O-CITY PROJECT

Topic 2 - Lesson 1. Effectiveness of infographics and data visualizations

This lesson has been prepared to make students understand the usefulness of visualizing data and information, provided that they respect some rules that make information visualization truly effective.

Infographics and Data Visualizations

In designing information you can deal with different types of outputs. You already know what a User Interface is and why you should design it carefully for assuring people a good User Experience. Now, we will focus on other two key visual tools for supporting people in finding the information they need in order to achieve their goal, for example completing a task (e.g. completing a visit in a natural area or a museum), or discovering more about a natural or cultural heritage in an engaging, pleasant, and accessible way: infographics and data visualizations.

Both Infographics and data visualizations are information visualizations, but the first ones present data already giving an interpretation of that dataset, while the second ones generally give more freedom to the user in analysing and managing the raw data, also, datasets can be regularly updated.

Although usually data visualizations are more powerful tools in exploring and dealing with data, all kinds of information visualisations can make them more readable and easily understandable. Generally, they allow a more enjoyable and engaging experience of users with complex data and information, which results in a better relationship with the product, service, brand or organization the information visualization refers to.

Infographics and data visualizations can be static or interactive representations of information and data. In the latter case, they need a User Interface allowing people to interact with data and information.

For example, in Figure 1, 2 and 3 you can see the "Dive into Intangible Cultural Heritage" project, an interactive visualization using web-semantics and graphic visualization to show and navigate through close to 500 elements inscribed on UNESCO's Lists of the 2003 Convention. The constantly evolving and updated visualization allows people to precisely dive into the intangible cultural heritage and discover deep inter-connections among the different elements. Since this is an interactive information visualization, visit the website for a more enjoyable experience: https://ich.unesco.org/dive/constellation. You can interact with the visualized data and also change type of data visualization (see Figure 3) using the functionalities of the User Interface.
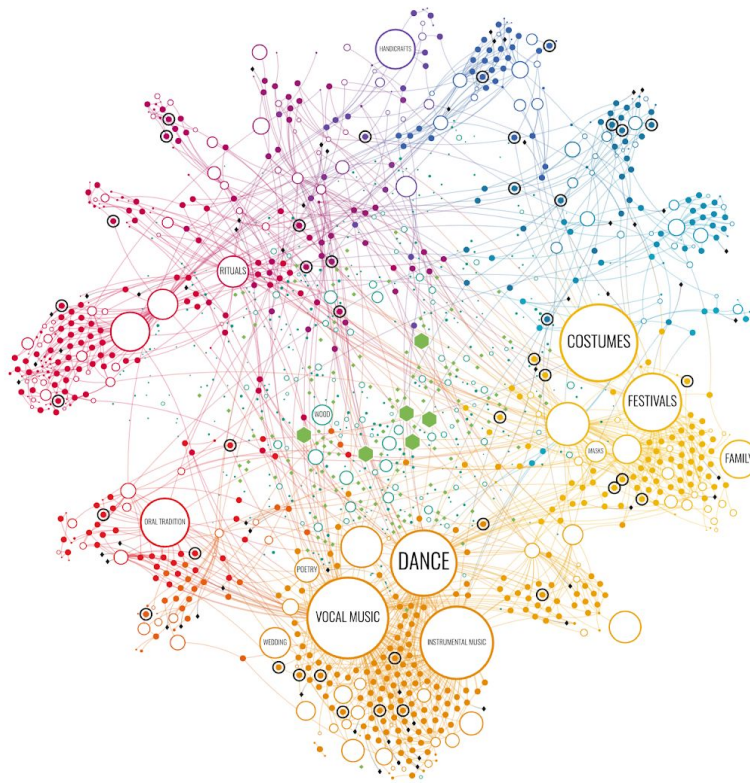
Fig. 1 - "Constellation", a data visualization by Nadieh Bremer for the "Dive into Intangible Cultural Heritage" project by UNESCO. Source: https://www.visualcinnamon.com/portfolio/intangible-cultural-heritage/

A constellation of living heritage elements

This interactive visual demonstrates the diversity and interconnectedness of the living heritage elements inscribed under the 2003 Convention. Navigate by concepts such as 'Dance', 'Family', or 'Rituals' to see almost 500 elements from communities in over 100 countries. Learn about this heritage and imagine where yours fits in!

CLICK Click on any of the objects to "fix" it. After which you can also click a line.

HOVER Move your mouse over any of the objects to see all of its connections.

ZOOM Scroll or pinch/spread to zoom in and out of the network.

