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# Data visualisation service definition



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## **Data Visualisation Services**

Prepared by PwC EU Services for the Publications Office of the European Union.

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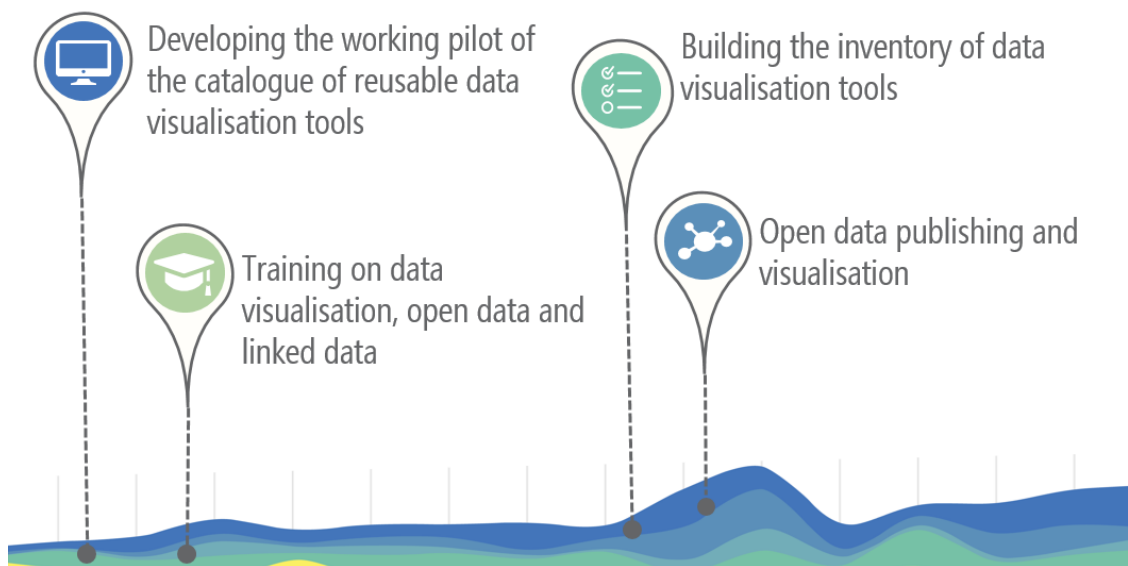
# Introduction

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# Context

The Publications Office of the European Union has embarked on several activities which contribute to the development of a data culture and the data capabilities within its institutions and agencies. In this context, the foreseen activities create synergies with existing initiatives of the Commission, such as participatory decision-making and on data standardisation among others. The focus of the activities for 2016-2017 has been set on:

- Developing capabilities in data visualisation and setting up a community of interest through the creation of a catalogue of reusable data visualisation tools.
- Improving access to information held by the EU institutions and agencies by opening it up and publishing it in reusable, machine-readable formats, in particular following the linked data paradigm.



## Stay informed:

- Joinup community:

[https://joinup.ec.europa.eu/asset/data\\_visualisation\\_and\\_open\\_data/description](https://joinup.ec.europa.eu/asset/data_visualisation_and_open_data/description)

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# Introduction

This document summarises best practices and on-going initiatives on data visualisation at the European Union Institutions and agencies.

More specifically, it includes:

- The basic steps for creating a data visualisation;
- A matrix mapping several of the most popular data visualisation tools to the type of skills required to use them;
- Services and recommendations for the Commission to have in mind when creating a visualisation;
- A list of existing data visualisation initiatives in the European Institutions and agencies;
- Key references and information resources in the field of data visualisation.

This document is intended for the following audiences:

- EU Institution and agency staff and their contractors;
- Public Administrations in Europe.

who want to acquire basic knowledge of data visualisation.



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Basic steps for creating a  
data visualisation

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# Basic steps for creating a data visualisation

Creating a data visualisation without proper preparation may lead to ineffective or unintended results. It is important to assess beforehand the *raison d'être* of the visualisation, the intended audience, as well as how and where the data will be displayed.

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## Question formulation



The first step should always be to **clearly state the business question to be answered**. By being conscious of the answer we need, we can more effectively choose the data required to answer it. A common mistake is to dive head first into the available data and end up losing the initial goal and over-complicating a rather simple process. Consequently, always start by answering the following questions:

- ❑ What do you want to accomplish?
  - Do I need to persuade management about a point of view?
  - Do I need to inform the public of some facts?
  - Do I bring new ideas or existing opinions?
  
