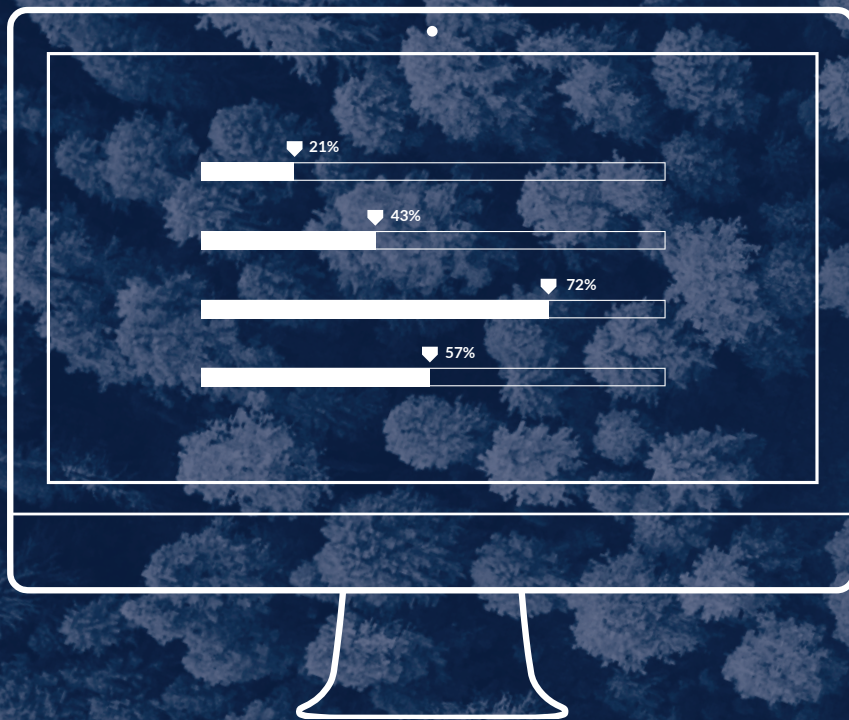


Dashboard Design

A white paper about the optimized design of interactive dashboards



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Creating a Dashboard in 11 Steps

We have written the whitepaper “Dashboard Design” for everyone who deals with dashboards, builds them themselves or supervises in their creation. In our consulting practice, we deal with dashboards every day and optimize them for our clients.

A dashboard, like any visualization, can be well designed and intuitive to experience or the complete opposite. In this whitepaper you will learn what a well-designed dashboard looks like, what you need to look out for and which steps need to be taken to create an optimal dashboard. We will look at how to combine the elements of a dashboard (charts, filters, legends, texts, etc.) into a meaningful whole that allows users to optimally experience and understand their data.

First of all, it is advisable to design a concept. Regardless of the tool of choice, we recommend Tableau. This opens the perspective and allows the designer to be more creative. We prefer to work with Adobe Illustrator and firstly create a graphical mockup, before we use the tool for data visualization at all. This allows us to find an optimal representation of the information on the one hand, which on the other hand - if necessary - is not out of the box, or contains freely created visualization forms. If you start directly in the tool, you take the risk of being influenced by the standard repertoire, which can lead to a suboptimal result, since there is no access to the information that is actually needed.

Of course, it is absolutely necessary to keep the possibilities of the tool in mind when dealing with this kind of free design. The designer at work must know the limitations and features of the tool.

But why do we want to take the trouble to invest time in the design at all?

- *Create a Graphical Mockup*
- *Make sketches*
- *Combination of functionality, truth & elegance*
- *Encourage users to use the dashboard*
- *Create acceptance for new technologies*

Fundamentally, it is about making the whole experience of a “Dashboard” as pleasant as possible. This starts with functionality and expressiveness, continues on to aesthetics and ends with the quality of interaction and usability.

In principle, there are three goals of a well-designed dashboard:

- Fulfilling the need for information
- Encouragement to use the dashboard
- Acceptance of reporting in the company (Buy in)

So let's get to the heart of the whitepaper and introduce the steps involved in creating an optimal dashboard.

Step 1 – Capture of requirements

Step 2 – Apply Style Guide defaults

Step 3 – Frames, “Real Estate” & Fonts

Step 4 – Layout

Step 5 – Definition of Charts

Step 6 – Color application

Step 7 – Formatting

Step 8 – Arrangement of filters

Step 9 – Unification & alignment

Step 10 – Interactivity & Usability

Step 11 – Feedback & Iterations

Step 1 – Capture the requirements

An optimal dashboard is adapted to the needs of the individual user. Thus, the first step is to capture the requirements - so-called requirements gathering. When necessary, this is done by interviewing the users.

A dashboard which has been created without the involvement of the user, however beautifully designed, will often miss its purpose.

First, the main key figures (KPIs), parameters (dimensions), measures, filters and data sources have to be defined. The data sources are hidden here as an aspect, because it is primarily a matter of describing the process of the design. Furthermore, it is necessary to keep the purpose of the dashboard in mind. Will it only be used on the desktop, or also on a handheld device, such as a tablet? Should a few or many details be visible at one glance? Will the dashboard be printed later? This influences the dimensions and also the arrangement of the individual elements.

It is not always possible to display all the required content on a single dashboard. In these cases, a comprehensive structure should be developed which maps the contents for several dashboards. For example, on different granularity levels and filter across and/or drill down relations between the individual dashboards.