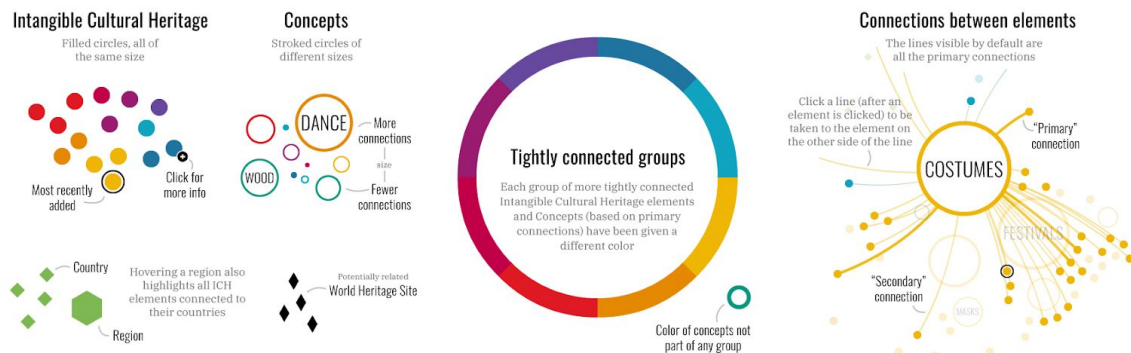**MOVE** Click, hold and drag around your mouse or finger to move the network.

Intangible Cultural Heritage
Filled circles, all of the same size

Most recently added

Click for more info

Concepts
Stroked circles of different sizes

DANCE — More connections

WOOD — size — Fewer connections

Country
Hovering a region also highlights all ICH elements connected to their countries
Region

Potentially related World Heritage Site

Tightly connected groups
Each group of more tightly connected Intangible Cultural Heritage elements and Concepts (based on primary connections) have been given a different color

Color of concepts not part of any group

Connections between elements
The lines visible by default are all the primary connections

Click a line (after an element is clicked) to be taken to the element on the other side of the line

"Primary" connection

COSTUMES

FESTIVALS

"Secondary" connection

MASKS

Fig. 2 - Detail of Figure 1 about how to read the infographic. Source: https://ich.unesco.org/dive/constellation
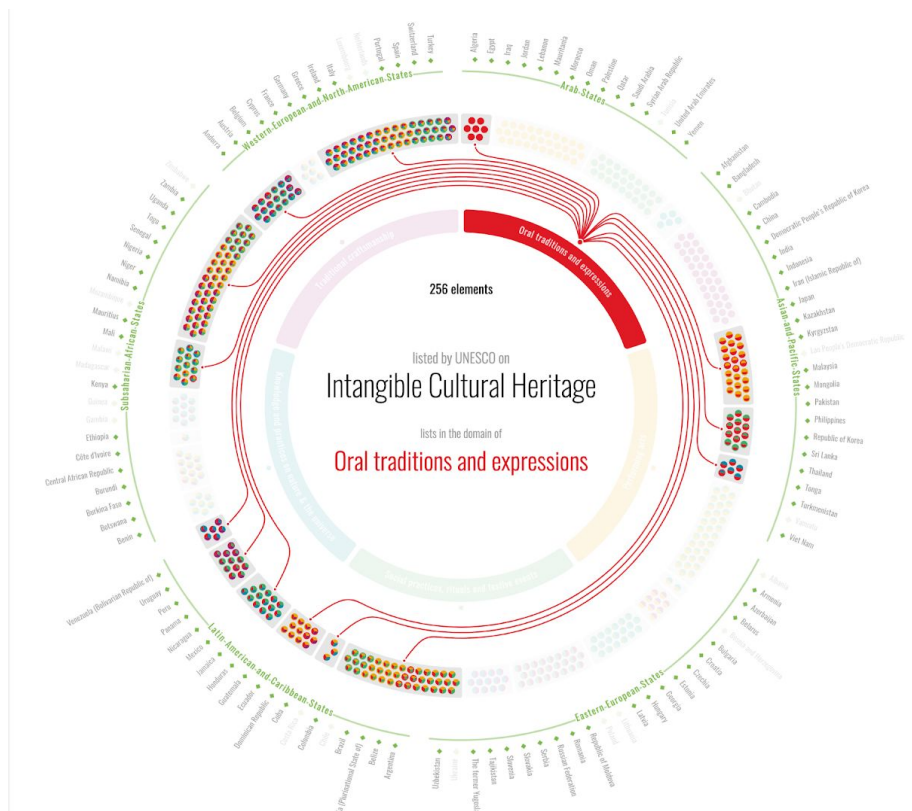
Fig. 3 - "Domains of the Convention" is one out of five kinds of data visualizations (Constellation, Sustainable Development, Biomes and natural resources, and Threats) created by Nadieh Bremer for the "Dive into 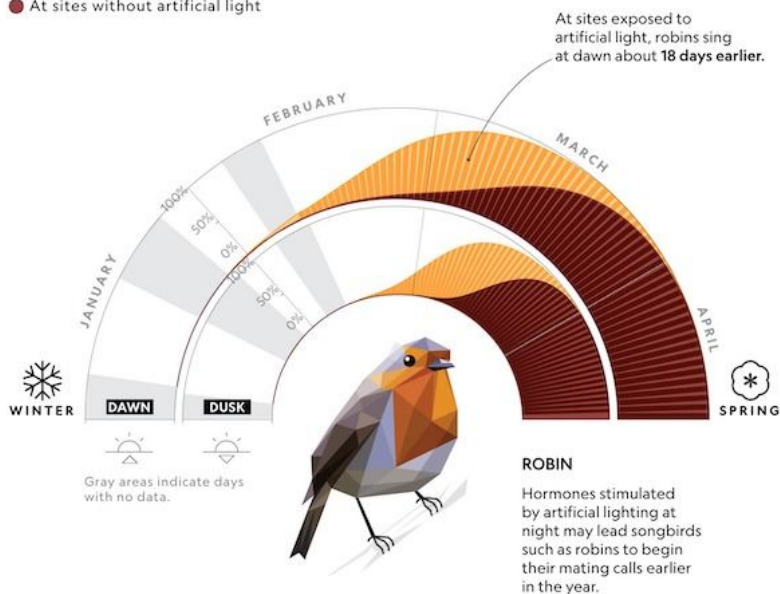Intangible Cultural Heritage" project by UNESCO. Source: https://www.visualcinnamon.com/portfolio/intangible-cultural-heritage/