- ❑ What is the key message I want to communicate?
  - Do I need to **explain** a current situation?
  - Do I need to **describe** a possible **future** situation?
  - Do I need to **compare** between different scenarios?
  
- ❑ Which is the target audience?
  - Is it high level decision makers?
  - Is it investigation journalists?
  - Is it laymen or technical people?
  - Is it citizens?
  
- ❑ What will the communication channel and medium be?
  - Will it be printed in a magazine?
  - Will it be printed on a poster?
  - Will it be inserted in a presentation?
  - Will it be hosted online in an interactive form?





The next step is to ensure that we have **all the data** we need **in the format** that we need it. In this step, one should ensure, among others, that data is:

### ☐ Available:

- ☐ Does the dataset already exist?
  - In an internal database;
  - Through an online data portal (e.g. [EUODP](#)); or
  - Through a data provider (e.g. [Gartner](#), [Forrester](#), [IDC](#)).
- ☐ If not can it be created?
  - By combining multiple datasets;
  - By harvesting online sources; or
  - By gathering through means of quantitative research.
  - Importantly, can this be done automatically?

### ☐ Interoperable:

- ☐ What is the data format?
  - Is it **open format**?  
Ideally, the data should be in open format (i.e. stored in a standard free from copyright, trademark or other commercial restrictions like CSV, JSON, RDF, etc.). This ensure that **multiple tools can be used** and it can **avoid excessive costs** for the otherwise needed commercial software.
  - Is it **structured or unstructured**?  
Structured data is data that is highly organised according to a defined model or scheme, such as tabular data. Unstructured data is essentially the opposite, such as text from webpages or videos. Ideally, **data should be structured** in order to be easily used.
  - Is it **machine readable**?  
Machine readable data is that which is in a format made for optimised consumption by a machine (e.g. CSV, XML, JSON). **Data should be in a machine readable format** as this greatly speeds up the process of importing it and ensures higher accuracy of it.
- ☐ In case different datasets have to be integrated?
  - Some tools can automatically combine data of different formats, otherwise manual transformation might be required. Programming skills can be required.



## ☐ Accessible:

### ☐ Is the **data freely available**?

- Numerous organisation publish quality data freely (e.g. [EU ODP](#), [Eurostat](#), [Digital Agenda](#)).

### ☐ Is the data usable (e.g. is there any **licensing**)?

- Sometimes data is not freely useable and may be subject to usage limitations due to legal issues. Examples of open data licenses are the [Creative Commons](#) license and the [Open Data Commons](#) licence.
- Licence issues should be handle carefully as it can lead to legal complications.

## ☐ Of good quality:

### ☐ Is the data **reliable**?

- Data that has been published on an official open data portal or endorsed by a major institution can usually be relied on because one can assume that some level of quality check has been done. This depends of course on the reliability of the source.

### ☐ Does the data have a **good enough quality**?

More often than not there will be issues in a dataset, such as: missing data, wrong data, inconsistent data and invalid data. These need to be detected beforehand in order to be addressed during the data preparation phase.

### ☐ Is the data described with appropriate **metadata**?

The metadata of a dataset give invaluable insight into its quality. It is best to always know the answers to some basic questions, such as:

- When was it created?
- Who is the curator?
- How was the data gathered? (researchers involved, quality measures)

## ☐ Relevant:

### ☐ Is the data suitable to answer my question?

- Does it cover the required time period?
- Does it cover the required geographical area?
- Does it cover the required demographics?

## Visualisation type selection



The next step is to select the visualisation itself. The following questions can help guide this process:

- ☐ What **message** do I want to communicate?
  - Different charts are more or less suitable to convey different messages. For example Line charts are great at displaying evolution, Pie chart at showing share, and maps at showing geographic distribution. For additional information please consult this [infographic](#).
- ☐ What is the **type** of data I need to display?
  - **Quantitative** data (i.e. measurable values), are suitable for all kinds of charts;
  - **Qualitative** data (e.g. categorical values as “Red”, “Green”, “Big”, “Small”), are usually used to break down quantitative data in visualisations, or are used to calculate counts to be used as quantitative data.;
  - **Network** data (e.g. Facebook, LinkedIn user relationship data), can be displayed through Network Graphs;
  - **Textual** data (e.g. text from tweets), can be displayed with wordclouds or be put in categories and displayed through common chart types;
  - **Log** Data (e.g. running process log files), are often displayed through dashboards to indicate spikes in system usage or number of errors.
- ☐ Will the visualisation be **static** (e.g. poster or image) or **dynamic** (e.g. a dashboard where the user can interact with the data)?
  - Different charts are more or less suitable for dynamic visualisations. One should take into account how a visualisation will look when data is added or removed from it, and whether it still conveys the message properly.
- ☐ Will it be communicated via a portal or on **social media**?
  - If yes, it is important that the visualisation is fancy, “catchy”, or that it has a “Wow effect” in order to stand out of the crowd and get noticed.
- ☐ Which **type of data visualisation** is it best to be used<sup>1</sup>?
  - The [EU Data Visualisation Catalogue](#) is an invaluable resource that offers guidance according all possible factors that can affect this decision.



