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Demonstration visualisations

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Abstract: This document presents a collection of budget and spending visualisation that demonstrates the usability and completeness of the visualisation framework for each of the stakeholders.

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Executive Summary

This deliverable is part of the Work Package 3, the main objective of which is to provide a user-friendly interface on the wealth of spending and budget data.

It demonstrates how the types of visualisations of the visualisation framework enable users to communicate budget and spending data, based on the work done in Task 3.1 that collected and categorized different types of possible uses to represent budget data.

For each visualization, this deliverable follows the same pattern: a short introduction explaining the visualization type, an assessment of the current situation of the tool and recommendations for possible next steps that would match the tool's capabilities with best practices in data visualization.

Abbreviations and Acronyms

TFT	The Football Tax, a WP5 case study
WP	Work Package

Glossary

The final user	The person that uses the visualisations framework, either to analyse the budget data or to create visualisation to convey a message
The reader	The person to whom the visualisation intended

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Introduction

Task T3.1 collected different types of possible uses to communicate budget and spending data. The visualisation framework allows the final user to create 8 types of demonstration visualisations that each fits a need.

	Tree map	Pie chart	Bubble tree	Sankey	Bar chart	Table	Line chart	Pivot table	*Map*
Showing breakdown of totals	X	X	X					X	
Contextualising big numbers	X								
Showing geographical distribution of funds									X
Showing trends over time							X		
Showing breakdown of funds by sector or recipient		X							
Showing networks of financial flows				X					
Following financial flows				X					
Comparing budgeting, commitment and execution	X				X				
Comparison of revenues, expenditures and debts		X							
Public finances per person						X		X	

Figure 1: Typology of visualisations to use by function

List of demonstration visualisations

Tree Map

Description

A tree map is an area-based visualisation that shows two variables using the size and the color of boxes. **They are used to display large numbers of values that exceed the number than can effectively be shown in a bar graph.** The levels in the hierarchy of the tree map are visualized as rectangles containing other rectangles. Each set of rectangles on the same level in the hierarchy represents a column or an expression in a data table. Each individual rectangle on a level in the hierarchy represents a category in a column.

Function

Tree map visualisations draw the reader's attention to the relative proportion of boxes and are useful for:

- Showing breakdowns of totals
- Contextualising big numbers
- Comparing budgeting, commitment and execution

Usability and completeness

In the visualisations framework, the size of the boxes represents the amount. The sum of all the elements in one branch sum to the value of the branch as a whole.

On click on a rectangle, the reader sees a new tree map that displays the distribution of the items in the chosen category.
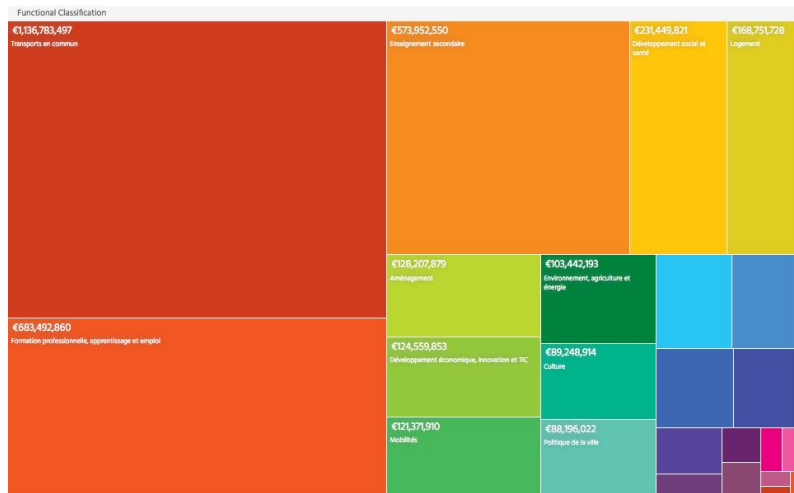
Figure 2: Tree map presenting the distribution per item in the executed budget 2015 of the Region Ile-De-France, France. Created with the visualisation framework .

Next steps

The use of colors

Colors of the boxes can be used to measure a performance or a change, such as growth over time. If it's not the case, color ranges should fit the data in for instance using different shades of one color.

Display of the labels

Labels are difficult to display in small spaces. For readability purposes, the visualisations framework should not display labels that are too long. Instead, these long labels should be displayed on tap or hover on a box of the visualization.