In the previous lessons, we go through two key points of information visualization: design process and visual language. Another key point to focus on to realize amazing infographics is data analysis and representation, since, as you have already seen from the examples shown so far, data are frequently used in information visualization. Indeed, they can be effectively used in infographics for telling a story by presenting data in a structured way about a specific topic, as in the following image (Figure 4).

WHEN THE TOO-EARLY BIRD SINGS

In spring songbirds greet the rising and setting sun with a cacophony of chirps meant to entice mates and claim territory. But artificial light has made the night sky brighter and disrupted the seasonal rhythms of birds that use day length as a cue to sing. Of six songbird species that scientists studied in Germany, four started singing earlier in the year because of night lighting. The long-term effects of light pollution on birds' ecosystems, and their survival, remain unclear.

LIKELIHOOD OF SINGING
- At sites with artificial light
- At sites without artificial light

At sites exposed to artificial light, robins sing at dawn about **18 days earlier.**

Gray areas indicate days with no data.

WINTER   DAWN   DUSK   **SPRING**

ROBIN

Hormones stimulated by artificial lighting at night may lead songbirds such as robins to begin their mating calls earlier in the year.

BLACKBIRD

During winter, blackbirds (and robins) may spend more time foraging in well-lit urban areas where they find warmth and more food.

BLUE TIT

Both tit species sing earliest in the year, at both dawn and dusk. For the blue tit, artificial light has a significant impact only at dusk.

GREAT TIT

Scientists don't know if longer mating seasons caused by artificial light will increase nesting success or exhaust birds like the great tit.

MÓNICA SERRANO AND RYAN T. WILLIAMS, NGM STAFF
SOURCES: ARNAUD DA SILVA, MIHAI VALCU, AND BART KEMPENAERS,
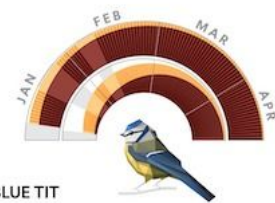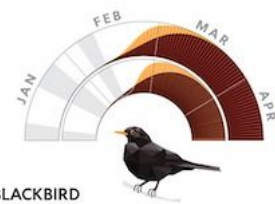MAX PLANCK INSTITUTE FOR ORNITHOLOGY

Fig. 4 - Infographic showing data and information about the effect of artificial light on birds' ecosystems. Source: https://www.nationalgeographic.com/magazine/2018/05/infographic-bird-song-artificial-light-pollution/

Indeed, data visualizations usually require some expertise in dealing with data, since they can be really demanding in making sense of data. However, since even simpler data representations can be included in infographics and other information visualizations, it is useful to have a basic knowledge about how to deal with data in order to create effective and good information visualizations, including infographics.