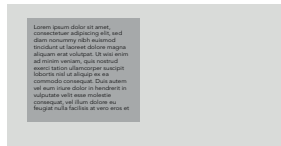
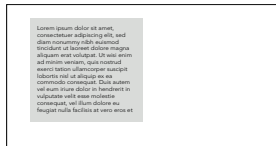
- *Adapt to the needs of the user*
- *Perform Requirements Gathering*
- *Conduct interviews*
- *Determine the purpose of use*

Step 2 – Apply Styleguide Defaults

It may not be obvious, but it is necessary to create the dashboard according to the styling specifications that the user is used to from their company.

This concerns the in-house color palettes, fonts as well as logo guidelines and tag lines. All of this influences the frame as well as the styling of the content, and not only ensures a quick visual orientation but also creates acceptance within the company. In addition, the independent design of a colour palette is spared.

- Apply in-house color palettes
- Unify fonts
- Observe logo guidelines
- Enable fast visual orientation
- Create acceptance for the dashboard

Whitespace and Position of the Logo		
Primary and Secondary Colors		
Background Foreground Colors		
Fontfamilies	Font 1 Minion	Font 2 Avenir
Fontsizes	12 pt	8 pt
Fontvariants	Font 1 Minion Regular	Font 1 Regular Italic
	Font 1 Minion Bold	Font 1 Minion Bold Italic
	Font 1 Minion Bold	Font 1 Bold Italic
Fontusage	Headline 1 Avenir 12pt	Headline 2 Avenir 8pt
	Runningtext 1 Minion 12pt	Runningtext 2 Minion 8pt

Elements of a style guide: free space surrounding the logo, placement of the logo, primary & secondary colors, foreground & background color, as well as the different font families and styles.

Step 3 — Frame, “Real Estate” & Fonts

Before designing the content, the layout of the dashboard is created. Headers with title and footer are created according to the style guide. When it comes to font size, it may be necessary to weigh up a complete compliance with the styling specifications against an optimized variant. One of the most important aspects to consider is that of the “real estate”.

Space is usually limited, especially if you want to include as much information as possible without scrolling (“above the fold”). This is an important aspect regarding usability. In this respect, the header is not too expansive and a good compromise must be found between legibility, aesthetics and space optimization.

For the header, it is recommended to work with a prominent heading as well as a subtitle. If you have several dashboards, for example, you can include the information from the overall project in the subtitle. Play with the possibilities of the style guide until you have found an exciting combination for title and subtitle.

The placement of the logo is specified in the style guide and is usually in the top right corner. However, it may also be sufficient if the logo is placed in the footer, because dashboards are often used internally.

It is important that the users trust a dashboard. Therefore, the information about the data origin, i.e. the source and the date of the last update, should be an important element. This can be located in the header or footer.

- *Header and footer according to style guide*
- *Consider above the fold*
- *Create an overview through space optimization*
- *Use different levels & hierarchies*
- *Use system fonts*

It may not necessarily be self-evident, but it is imperative to create the dashboard according to the styling specifications the user is used to from their company.

Marketing Dashboard

Operational Level

Header with title and subtitle below

Client Dashboard

Client name

Data as of 2017-03-08

Sourced from System A

Header with title and subtitle above and data information

Standard A4 Landscape Dashboard. Add Sector Name										
Bdgt COGS	Bdgt Margin	Budget Profit	Budget Sales	COGS	Expenses	Inventory	Margin	Marketing	Profit	Sales
\$317.880	\$428.280	\$258.760	\$746.160	\$358.672	\$229.662	749	\$443.038	\$132.474	\$259.543	\$819.811

Compact header with title and subtitle in one line and a KPI bar

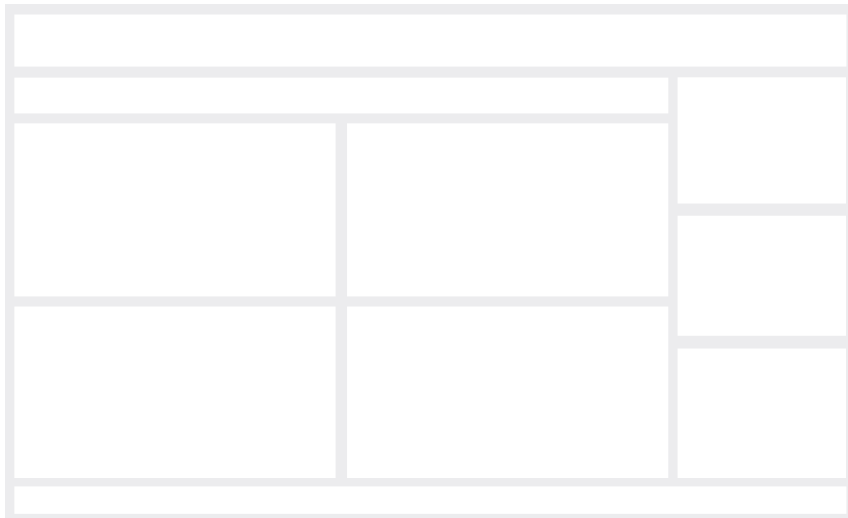
Step 4 – Layout

The collected requirements and reporting needs are now incorporated into the creation of the dashboard. It is crucial whether we are dealing with multiple topics, each with multiple charts, or just one topic.