Presentation of node details

When the reader selects a node in a tree map, she should see the available details either in a tooltip window or in the sidebar. If the detail is substantial in size, it is best to push it into a sidebar. Simpler data can show up in a box like tooltip.
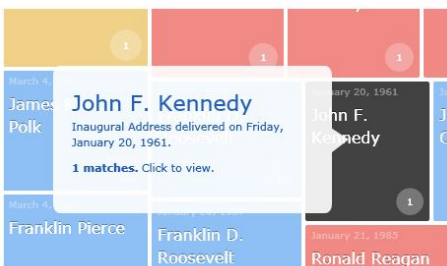
Figure 3: Example of a tooltip that displays more details on the data point selected, that could be used in the visualisation framework.

Pie chart

Description

The pie chart is divided into sections that illustrate a numerical proportion. Each section expresses its quantity through the size of the central angle in proportion to the others. **Pie charts are best used when making part-to-whole comparisons.** They have the most impact when the proportion being expressed holds more importance than the specific numbers. They are most clearly understood when using small data sets, often grouping smaller data into an "other" category on the chart.
Note: The pie chart needs to be used carefully as the human eye has trouble distinguishing proportion in the segments, meaning the impact of the data can be lost or misinterpreted (Few, 2009).

Function

Pie chart visualisations highlight the share of one single item (e.g operating expenses) compared to the total and are useful for:

- Showing breakdown of totals
- Showing breakdown of funds by sector or recipient
- Comparing revenues, expenditures and liabilities

Usability and completeness

When talking of budget data, pie charts are useful to represent the share of a specific item compared to the whole budget. The chart has to be accompanied with an explanatory text where the reader can find the absolutes values and not only the percentages.
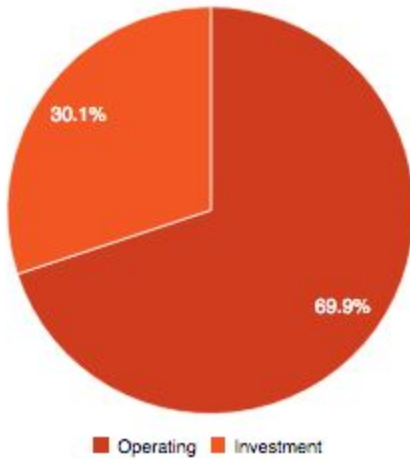
Figure 4: Pie chart presenting the share of operating expenses and investment expenses in the 2016 budget of the city of Rennes, France. Created with the visualisation framework .

Source

Next steps

Limitation of 5 categories per chart

It's difficult, if not impossible, to understand a chart with too many values. It decreases the understanding and impact of the visualisation.

In order to avoid these traps, we can either display a warning message to the final user if she has more than 5 categories to display or group smaller values into an "other" or "miscellaneous" category.
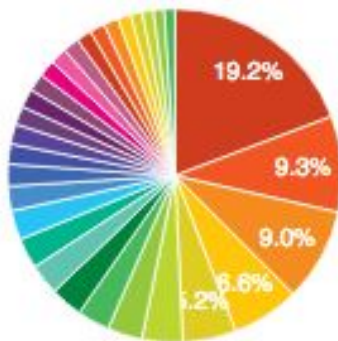

Figure 5: Pie chart presenting distribution of the revenues in the 2016 budget of the city of Rennes, France. Created with the visualisation framework .

Source

Following aesthetic minimalism guidelines can convey the message more efficiently.

Edward Tufte suggests to remove all elements that are not related to data and actively interfere with the reading and understanding of a visualisation (Tufte, 1983).

The donut chart visualisation

Donut charts are interesting as they allow the reader to directly see the absolute values of each slice and of the total.
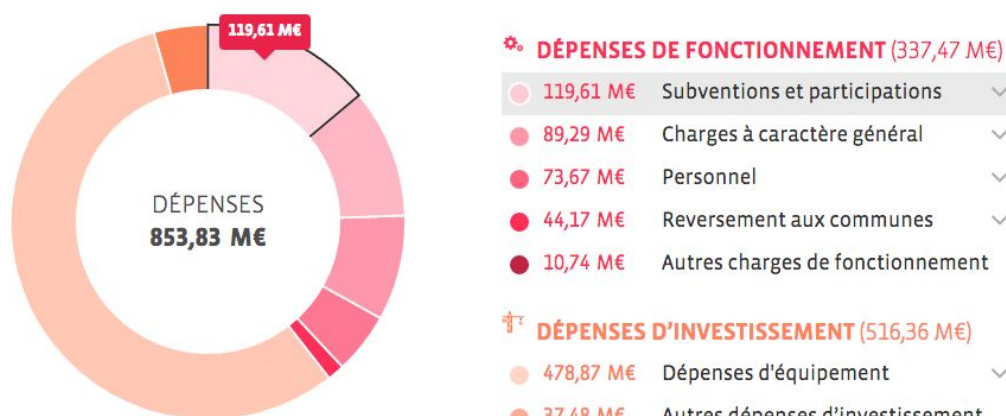