Data Analysis and representation

Here a few basic considerations about analysis and representation of data within an information visualization. Of course, this is not an exhaustive dissertation about a complex and evolving field of science. However, it is enough for coming to create an infographic at the end of this course.

Data visualization is visually presenting structured or unstructured data by using graphical techniques. It also supports people in inferring information from raw data by directly navigating and exploring a specific dataset.

Why is Data Visualization important?

- It helps people in understanding data and information faster.
- It helps finding connections, i.e. insight and key patterns, between tons of information.
- It is suitable to engage people.

How can data be represented?
- Simple forms and shapes, i.e. simple visual representation of data of only two dimensions, such as charts and graphs, or complex forms and shapes, even allowing users to interact with data, such as animated visualizations.
- Static images or dynamic, such as interactive visualizations, that can change with the actions of the user, and videos.
- Historical data, i.e. referred to past events, or in real time, i.e. referred to ongoing events.

Importance of information visualization
Information visualization makes knowledge more accessible by simplifying large dataset and offering an interpretation of rather complex issues (or simply of issues better conveyed by images) through an intuitive story and a catchy design.
In this way they capture attention, make understandable hard-to-grasp concepts, provide a clear picture about the interest topic, help memorability, and create engagement.
The main goal in creating an information visualization is helping people in understanding something better and more efficiently. Indeed, infographic and data visualization are a form of communication.

Applied to natural and cultural heritage, information visualization can be a useful tool for engaging people and making them aware of unknown resources or peculiarities. By presenting information and data in an appealing and pleasant way, infographics and data visualizations can better draw attention to complex issues and hard to read contents about a natural or cultural heritage. Morevore, as we said in the other lessons, they can also favour a better relationship with the organization delivering the information.

For example, the infographics designer Simon Scarr realized the following infographic (Figure 6 and 7) published in the Hong Kong's South China Morning Post newspaper to show the prolific career of Pablo Picasso in more detail. The information visualization was created since there was an exhibition of the famed artist at the Heritage Museum in Sha Tin, Hong Kong, showing just a tiny fraction of all the work he produced in his lifetime.
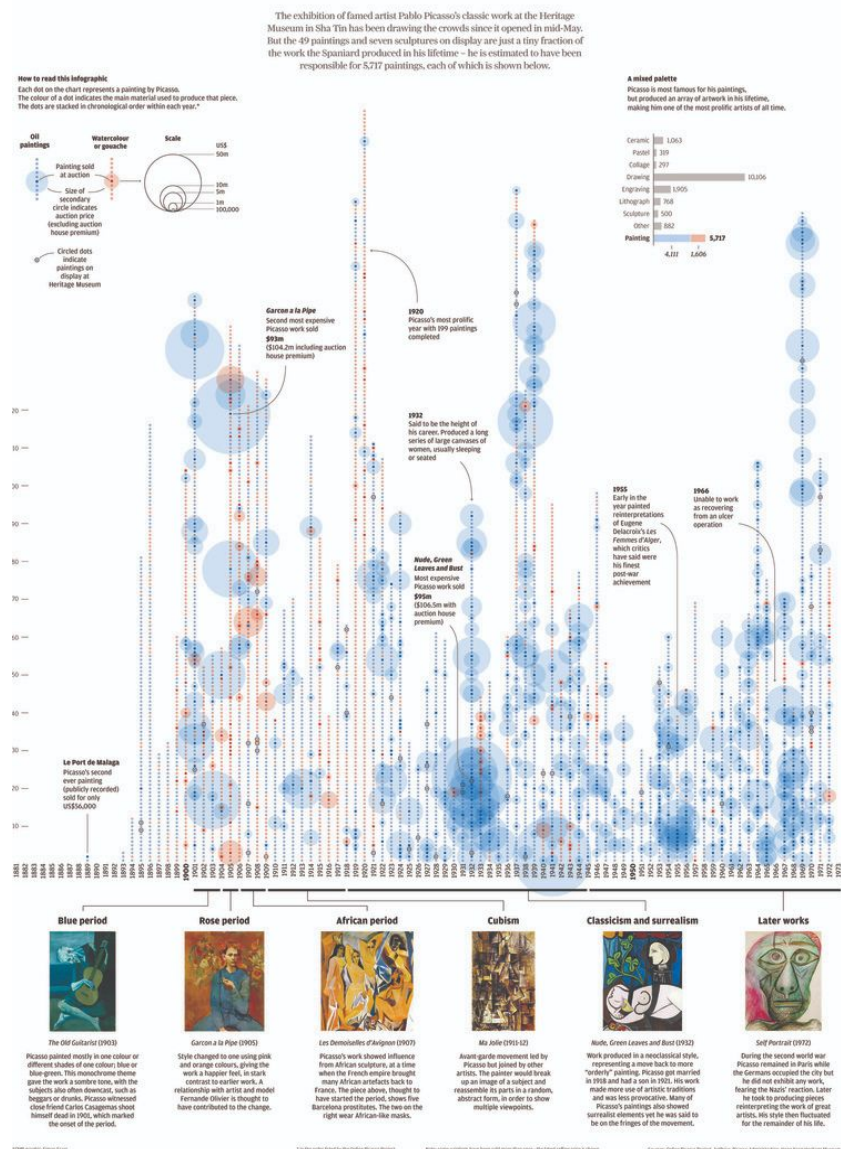
Fig. 6 - Infographic showing data and information about the prolific career of Pablo Picasso by Simon Scarr. The information visualization presents the work of Picasso year by year, indicating also painting material and selling price if the piece went to auction. Source: http://www.simonscarr.com/picasso
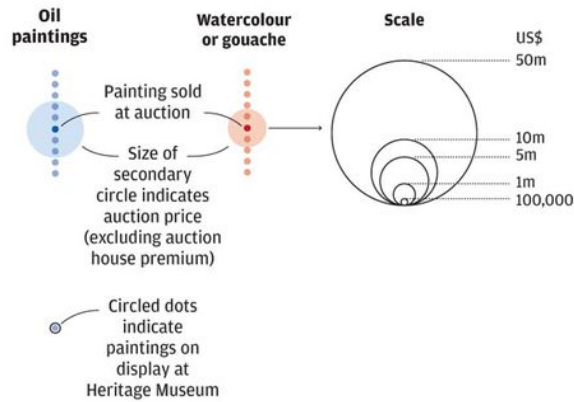
Fig. 7 - Detail of Figure 6 about how to read the infographic. Source: http://www.simonscarr.com/picasso