For example, we look at both sales developments (high-level) and growth, as well as details on individual products (low-level) for which we want to distinguish between different aspects.

If several aspects or different questions are answered within one dashboard, it is recommended to work with sections that can be clearly visually distinguished from other sections. This can be achieved, for example, with a kind of index card based on a raster layout.

- *Apply grid layout*
- *Ensure visual distinctiveness*
- *Insert white space*
- *Clarity through high-level to low-level*



Empty dashboard with sections

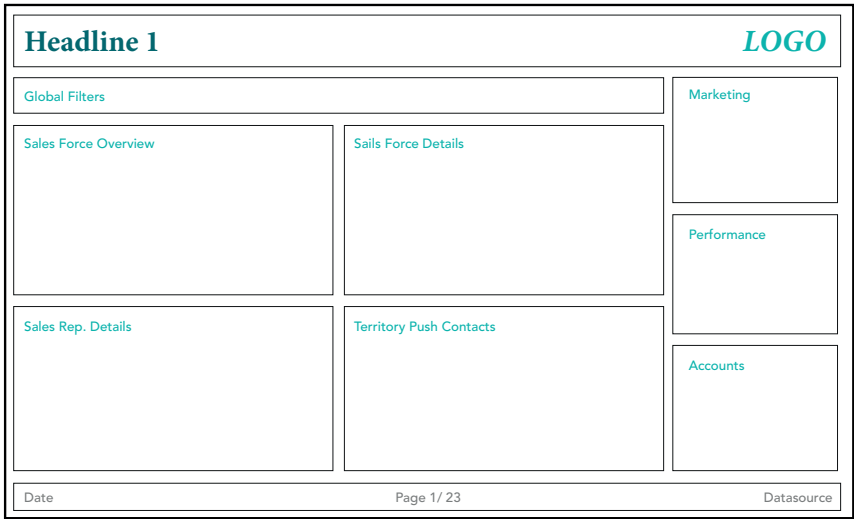
If sections are not required, you should always work with “white-space”, i.e. spaces that you arrange between the charts. This allows the user to distinguish the individual charts and areas at one glance.

The sections are given a heading. Individual charts are named within the sections.

For the structure and flow of information in a dashboard, the basic rule is that you want to show high-level or general KPIs as well as the most important information first. So these should be placed at the top left. In the opposite bottom right corner you arrange either the most unimportant or the most detailed information.

The stream of information builds and becomes more and more detailed, therefore providing the user with what they need to know.

You can start this step with a drawing and roughly determine the arrangement of the information. This is helpful when assessing the available space. However, one should also remain mentally flexible, because further steps can show that the real estate must be planned differently. It is possible, for example, that a certain aspect has to be illustrated with many or large charts.