After selecting our visualisation type there is a need to prepare the data. In most visualisation projects preparing the data is a **major part** of the process and should under no circumstances be underestimated.

Data preparation may requires medium to deep technical expertise depending on the project. Mistakes cannot be tolerated in the preparation phase as they can lead to dysfunctional visualisations at best, and to providing an untrue message and lead to wrong decisions at worst.

Things to consider here are:

- ☐ Is data in the **format** required by the visualisation?
  - More often than not is not the case and some kind of transformation is required. It is good practice to check the results by alternative means and compare the results to ensure it has been done correctly.
- ☐ Is the **data ready to use**? It may require:
  - **Cleaning** (e.g. removing wrong values, fixing inaccurate or inconsistent values);
  - **Structuring** (e.g. creating a data model to fit the data into in order to allow the development of visualisations).



Depending on the desired outcome there are **multiple tools available**. One must always take the time to **select the right one** as this can greatly improve the results and affect the development process. However with the different tools comes different technical skill requirements as well.

For instance, Excel allows the creation of **simple visualisations** from tabular data, while having the unique advantage of being familiar to mostly anyone who has ever used a computer, thus allowing for easy sharing and collaborative work.

QlikSense and Tableau are easy to use **dashboarding** tools that require limited technical knowledge and allow for the creation of fancy interactive visualisations to assist in data exploration and decision making.

D3 offers unparalleled flexibility for creating **online visualisations**, however it requires substantial coding, thus limiting it to highly technical users.

For a more complete breakdown of available options refer to the [EU Data Visualisation Catalogue](#).

In this step special attention should be paid on:

- ❑ **Annotations:** visualisation should not contain too much text, nevertheless a title is always required. Additional text (e.g. subtitles, labels, legends) should be used only when necessary. Depending of the audience you may consider to publish your visualisation in multiple language.
- ❑ **Arrangement:** improper arrangement of graph elements can at best confuse readers and at worst mislead them. Thoughtful arrangement makes a data visualization easier to interpret. This includes element proportions and ordering, axis intervals, etc.
- ❑ **Colours:** colours lets you guide the viewer's eye, draw attention to different points and tell your a story. Therefore, it can be the difference between a good and a bad visualisation. If your organisation has a graphical guide (e.g. [Eurostat](#)) it should be followed. If not, you can use a tool to select colours (e.g. <http://colorbrewer2.org/>).



In this step of the process the following points should be addressed:

- ❑ What is the **sustainability** of my visualisation? Is my visualisation dependent on specific infrastructure (server, data portal, etc.) or a dataset?
  - If yes, then we need to investigate the systems behind it.
  - How will the database communicate with the front end interface?
  - What is the sustainability of the server and the databases?
  - Does the visualisation require periodical updates of the data to feed into it? If yes, can I use an API to access data?
  - What could cause problems?
- ❑ Does the visualisation respect the **visualisation guidelines** (e.g. [web accessibility](#) and [accessibility requirements suitable for public procurement of ICT products and services in Europe](#))?
- ❑ What **medium** will be used to display the visualisation (e.g. poster, LCD screens, interactive webpage...)?
  - When it is a poster, or any other printed medium, what you see is what you get. However when the medium is digital, then one needs to test the visualisation on different possible displays that may be used to view it. This can affect all kinds of characteristics, from colours to sizes to parts of it being hidden, and may subsequently impact the message.



Finally, in order to be sustainable your visualisations need to be documented. Here is a list of points that should appear in any documentation:

### ❑ **Scoping:**

- **Who made the visualisation?** Name of the publisher, name of the producer, etc..
- **What was the purpose?** logo, leaflet, brochure, posters, etc.
- **What is the key message you wanted to communicate?** Give description and quality values.
- **Who was the target audience?** internal or external actors, fields of activity, etc.

### ❑ **Visualisation Description:**

- Description of the visualisation solution.
- Methodologies involved.
- Technologies and tools involved.
- Internet address (if applicable).
- Screenshots.
- Multilingual coverage (number of languages and their ISO code).