Infographics and data visualizations can surely be even less elaborated, but they remain an opportunity to promote heritage in an easy-to-access and widespread way, as the following examples show (Figure 8, 9, and 10).
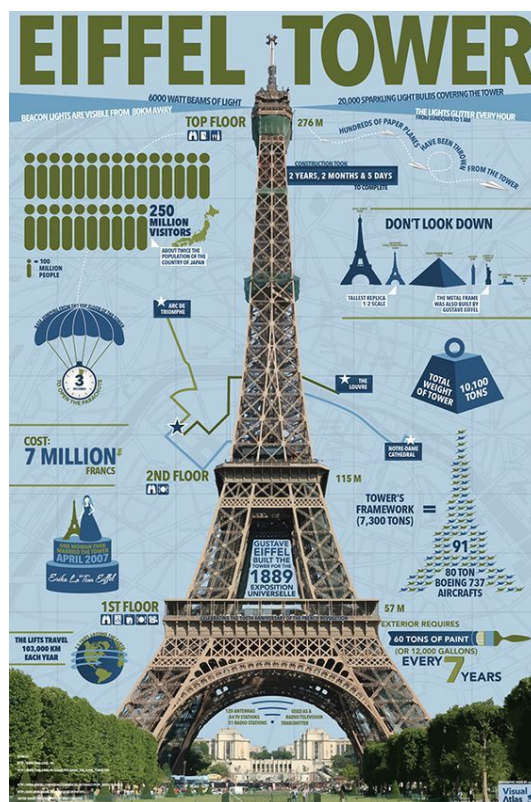
Fig. 9 - Infographic showing data and information about the Rizal Monument. Source:
https://www.spot.ph/entertainment/57493/infographic-the-rizal-monument
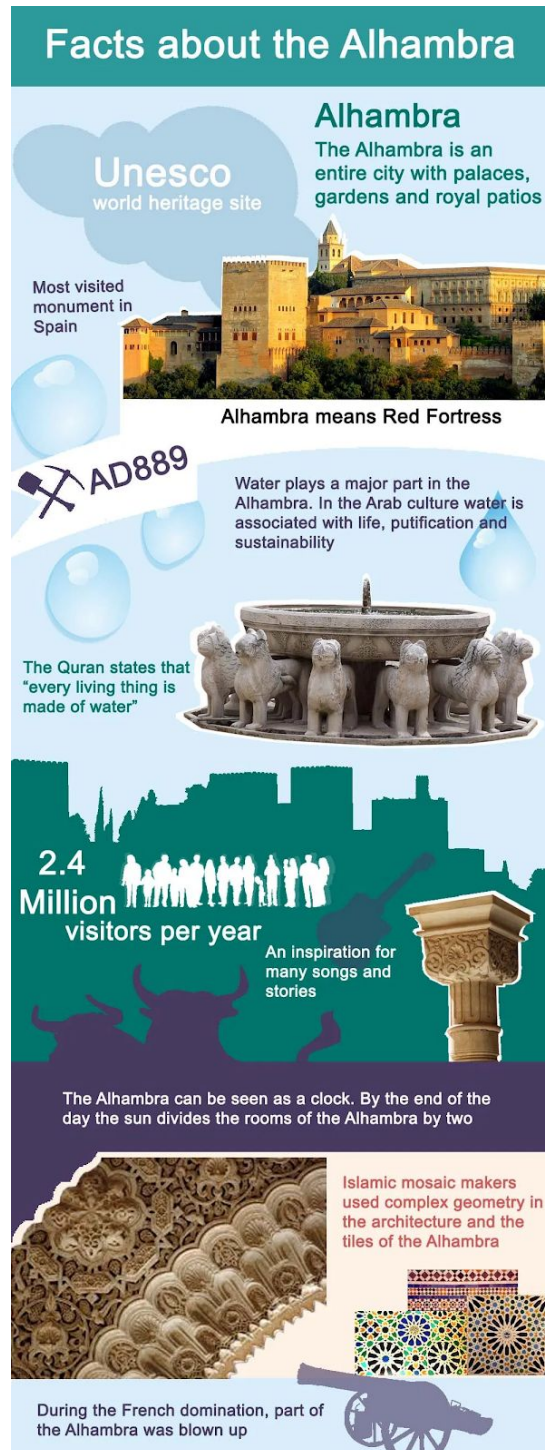
Fig. 10 - Infographic showing data and information about the Alhambra. Source:
https://visitgranada.net/facts-about-alhambra