Dashboard with section titles

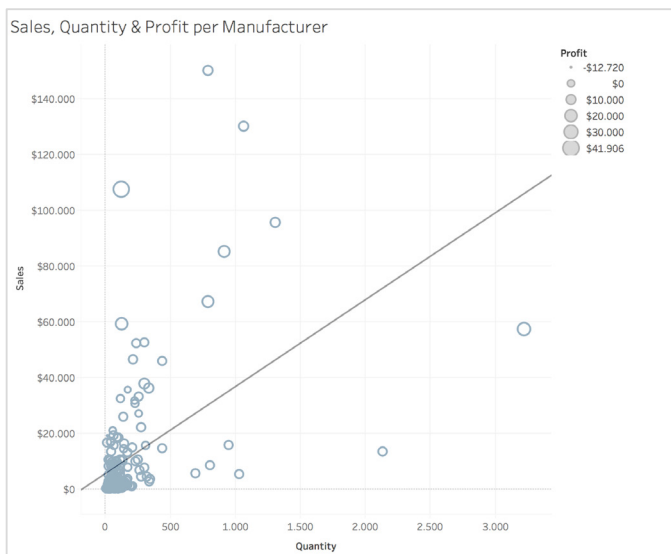
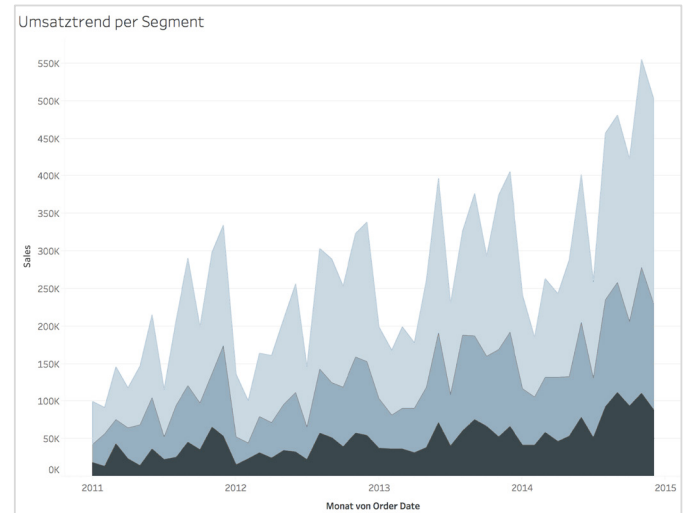
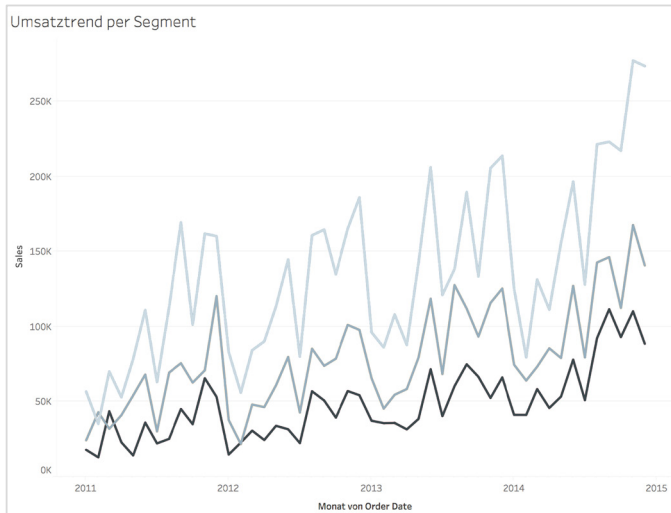
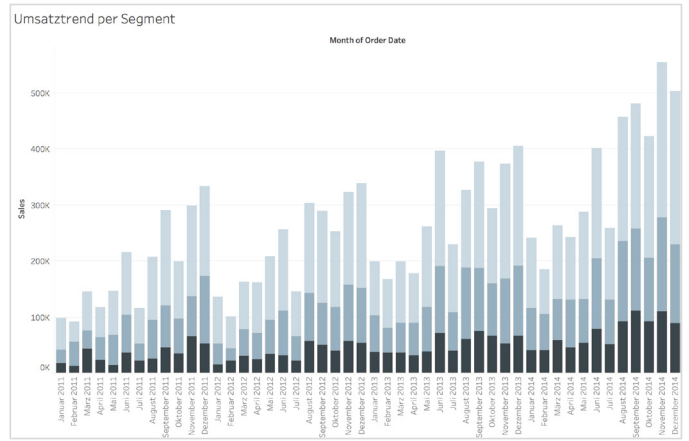
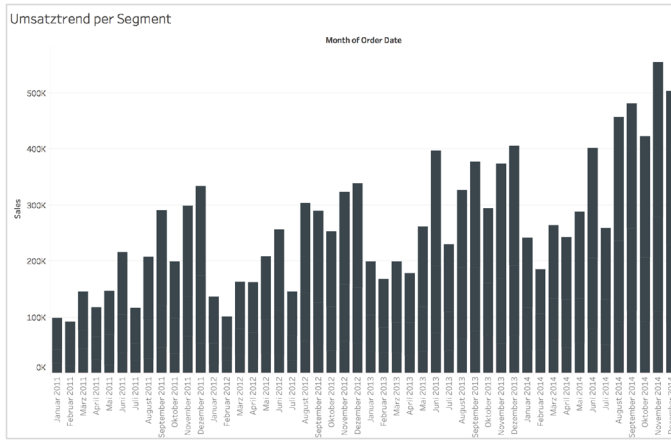
Step 5 – Definition of Charts

The aim of the actual data visualization is to present the desired information optimally, i.e. in the most accessible and meaningful way possible. Our goal here is to convey the values of the key figures in such a way that they can be interpreted as precisely as possible in a short time. To design effective dashboards, you must resist the temptation to use purely decorative chart types.

Since it is more difficult to compare surfaces with each other, pie charts and bubble charts are disadvantageous in communicating differences. Bar charts, line charts and scatter plots are preferable because they make the differences very clear. This is because we only need to compare the length or position in the room. For us, length is the simplest visual attribute to convey differences.

However, in the other cases, where a bar chart does not provide the necessary information, there is still enough room for creativity. Here you can of course try out other standard chart types (in Tableau: click “Show Me”) or design something yourself. As soon as polygons are part of the dashboard, you should rather distance yourself from designing a chart yourself. Between standard (“Show Me”) and polygons, however, there is a wide field where you can get creative and achieve the desired information result with the help of standard elements as building blocks such as bars and lines. Here are a few examples.

- *Satisfy information needs*
- *Use preattentive perception*
- *Enhance standard elements with custom charts*
- *Display KPIs as numbers if possible*