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Which tools for whom



# Which tools for whom

There are numerous tools available for creating data visualisations. Although some are accessible to anyone, others require specific skills or trainings to be able to effectively use them. The matrix below maps some of the most popular tools to the type of user.

Tool	Basic User	Advanced User	Software Developer	Technical Skills	Pricing
<a href="#">D3.JS</a>			✓	HTML, CSS, Javascript	Free
<a href="#">Eurostat Tools</a>	✓			None	Free
<a href="#">FusionCharts.js</a>			✓	HTML, CSS, Javascript	Commercial
<a href="#">Google Charts</a>			✓	HTML, CSS, Javascript	Free
<a href="#">HighCharts.js</a>			✓	HTML, CSS, Javascript	Commercial
<a href="#">Infogr.am</a>	✓			None	Commercial
<a href="#">Leaflet.js</a>			✓	HTML, CSS, Javascript	Free
<a href="#">Microsoft Excel</a>	✓			None	Commercial
<a href="#">Power BI</a>	✓			None	Commercial
<a href="#">Piktochart</a>	✓			None	Commercial
<a href="#">Piwik</a>		✓		HTML, CSS, Javascript	Free
<a href="#">Qlik Sense</a>	✓		✓	Qlik Script	Free
<a href="#">QlikView</a>	✓		✓	Qlik Script	Commercial
<a href="#">Raw</a>	✓			None	Free
<a href="#">Sisense</a>		✓		None	Commercial
<a href="#">Statistical Atlas</a>	✓			None	Free
<a href="#">Statwing</a>	✓			None	Commercial
<a href="#">Tableau</a>	✓			None	Commercial
<a href="#">Tableau Public</a>	✓			None	Free
<a href="#">Timeline.js</a>			✓	HTML, CSS	Free
<a href="#">Trendalizer</a>	✓			None	Free

More information and tools can be found on the catalogue of reusable data visualisation tools developed by the Publications Office of the EU: [http://52.50.205.146:8890/data\\_visualisation\\_catalogue/](http://52.50.205.146:8890/data_visualisation_catalogue/)



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## Data visualisation initiatives in the EU Institutions and agencies

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## Data visualisation initiatives in the EU institutions and agencies

Project	Charts
Institution	Directorate-General for Communication
Details	A chart is a tool that allows you to present numeric data in a graphical view. Charts can be interactive and published in a web page. These charts can be created using HighChart, a JavaScript library supporting several types of charts. ( <a href="#">link to the tool</a> )

Project	Map
Institution	Directorate-General for Communication
Details	Map lets you embed interactive maps in your website. You can customize maps by displaying data in overlays. You can create your own overlays. Map is also a JavaScript library driven by Leaflet. ( <a href="#">link to the tool</a> )

Project	GISCO (Geographic Information System of the Commission)
Institution	Eurostat
Details	GISCO (Geographical Information System of the Commission) is a service of Eurostat that answers needs for geographical information at the level of the European Union, the Member States and regions. ( <a href="#">link</a> )

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## Data visualisation initiatives in the EU institutions and agencies

Project	
<b>Data visualisations at the Fundamental Rights Agency</b>	
Institution	European Union Agency for Fundamental Rights (FRA)
Details	Visualisations to display interactively and visually the results of survey about fundamental rights. ( <a href="#">link to presentation</a> )
Project	
<b>European Structural and Investment Funds (ESIF) open data platform</b>	
Institution	DG REGIO
Details	Monitoring platform to report information about EU funding, increasing transparency, boosting programmes' performance and facilitating engagement with the stakeholders. ( <a href="#">link to presentation</a> )
Project	
<b>Visualisation tools for statistics: the DIGICOM project as an accelerator</b>	
Institution	DG ESTAT
Details	Creating and sharing new, innovative dissemination products, tools and services for the European Statistical System. ( <a href="#">link to presentation</a> )
Project	
<b>Data visualisations at EEA</b>	
Institution	European Environment Agency
Details	The EEA use a lot of visualisations to represents information. To do so, they use the following tools and techniques: DaViz, Tableau, ArcGIS, Kibana, ElasticSearch, Statwing. ( <a href="#">link to presentation</a> )

For additional information, please refer to [this page](#).