How to make effective infographics and data visualizations

As already shown in other lessons, in creating infographics you should start from analysing the users and the context according to a User-Centered Design approach.
You should also define what the infographic should be about (main content and topic), always having the user and the context in mind.

Remember that a good information visualization, as well as a good user interface, always meets the user needs. So in designing your infographic or data visualization, ask yourself:
- What information does the user need?
- Why does the user need that information (goal)?
- What will the user do to find or after finding the information (interaction)?
- Does the information provided effectively support the user in reaching his/her goal?

After that, you should focus on how and where collecting the information and data to be inserted in the infographic. Especially when dealing with data visualization, it is fundamental to follow an adequate process for gathering, elaborating, analysing, and synthesizing data.

Figure 11 shows the process that data scientists usually follow when analysing data, according to the OSEMN framework.

The framework was introduced by Hilary Mason and Chris Wiggins in 2010 and highlights 5 key steps in the data science process:
- Obtain data: E.g., from surveys, queries from databases or APIs, online repositories, etc.
- Scrub data: E.g., cleaning data to be as error-free and uniform as possible, filtering data, handling missing data, converting formats, etc.
- Explore data: E.g., using descriptive statistics and data visualization to understand the data.
- Model data: E.g., clustering and categorizing data, using machine learning algorithms to make sense of data and gain useful insight, etc.