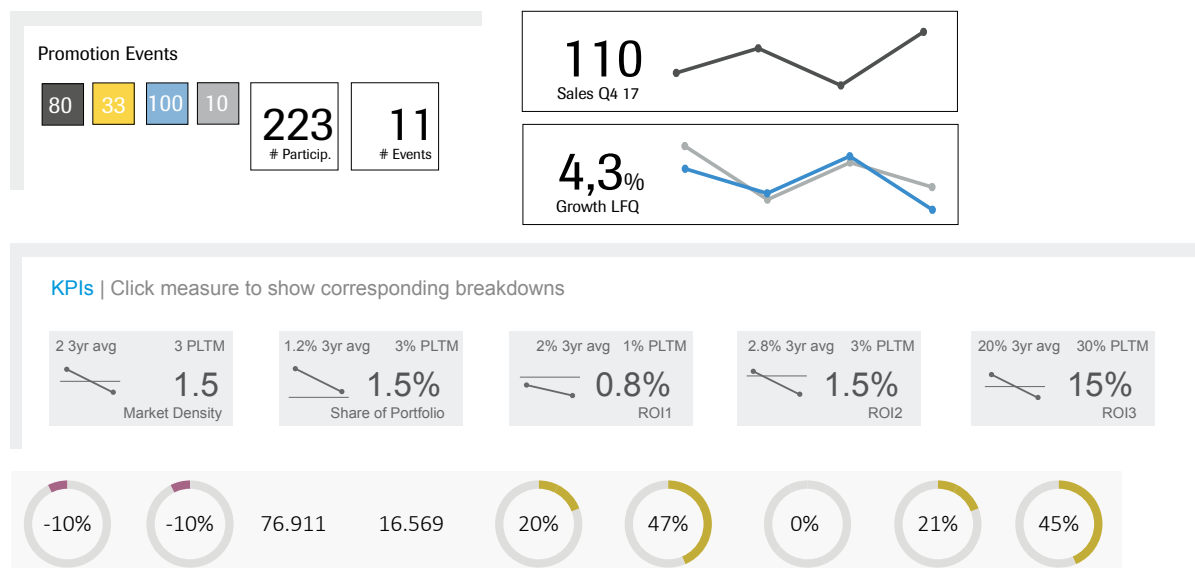


Examples for custom charts from standard elements as building blocks

Give the most important questions the highest prominence on your dashboard, both in terms of section order and within sections.

To display the KPIs that do not require a detailed visual representation, it is recommended to work with large numbers.

The description of the metric can be designed in a small font, since you learn over time what is written there and you almost don't need it anymore. If not everything fits into the heading, the rest of the information can be placed in the tooltip. After all, with dashboards - at least with Tableau - we are dealing with interactive dashboards that have this advantage. This should be used rather than overloading the dashboard with details. Here, it makes sense to balance completeness, simplicity and clarity as well.



Examples for the Representation of KPIs

These figures act as shortcuts and summaries of what is presented in more detail in the charts. For example, if you want to check the current figures at one glance before a meeting, refer to this. KPIs can apply to the entire dashboard or be displayed per section. This is determined by the requirements of the users.

Regardless of how the data is presented, you will have to make compromises. You cannot answer every question in a single chart. Instead, you want your chosen chart to answer the question that is the most important one. For further questions, use a different chart that answers them optimally.

Step 6 – Color application

Colors are the most important aspect of dashboard design, along with the right chart type. You should not use colors to artificially embellish a boring dashboard. In fact, the best dashboards get by with very few colors. Colors should be used specifically to distinguish between different categories or to highlight or emphasize something (keyword: alert).

- Use colors specifically to differentiate
- Use standard fill color
- Consider colour blindness
- Add legends

It is necessary to designate a default color that becomes the fill color for all charts that do not require color differentiation, i.e. where the color is not used for a dimension. This gives the dashboard a uniform look. It is recommended to take one or more colors from the Style Guide.

At this point, the topic red-green as well as the aspect of color sense disorders (e.g. color blindness) should not be missing. It is very tempting to work with a red-green color palette if you are dealing with positive and negative deviations, but there are other ways and this usually looks better. You could sum it up like this: Blue is the new green and yellow or orange the new red.

Otherwise you can add yellow and orange or something reddish to the defined standard color (if the standard color does not contain red or magenta itself).

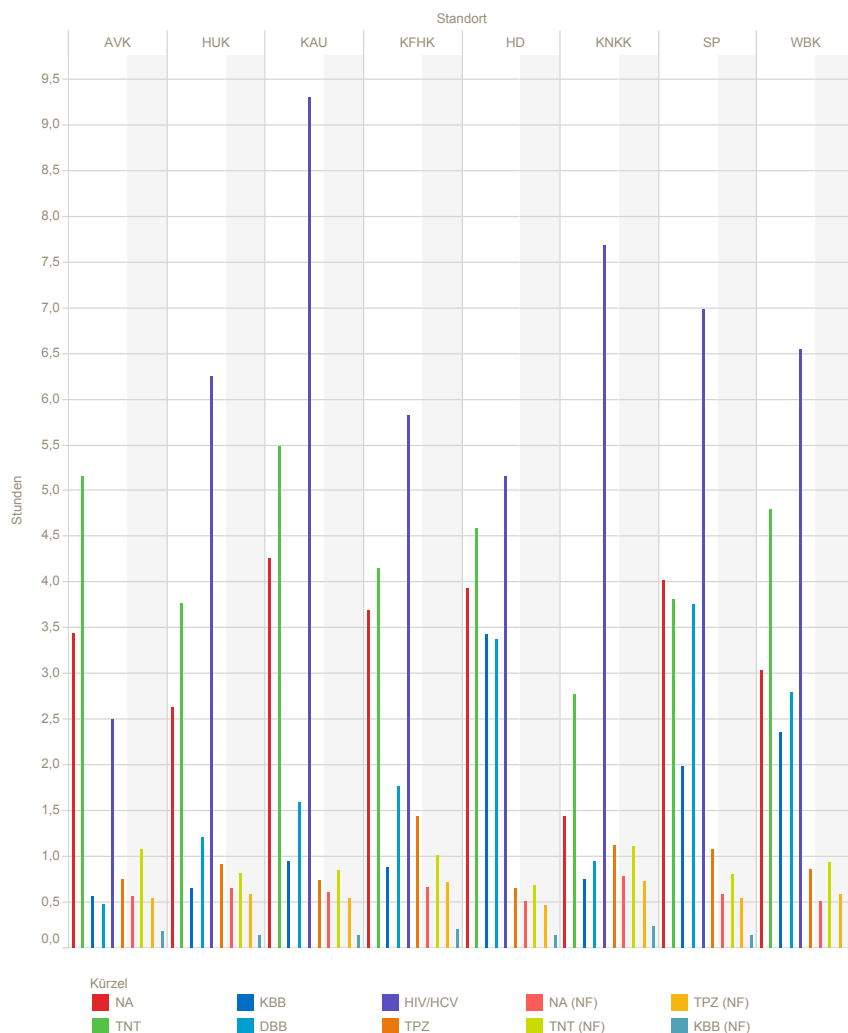


Alternative red-green pallets

There is the possibility to check your colors: Adobe Illustrator, for example, has a simulation of color blindness in the View menu choosing "Arrange Proof".

