figure 23 Data.gouv.fr

Opendata.fi. goes further, in specifying it is a portal for both 'Open Data and interoperability tools'.

Figure 24 Opendata.fi showing the integrated search for data and interoperability tools

10. Be Accessible

A survey of 260 Open Data portals discovered that nearly one quarter of the datasets were published as non-machine readable portable document format (PDF).[24] However, it is possible to err in formats at both ends of the data publishing spectrum. Portals that focus on Application Processing Interfaces (APIs) to the exclusion of other formats preclude use as equally as those with too many PDFs. It does this in three ways: firstly, it limits use to those with the skills and software to work with an API; secondly, the content cannot easily be viewed, and some processing is required before it can be easily visualised, unlike, for instance, a simple spreadsheet; thirdly, an API is not necessarily a suitable vehicle for a smaller dataset.

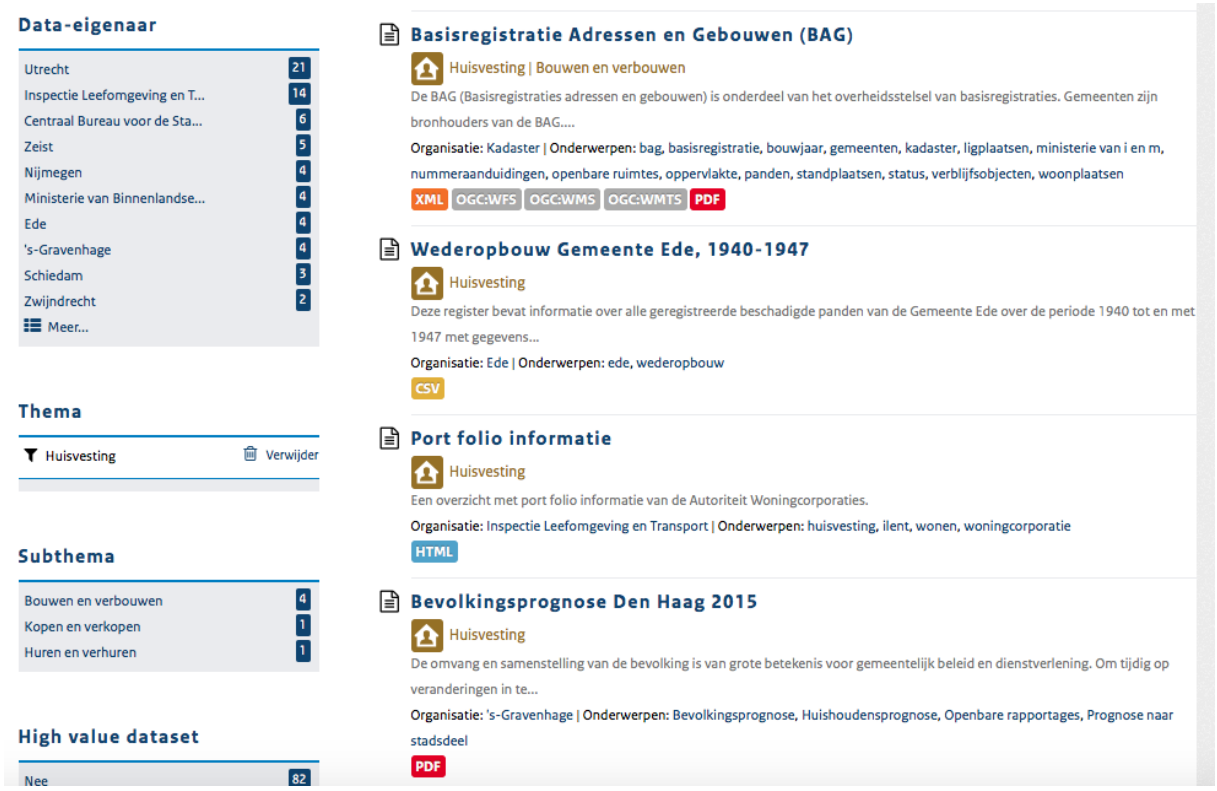


Figure 25 Data.overheid.nl: the PDF only dataset is not machine readable, and the dataset with 4 machine-readable formats is not easily manipulated by the average person

Portal owners can work with data publishers to improve publication formats, and act as a feedback filter between users and publishers. This would fulfil a need for users to recommend and request improvements, while at the same time preventing overload for data publishers via third party prioritisation.

Outlook

These 10 areas may seem intimidating for portal owners, but can be operationalised as effective future proofing, using the following 4 steps:

1. The first step to implement is a review of the portal to see how it measures up. What is the gap between the ideal solution and the existing one?
2. Secondly, address the front end issues such as co-location of tools, and better organisation. Engage with users for their feedback and suggestions. This may include the piloting of changes to the way the catalogue is ordered, or simple exit surveys on whether visitors found the data they were looking for.
3. Thirdly, engage data owners. Linked data and increased documentation require their input, so it is vital to ensure they are aware of the benefits of these.
4. Finally, identify the challenges that cannot be solved alone. Challenges that require joined up solutions can be tackled by working together with other countries/stakeholders under the umbrella of projects such as the European Data Portal. Data owners should ensure they are actively engaged with such programmes.