Figure 6: Donut chart presenting the distribution of the expenses in the 2016 budget of the city of Rennes, France. The red slices are the operating expenses and orange ones the investment expenses. On hover, the detailed amount of the slice is displayed.

[Source](#)

Bubble tree

Description

The bubble tree communicates two dimensions of data: each bubble represents an item and the numerical value is visualised with the size of the bubble.

As in the tree map visualisation, a hierarchy can be represented - the bubble tree contains other bubble trees displayed after a click on a bubble. But as opposed to the tree map visualisation, the bubble tree displays the total of the amount in its center.

Function

Bubble trees are effective to show the distribution of items and their hierarchy. The visualisations are useful for:

- Showing breakdown of totals

Usability and completeness

When visualising spending and budget data, the bubble tree created with the visualisations framework allow the reader to see the distribution of each item, their proportion, their absolute value and the breakdown of each item.
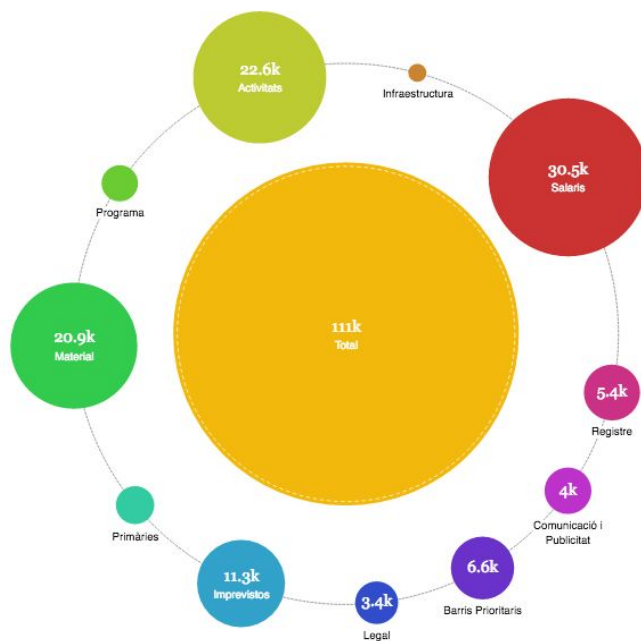

Figure 7: Bubble tree presenting the distribution of the expenses in the 2015 budget of the city of Barcelona, Spain. On click on a bubble, the reader sees another tree map filtered with the chosen item. Created with the visualisation framework .

Source

Next steps

The use of colors

The colors can be used to add another dimension like the direction - revenue or expense - or the type of the money flow - operating or investment.

When the colors are used to represent a category, the click on a category (bubble) should display the corresponding subtree where all the bubble have the same color range as the main category.
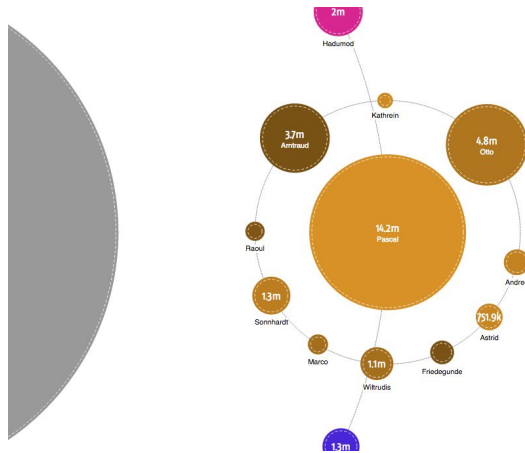

Figure 8: Demonstration of a bubble tree where the subtree has the same color scale as the main category.

Sankey diagram

Description

A sankey diagram is a visualisation used to display a flow from one item (node) to another. The width of the connections (links) is shown proportionally to the flow quantity.