As soon as you make a dimension distinguishable by color, e.g. in a line chart, it is necessary to explain the color coding. This is done classically with a key. However, if there are more than seven values, we are no longer cognitively able to understand the key. We have to look at every single value.

Our short-term memory is not designed to absorb much information. When we have reached the fourth or fifth value, we have already forgotten the first one again. For this reason, we recommend working with labels, e.g. on the line itself, when displaying upwards of seven values.



If more than 7 categories are color coded, the differentiation as well as the assignment will be difficult.

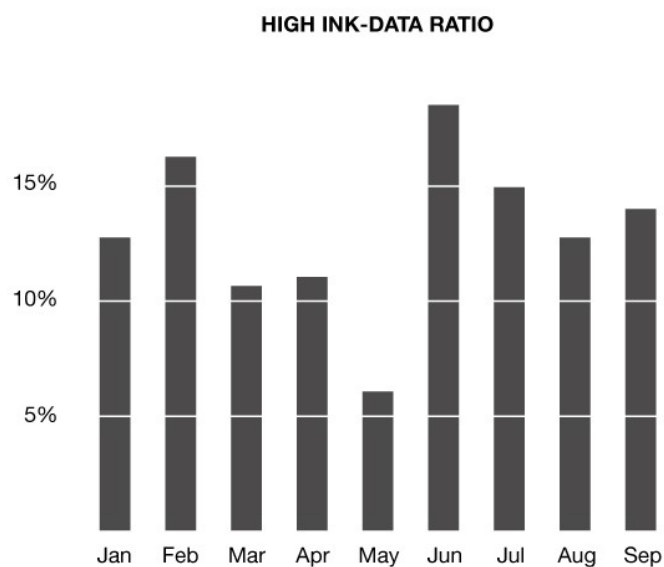
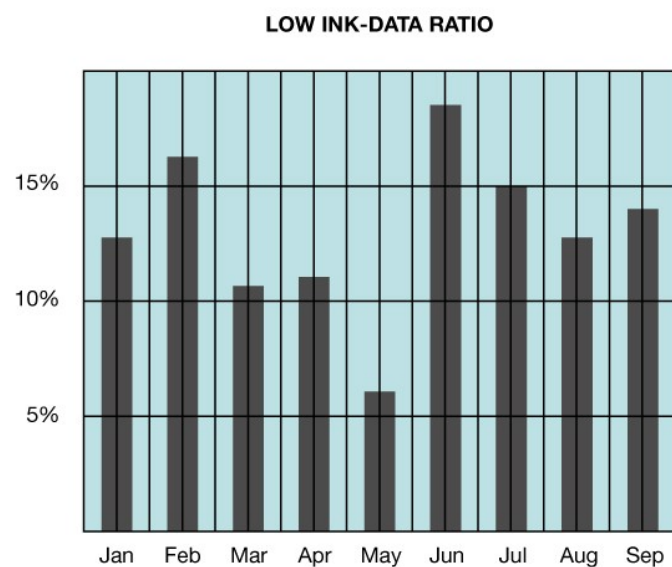
Step 7 – Formatting

It does not always make sense to display all the grid lines, frames, axes and dividers that the tool presets by default. Here it has to be decided again whether these elements are useful for recording the information or whether they can be discarded.

Again, keep in mind to create a design that is as clean and clear as possible. Less is more!

Edward Tufte, whose work has contributed significantly to the design of effective data presentations, uses the term “data ink ratio” in this context. He demands that any decorative elements should be left out of visual representations and that ink should only be used to transmit really important data. So good dashboards should only contain data ink. Non-data ink is to be erased wherever possible. The reason for this is to avoid the user paying attention to irrelevant elements.

- *Enable clean design through optimized data ink ratio*



The light blue background does not contribute to the fact that the information in the left diagram can be seen more clearly.

17

Step 9 – Unification & alignment

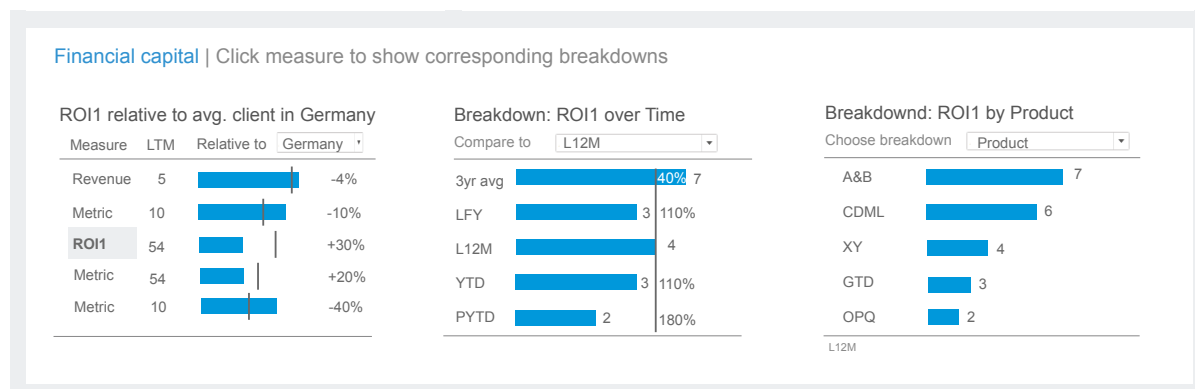
For a pleasant experience with a dashboard or a seamless intake of information, it is important that it appears as smooth and clean as possible. There are a few aspects that influence this: The width of the columns should be the same across the dashboard, axes and dividers should be aligned horizontally or vertically if possible.