This should ensure that portals stand in good stead for a future which is going to see a greater balance of users and publishers. On the publishing side, data will increasingly come from not just government but also other sources of publicly funded data; as the Internet of Things develops then citizen sensor data sets will proliferate and become more valuable when shared; resource-scarce groups such as social enterprises may also find value in sharing and combining data – especially when this allows them access to tools that enhance their understanding of their data. Regarding users, commercial data hubs such as Kaggle and qDatum already think of their customers in more forensic detail and portals should follow this lead. In a post entitled, 'Making Kaggle the home of Open Data' the following types of customers are listed: scientist, hobbyist, package author, data vendor, student, company or non-profit and government.[25] Although it makes little sense in the highly distributed world of Open Data for portal owners to try to attempt to understand the vast range of possible uses of data, it is certainly valuable to try to understand a range of users, and consider the best value proposition.

Conclusion

To conclude, not all these approaches are equal in effort. Some are more challenging than others, but together they represent a coherent strategy to minimise current problems and achieve use and impact. Ultimately, the Open Data ecosystem will have to embrace a paradigm shift towards a Web of Data where datasets are described and discovered just like ordinary Web documents. At the same time, portals will remain an important tool to bring together data and other resources, including documentation, reviews, stories, applications and requests in a coherent narrative; to promote and inform about the work of the publishers, aggregate content and drive traffic; and to engage with different communities. However, even in this role, portal owners and publishers need to substantially improve their customer experience, using tools and methods that are the norm in many other digital areas, and consider sustainable financing models, whether that means paywalls for certain types of datasets, advertising, a wider range of publishers or co-ownership models.

Endnotes

[1] According to European Data Portal report 'Open Data Maturity in Europe' (2016), only four of the EU28+ countries did not yet have a national Open Data Portal; Latvia, Liechtenstein, Luxembourg and Malta. In 2016 Luxembourg launched its portal and was joined in 2017 by Latvia and Malta.

[2] See, for example, https://data.london.gov.uk/data-requests/

[3] See, for example, https://data.gov.uk/apps

[4] Anne L. Washington (George Mason University), David Cristian Morar (George Mason University): Open Data Repositories: Intimating Data Publics through File Formats.

[5] https://www.datacite.org/cite-your-data.html

[6] https://www.nature.com/articles/sdata201618

[7] Sarah Leonard, 2012

[8] Apart from those referenced elsewhere: Recommendations for Open Data Portals, from Set up to Sustainability
https://www.europeandataportal.eu/sites/default/files/edp_s3wp4_sustainability_recommendations.pdf
Open Data User Group, National Information Infrastructure
https://data.gov.uk/sites/default/files/library/odugUK_NII_final%20%281%29.pdf
Open Data in the Health Sector http://openhealthcare.org.uk/open-data-in-the-health-sector Data Experiences and Data Visualisation and Data Worlds http://jonathangray.org/2017/02/28/data-experience-density/
Do we need portals for Open Data? http://odcamp.org.uk/do-we-need-a-portals-for-open-data/
Best Practice: (Re)Use Federated Tools https://www.europeandataportal.eu/sites/default/files/reuse-federated-tools.pdf

[9] https://theodi.org/what-is-open-data

[10] https://www.dawex.com/en/

[11] https://www.qdatum.io/

[12] https://socrata.com/

[13] https://support.socrata.com/hc/en-us/articles/202949968-Learn-about-data-portal-usage-from-Socrata-Site-Analytics

[14] Kacprzak, E., Koesten, L. M., Ibáñez, L. D., Simperl, E., & Tennison, J. (2017). A Query Log Analysis of Dataset Search. In *International Conference on Web Engineering* (pp. 429-436). Springer.

[15] https://developers.google.com/search/docs/data-types/datasets

[16] Koesten, L, Kacprzak, E, Tennison, J and Simperl, E (2017) Trials and Tribulations of Working with Structured Data - a Study on Information Seeking Behaviour CHI '17 Proceedings of the 2017 ACM SIGCHI Conference on Human Factors in Computing Systems

[17] https://certificates.theodi.org/en/

[18] http://5stardata.info/en/

[19] https://joinup.ec.europa.eu/asset/dcat_application_profile/description

[20] https://www.europeandataportal.eu/sites/default/files/re-using_open_data.pdf p40

[21] https://medium.com/@nicolasterpolilli/the-global-epic-of-data-distribution-779638eab6be

[22] http://visual.ons.gov.uk

[23] http://geo-explore.ecs.soton.ac.uk

[24] Open Data Portal Watch http://data.wu.ac.at/portalwatch

[25] http://blog.kaggle.com/2016/08/17/making-kaggle-the-home-of-open-data/