- Interpret results: E.g., making meaningful conclusions from data, communicating results, etc.
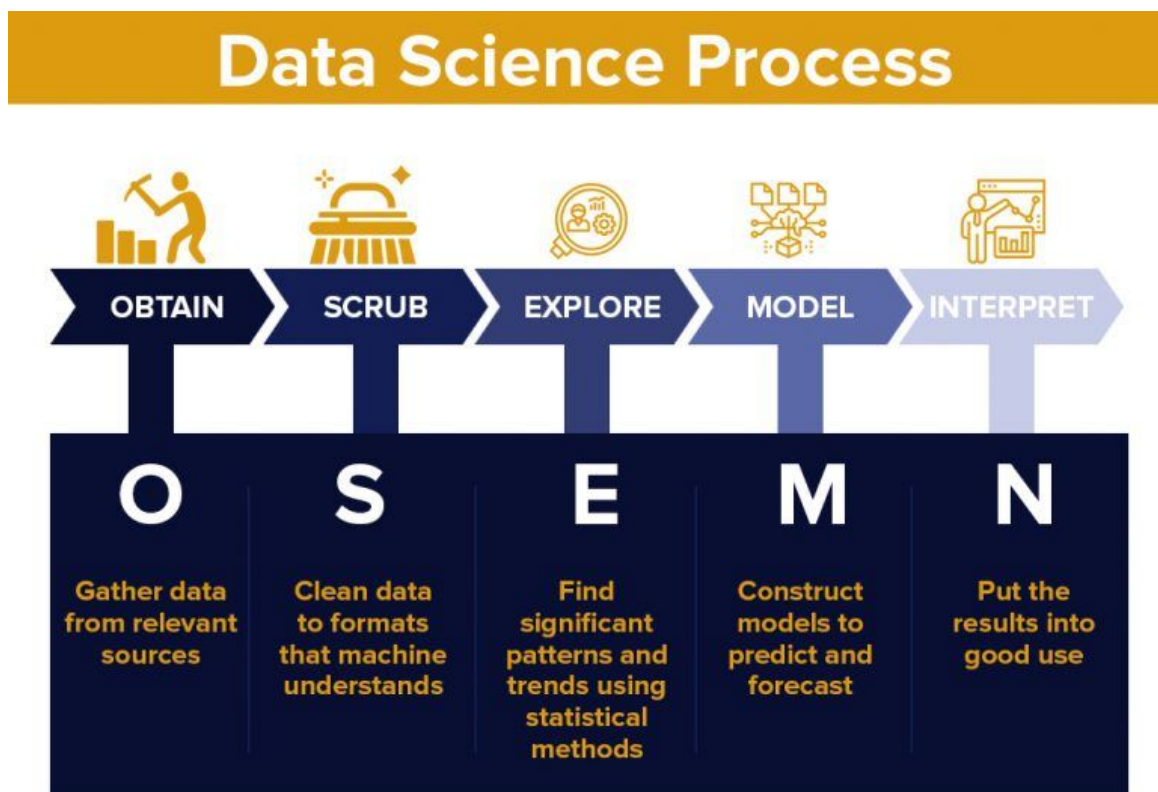
Fig. 11 - OSEMN framework. Source: https://www.guide2research.com/research/how-to-become-a-data-scientist

Please note that in creating an infographic you do not necessarily need to conduct advanced statistical analysis, you can just refer to a simple data table for collecting data.

What really matters is referring to reliable and appropriate sources, i.e. accurate, relevant, and useful. Therefore, be sure that the source of your data and information is a credible one and that the information provided is coherent with your project.

Referring to sources, you can find different typologies of data. The following list is not exhaustive, but present a quite good variety of possible sources for data about natural and cultural heritage:

- **Data collected from research**: For example quantitative data derived from surveys, questionnaires, etc.
- **Open data**: Data freely available to everyone to use and re-publish as they wish, without restrictions on access and reuse.
- **Big data**: Large quantity of data (volume), from different sources (e.g. smart sensors in a city), continuously produced and increased.
- **Crowdsourcing**: Data produced by a large group of people (crowd). It combines the contribution (data or information) of numerous self-selected volunteers to achieve a cumulative result (e.g. thematic maps from the geodata produced by our smartphones).
- **Sentiment analysis**: Data useful to analyse the "sentiment" (i.e. affective states and subjective information) of people, for example from social media.
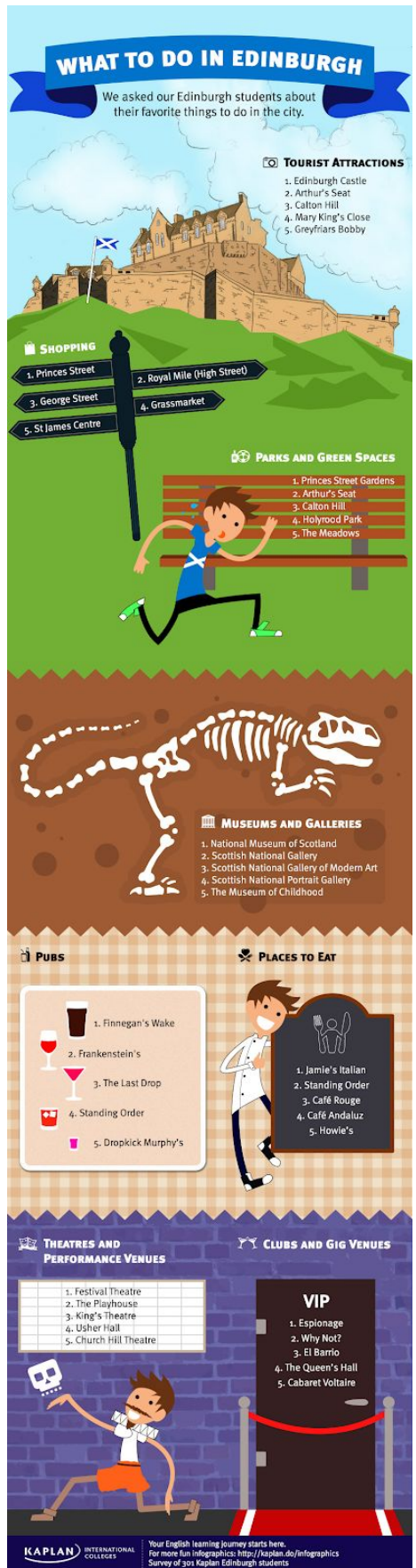
Fig. 12 - Example of infographic that takes its data from a survey. Source:
https://graphs.net/few-things-to-do-in-edinburgh.html; https://www.kaplaninternational.com/