The more pixel-perfect the first mockup is, the more likely it is to delight your target audience.

Elements such as KPI boxes should be designed in the same way at every point, i.e. in the same size, etc. If the look and feel is consistently designed within the dashboard, it makes it easier for the user to “read”, since it is not necessary to learn again and again what works in which way.

Another example is, if you decide to use a sparkline to accompany the KPIs, then it should be the same size and format at every point where it is used. By recognizing them, you spare the user the capacity to process them.

- *Create a calm looking dashboard*
- *Pixel perfection increases visual quality*
- *Consider uniformity*



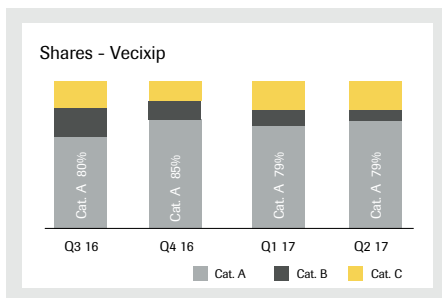
The bars of the three charts all have the same line width, the charts are aligned flush horizontally.

Step 10 – Interactivity & Usability

This whitepaper mainly deals with the design of dashboards within a mockup, i.e. before using the implementation tool. Because of this the interactivity is not discussed, like drilldown, switch from an overview dashboard to a detail dashboard, highlighting, filtering by click, etc. These very important aspects are only mentioned here.

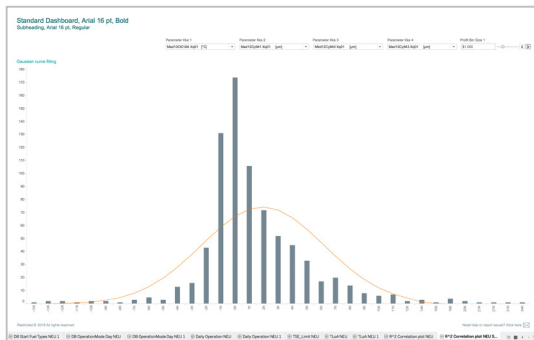
If you work with filters and drilldowns, it is advisable to adjust the titles of the charts accordingly, e.g. put the now displayed product name in the title instead of “products”. By doing this, you simplify the orientation.

- *Select dynamic titles*
- *View with reduced or increased data volume*
- *Comments & hints*
- *Time of loading*



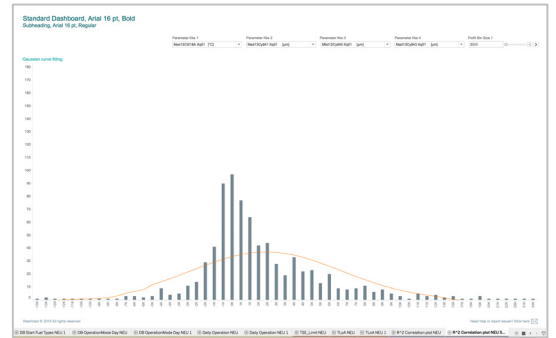
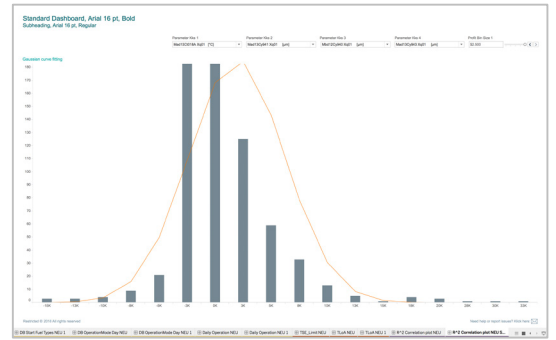
Product name in title

Depending on the interaction, the amount of data in a chart can change drastically. On the one hand, it can be greatly reduced, with chart elements being extremely inflated when the tool fills the space. Or the content is heavily squeezed, e.g. in a table, where lines have been added. To prevent this, you should configure the chart so that a scrollbar is added when the amount of data increases. In the first case with the inflated bars, one should “fix” the size and/or prevent an automatic fitting. The order depends very much on the data as well as on the interactions, which is why you cannot name a rule of thumb. However, keep these aspects in mind when designing.



less data

more data



The display may vary depending on the amount of data filtered.

In general, make it as easy as possible for users to use your dashboard.

Usability includes many aspects already mentioned above, such as working with sections, settling as much above the fold as possible, white space, keys and data ink ratio.

Use the title, for example with comments and hints, to explain how to use the chart. Hereby you “get the users attention” and increase the usability enormously (examples see above).