Function

In allowing the reader to visualise at the same time the direction, the distribution and the quantity of the flows, sankey visualisations are useful for:

- Showing networks of financial flows
- Following financial flows

Usability and completeness

The sankey diagram allows the final user to create a visualisation that shows the distribution of funds by items and sub-items. The reader can see the proportion of the budget allocated for a specific item in each category.
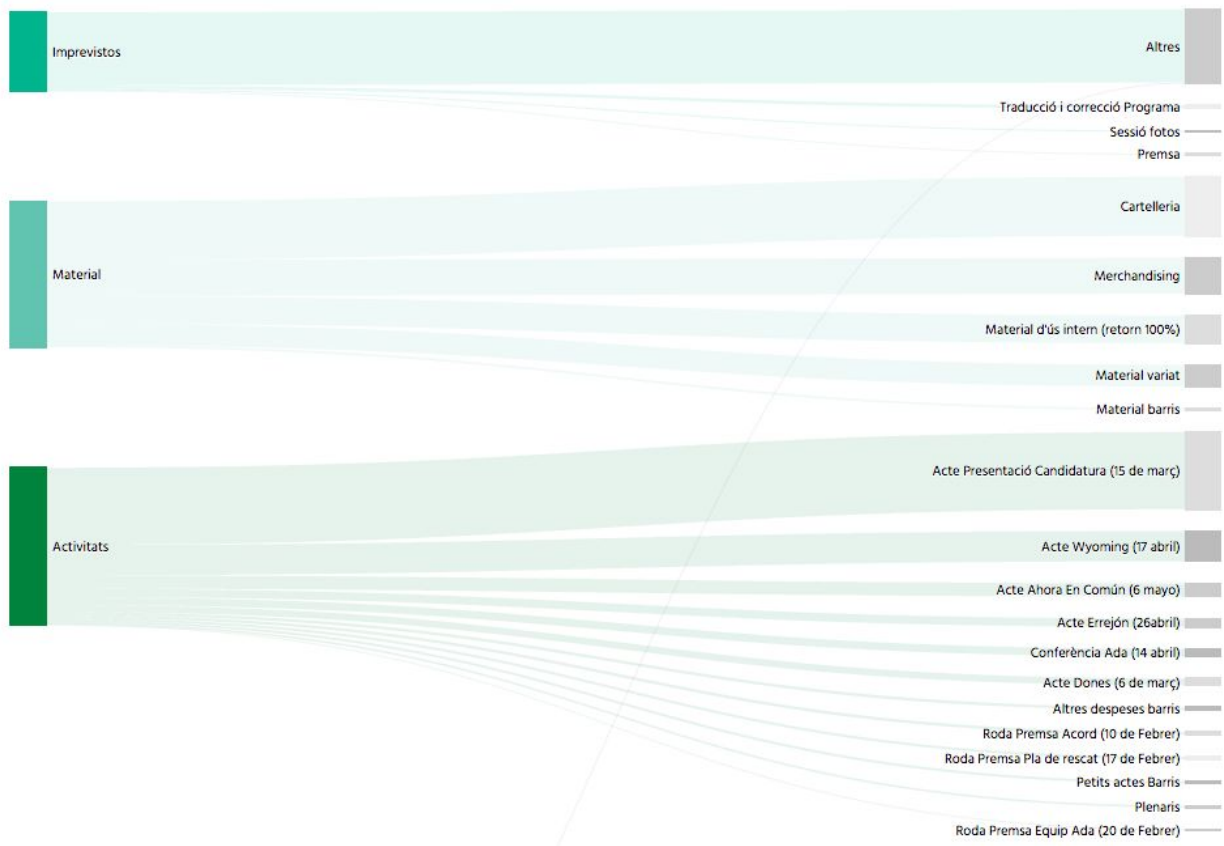
Figure 9: Sankey diagram presenting the distribution of expenses by item and sub-item in the 2015 budget of the city of Barcelona, Spain. Created with the visualisation framework .

Next steps

The use of payer/beneficiary

The sankey visualisation can be useful to visualise who is giving and who is getting money.