Fig. 13 - Example of Open Data repository about cultural heritage. Source: https://www.europeandataportal.eu/en

Undoubtedly, to obtain effective data visualizations, the bigger and more complex the dataset used the greater the need for advanced and experienced professionals. However, good results can also be reached using simpler datasets or dedicated online tools.

Summing up, there are some steps mostly dealing with usability and reliability, that you need to follow in order to create effective infographics and data visualizations. Following, some suggestions.

A focus on usability and user experience is always needed in the design of infographics and data visualizations. It includes:
- Before creating an infographic or data visualization, identifying its specific purpose.
- Selecting the right information to visualize.
- Selecting the right graphic to visualize information.
- Understanding the right information from the data representation.
- Focusing on how people can use the data visualization (the effect of the data) and their subsequent actions.
- Focusing on how people can interact with the data (user-centric approach).

A focus on reliability is particularly needed for data visualization. Indeed, although other types of information visualizations could be more addressed to other goals, e.g. to evoke emotions, than

presenting solid data, information visualizations are more useful and effective when they present trustworthy and fact-checked data and information. Therefore, reliability includes:

- Checking and citing the sources of information (especially in order to avoid biased and flawed data).
- Standardising sources (when many data sources are required).
- Ensuring the quality of data collection techniques.
- Focusing on the completeness of data.
- Making sure that data are appropriately stored.
- Making sure that the chosen mode and model for the data analysis are correct.
- Ensuring that the privacy of the people to whom the data refers is respected.
- Avoiding that prejudices (bias or assumptions) influence the way data are analyzed or read.
- Avoiding confusing charts.
- Giving clear instructions and keys to read the information visualization, especially the data visualizations (See Figures 2 and 7).
- Reporting clear and functioning URLs of the data sources used for the data visualization.

Lastly, here some quick tips and rules for creating effective infographics and data visualizations that you can use in creating your infographic:

- Adopt a minimalistic approach (less is more), i.e. be sure to remove unnecessary elements. Use a simple language.
- If you use data, make sure they are really relevant, accurate, useful, and not biased (i.e. based on assumptions instead of facts). Moreover, they should be part of a coherent visual composition in order to clearly convey their meaning.
  Check information and cite sources.
- Use graphs and charts immediately readable and easy to interact with, if it is the case.
  Pay attention to the understandability of the labels you used, if any.
  Give some clear legends, or keys, that can facilitate the reading of the data, otherwise the visualisation could be harder to understand.
- Favour storytelling, since pictures tell a thousand stories. Be sure to create a coherent story. Do not simply report charts, but show a purpose in representing the data (especially for infographics, as purpose turns data into information).
- Make more evident the most important elements you want people to focus on.
  Use icons (or other symbols) to convey more instantaneous messages, especially if you have limited space. Generally, it is difficult to enclose in a few words what icons convey in a few signs.
  Use the cultural conventions and metaphors to facilitate the understanding.
- Present information in a clear manner, do not be ambiguous.
  Create interaction and information flows that do not confuse or overwhelm the user.
  Be consistent in the different parts of the infographic.
  Make sure that the visuals and the story presented in your information visualizations is clear and understandable to others than you.
- Remember the Gestalt rules and the basic visual elements in UX (e.g. hierarchy, appropriate margins and space among different elements, restrained colour scheme, logic and easy-to-follow order in organizing elements, etc.).
  Remember that colours, typefaces, and icons can convey specific meanings.

- Always keep your user in mind!

Conclusions

This introduction to infographics makes us understand how useful they are in favouring people's comprehension of data and information and it makes us reflect on how to make them truly effective.