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## Data visualisation initiatives in the EU institutions and agencies

Project		TIM: Visualisation tools for policy-making
Institution	DG JRC	
Details	JRC is developing a series of tools to track and technological development and innovation. ( <a href="#">link to presentation</a> )	
Project		Agricultural market dashboard project – from Excel to QlikView
Institution	DG AGRI	
Details	Data collected on agricultural markets were made available through PDF “dashboards” created via Excel. Afterwards, DG AGRI decided to build a data warehouse and work with QlikView to build a digital, interactive dashboard ( <a href="#">link to presentation</a> )	
Project		The Gender Statistics database
Institution	European Institute for Gender Equality	
Details	EIGE created a database to consolidate data available about gender equality in the EU. This tool is available online and allows to browse the data and create visualisation that can be exported. Moreover, an API is available. ( <a href="#">link to presentation</a> )	
Project		Reusable solution for the dissemination of statistics Renovation of Eurostat dissemination tools
Institution	Eurostat	
Details	Offering a centralised tool for export, search and explore the data (visualise, compare, export, etc.) in order to simplify the operational management and to reduce the technical complexity. ( <a href="#">link to presentation</a> and <a href="#">link to presentation</a> )	

For additional information, please refer to [this page](#).

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## Data visualisation initiatives in the EU institutions and agencies

<b>Project</b>	
<b>Surveillance Atlas of Infectious diseases/ Business Intelligence tool for further data analysis</b>	
Institution	Surveillance Atlas of Infectious diseases/ Business Intelligence tool for further data analysis
Details	ATLAS gives access online to EU/EEA infectious disease surveillance data through an interactive interface. Moreover a BI suite is used to access, analyse and manipulates these data and create charts and maps. ( <a href="#">link to presentation</a> )
<b>Project</b>	
<b>Use of Tableau Software in the BeO and RIO project and use of D3 in MIDAS</b>	
Institution	DG JRC
Details	Data visualisations used to monitor research and innovation and bioeconomy using Tableau and D3. ( <a href="#">link to presentation</a> )

For additional information, please refer to [this page](#).



## Additional information

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# The European Commission catalogue of data visualisation tools

The Publications Office of the EU is also developing capabilities in data visualisation and setting up a community of interest through the creation of a catalogue of reusable data visualisation tools:

[http://52.50.205.146:8890/data\\_visualisation\\_catalogue/](http://52.50.205.146:8890/data_visualisation_catalogue/)

This catalogue allows relevant stakeholders to discover tools that will help them understand underlying patterns of the datasets, as well as to convey complex information to an audience in a manner that can be quickly consumed and easily understood without further explanation, and by encouraging and contributing to the culture of reusing software solutions and knowledge. Stakeholders can also contribute either by submitting the description and related documentation of a visualisation tool that is not in the catalogue yet, by including technical documentation or guidelines of a visualisation tool, or by submitting examples created with a specific tool. Finally, stakeholders can ask questions or provide opinions of the visualisation tools through the forum.

Find out more about this project:

<https://bookshop.europa.eu/en/report-on-reusable-data-visualisation-tools-to-support-data-driven-policymaking-pbOA0416619/>



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## Online resources

### Data visualisation specialists

We will present here some very interesting people to follow when it comes to visualisations:

- [Edward Tufte](#): Edward Tufte is a statistician and artist, specialised in data visualisation. He is Professor Emeritus of Political Science, Statistics, and Computer Science at Yale University and wrote several books about data visualisation.
- [Stephen Few](#): Stephen Few is a leading expert in data visualisation for sense-making and communication. He founded Perceptual Edge, and wrote several guides about business graphics, the visual design of dashboards and visual data analysis.
- [Alberto Cairo](#): Alberto Cairo is the Knight Chair in Visual Journalism at the School of Communication of the University of Miami. He worked several years in the field of data-journalism, infographics and multimedia. He wrote two books about data visualisation and teaches courses on graphics and visualisations to journalism students.
- [Andy Kirk](#): Andy Kirk is a freelancer specialised in data visualisation. He works as a consultant and provides training. He is also an author, speaker and researcher.

### Online resources

There are several catalogues of data visualisation tools and podcasts that are interesting sources of information:

- <http://www.datavizcatalogue.com/> This site contains a library of different information visualisation types.
- <http://keshif.me/demo/VisTools> This site contains a web-based data exploration tool, to enable data exploration with the least effort, the most insights, in the shortest time.
- <http://data-journalismtools.silk.co/> This site is a structured database listing tools and resources that can be used to create visualisations.
- <http://datastori.es> is a podcast on data visualization with Enrico Bertini and Moritz Stefaner.
- <http://www.designingmapinterfaces.com> lists UI Patterns & Best Practices for Map Applications.