This type of visualisation has been developed in one of the tools developed in Work Package 5 to display which professional football club received money from which public body and in which proportion.
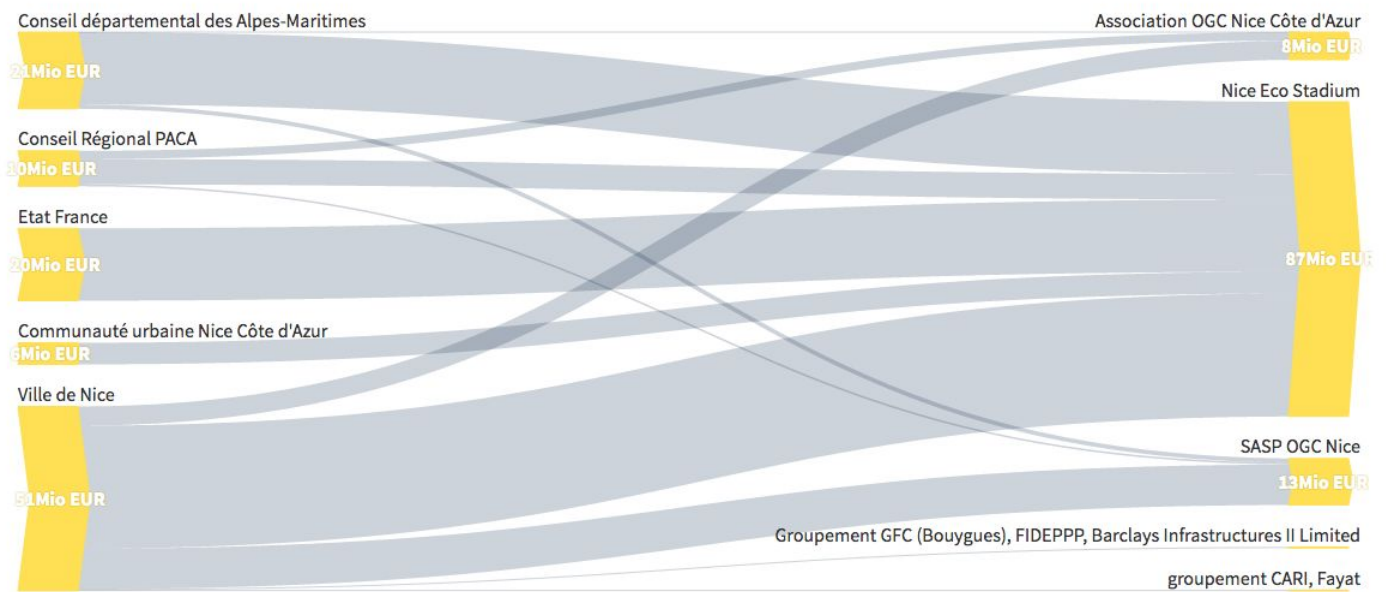
Figure 10: Sankey diagram from the tool developed in WP5 presenting the public money spent to support the football club OGC Nice, in France. The nodes of the left are the public administration and the nodes on the right are the entities that represent the football club or the stadium.

Source

Display the total amount of a node

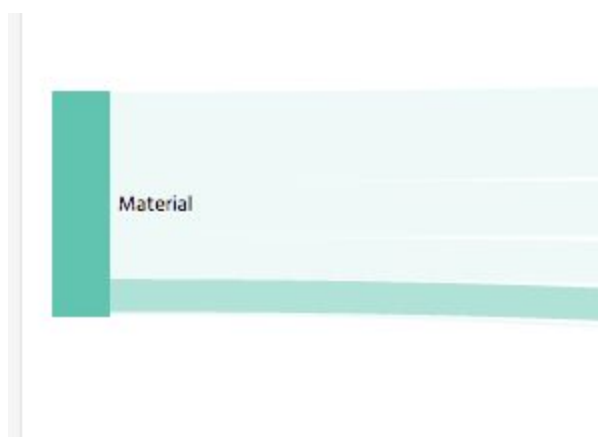The root of the links can be used to display the amount of money represented by a node.

Figure 11: The green area could be used to display the amount of money for the item "Material". Created with the visualisation framework .

Display the numbers in the legible way

To increase the legibility, the numbers can be displayed in a human-friendly way in changing the precision of the amounts. A value "11,069.15" can be better understood as "11K€".

Display the currency

To add the context, the currency of the amount displayed should be always visible to the reader.

Bar chart

Description

The bar chart is a chart with rectangular columns proportional in length to the values they represent. The x-axis represents the categories and the y-axis represents a discrete value.

Bar charts can convey the message with a huge impact, it's a simple and straightforward way to visually communicate data.

Function

The reader can compare data and categories at a glance with bar charts. The visualisations are useful for:

- Comparing budgeting, commitment and execution

Usability and completeness

Bar chart visualisations are a highly versatile way to communicate data. **When it comes to budget data, they can be use to present the distribution of funds by category or to compare amounts spent by payers/territories.**
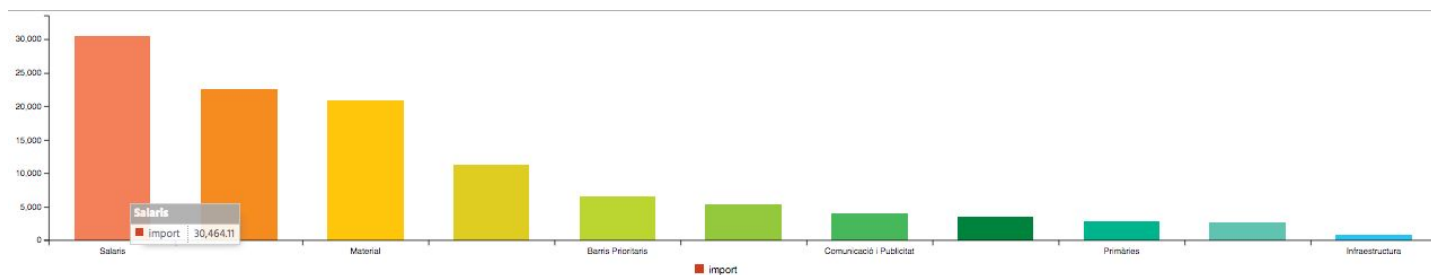

Figure 12: Bar chart presenting the distribution of the expenses by item in the 2015 budget of the city of Barcelona, Spain. Created with the visualisation framework .

Source

Labelling the axes

Labelling the axes helps the final user to understand the data at glance. In the visualisations framework, the y-axis should display the currency.

Avoid the legend when only one data category is used

When only one data category is used (in the screenshot above, the amount of money) the legend is unnecessary. The title can already contain all needed information or the x-axis can be labelled directly.

The use of colors

The color of the bars should be the same for the bars of the same category. Color consistency is important and increases the legibility for readers.

Pivot table

Description

A pivot table is a visualisation that summarizes data. With the pivot table, the final user can aggregate data per type/category and explore the raw data.

Function

In allowing the reader to summarize, analyze, explore, and present the data, pivot table visualisations are useful for:

- Showing public finances per person
- Showing breakdown of totals

Usability and completeness

In public budget data, pivot tables can be used to summarize data per payer, per beneficiary, per date, per category and others. It allows the final user or the reader to answer in a glance questions like: "How much money was spent in 2009 by the city of Barcelona - Spain, for the personal costs?" question that cannot be answered easily with the granular data.

	fiscal_date	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Totals
payer*															
Communauté urbaine Nice Côte d'Azur									6,000,000						6,000,000
Conseil départemental des Alpes-Maritimes		412,021	457,343						20,008,148	7,295	10,579	7,433	149,229	165,866	21,217,913
Conseil Régional PACA				438,528	438,528	449,990	449,995	449,992	7,291,704	226,204	108,800	108,800	108,800	100,000	10,171,342
Etat France									20,000,000						20,000,000
Ville de Nice						2,682,979	3,875,526	450,000	15,280,045	2,311,814	2,833,587	3,038,162	12,161,277	10,000,000	52,633,389
Totals		412,021	457,343	438,528	438,528	3,132,969	4,325,521	899,992	68,579,897	2,545,313	2,952,966	3,154,395	12,419,306	10,265,866	110,022,645

Figure 13: Pivot table presenting the public money spent to support the football club OGC Nice and its stadium, in France, from 2003 to 2015.

Source

Add basic statistics operations

By default, the visualisation framework displays the sum of the data points. To allow the user doing further analysis, basic statistics operations, like mean or median, can be implemented.

Line chart

Description

Line charts display information as a series of data points connected by straight line segments. They are best used to visualise changes over time, using equal intervals of time between each data point.

Function

The advantage of line charts is that they enable the comparison of slopes, which is not possible in a bar chart. For each data point, the reader visualizes a given amount and a date on a line chart. These visualisations are useful for:

- Showing trends over time

Usability and completeness

The final user can create a line chart to present the data uploaded and filter the visualisation to present only the items needed.
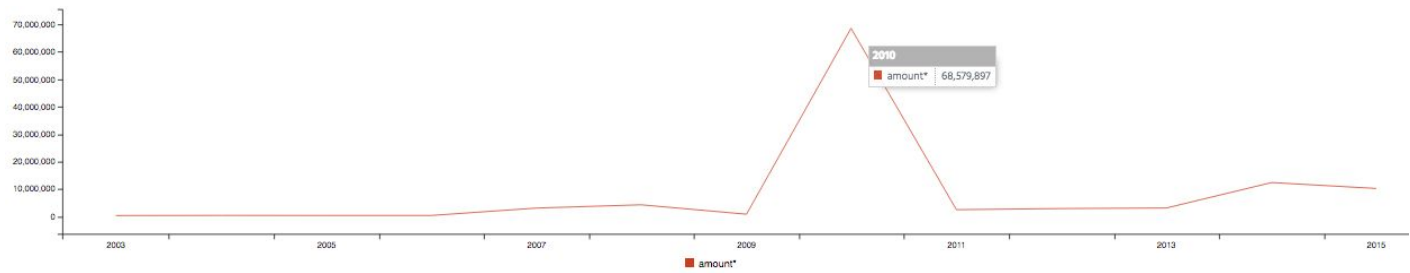
Figure 14: Line chart presenting the public money received by the football club OGC Nice, in France from 2003 to 2015. Created with the visualisation framework .

[Source](#)

Next steps

Labelling the lines directly

Labelling the lines helps the final user to understand the data and identify lines at glance instead of referencing a legend (Wong, 2010).

Allow multiple lines

Having multiple lines displayed on the chart could allow the user to see the breakdown of the total amount and the trend over time at the same time.

Finding the best ratio

The aspect ratio make the reader perceive slopes differently. A common used technique to increase the readability is called "banking", where the slopes in a line chart are average to 45°, (Cleveland, 1993).

Accessibility and readability

Limitation of the number of colors

The same color should be used to represent the same variables, so the readers can focus on comparing the data (Wong, 2010).

When the data do not represent the same variable, it's better to use graduating shades of one color - colors on the same side of the color wheel - instead of totally different colors.

Color-blind audiences

According to the National Institute of Health of the United States, 8% of men and 0.5% of women[1] are suffering from the common form of red-green color blindness. They have difficulty distinguishing between reds, greens, browns and oranges that makes it difficult to read color-coded information such as bar graphs and pie charts.

To include these readers in the audience, some tests can be performed to ensure the readability of the visualisation.

Convert to grayscale

Converting the visualisation in black and white, can assess that the contrast in values is sufficient (Wong, 2010).

Figure 15: A visualisation created with the visualisation framework, original and in grayscale. Some colors look similar in grayscale, meaning the contrast is not sufficient.

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[1] Source

Tools to simulate the effect of different types of color blindness

Tools such as ColorOracle can be used to simulate the effect of different types of color blindness (Jenny & Kelso, 2007).
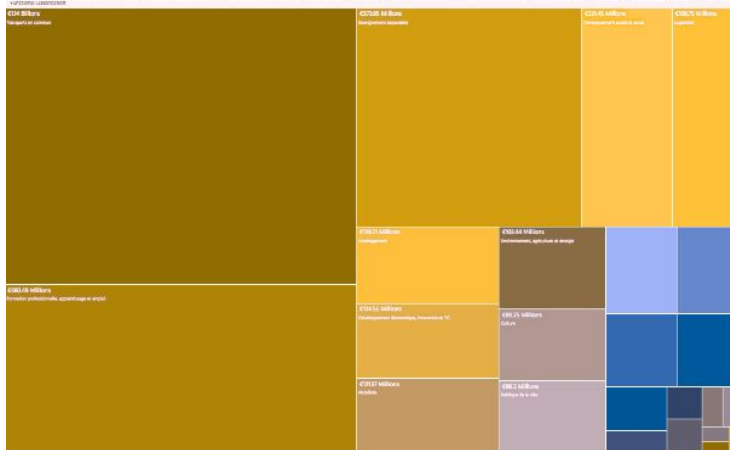
Figure 16: A visualisation created with the visualisation framework, and modified using Color Oracle to simulate Deuteranopia.

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Annex: List of demonstration visualisations