Last but not least, let us mention loading times that should not exceed five seconds, otherwise attentiveness will dwindle.

Step 11 – Feedback & Iterations

The next step is to get some initial feedback on the visual design and content. It won't stop with this first mockup - iterations are normal and necessary. However, we make it so that a mock-up is well-designed from the beginning so that the users quickly accept it.

- *Schedule two iterations*
- *Prepare variants*
- *Establish user training*

As a rule, you should not do more than two more iterations, which means that in the first presentation of the dashboard, all aspects of the customization should already be discussed. The second iteration will be discussed with the users and most likely only small things will be adjusted.

No major changes should be made at this point in the process.

If you show your dashboard to the users, it is advisable to bring several variants at the same time - this usually concerns different colour variants. It is easier to make a decision if you can compare the differences visually rather than just talk about them.

It can and will happen that users will reject certain chart types, either out of personal preference or simply because they don't understand the chart (at first go). This is often the case with waterfall charts and box plots. This does not necessarily mean that you should discard these charts. You can train users to understand them.

Once you have understood how a Waterfall Chart works, for example, it reveals a lot of information that you can't better depict otherwise.

And in general: Train your users how to use the dashboard. Our experience usually shows that users prefer what they are used to and are initially sceptical about what is new. Behind the term "intuitive dashboard" is the idea of rediscovering the familiar in a new context.

Final thought

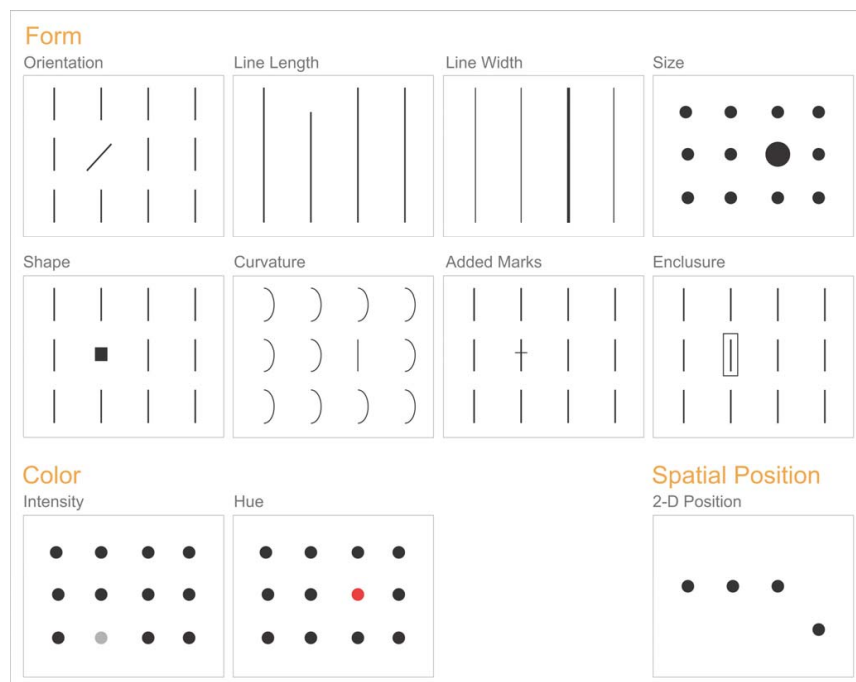
There is no such thing as a dashboard that is completely suitable for every person. The goal is rather to develop a relevant dashboard for the users who need to understand it. The challenge is to find a good compromise between optimal presentation, but also time and efficiency...

It is not an easy task, but with this whitepaper we hope that we made it easier for you.

Finally, we would like to give you a list of so-called “preattentive” attributes by Stephen Few. These are visual attributes that we perceive particularly quickly and effortlessly, making them very suitable for data visualization. The entire paper “Visual Perception” by Stephen Few is highly recommended.

We wish you much pleasure and success in designing your dashboards!

- *There is no such thing as the perfect dashboard*
- *preattentive attributes according to Stephen Few*



Preattentive attributes according to Stephen Few
https://perceptualedge.com/articles/ie/visual_perception.pdf

About M2.

Since 2009, M2 has been offering consulting and project services - including IT, process and quality management - in the field of Business Intelligence.

M2 has critical expertise and experience. We are familiar with the relevant technologies, are partners of leading companies such as Tableau, Amazon Web Services, Alteryx, DataVirtuality and Exasol and we have many years of experience mediating between IT and management. We are aware of the power of data visualization in transformation processes and offer business intelligence consulting along the entire value chain.

As the first Tableau partner in Germany, we embody the self-service business intelligence concept! From data integration and transformation in ETL processes to finished dashboards for data visualization: Our Business Intelligence consultants are experts in Tableau software and other related products and we are happy to offer training and workshops.

About the authors

Ewa Tuteja has many years of experience in data visualization, mainly with the help of Tableau software. Her main focus lies in the development of interactive visualizations for the public, e.g. with the help of Open Data as well as the development of dashboards in the field of Business Intelligence.

She is also involved in artistic data projects. Her portfolio can be found at www.tuteja.info.

Visualizations created with Tableau can be found under the M2 profile on Tableau Public: <https://public.tableau.com/profile/m2.6352>.



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Since July 2018, he has also headed the Business Intelligence team at M2 together with Manuel Mang.



Christoph Maurer is a Data Visualization Specialist at M2, where he is responsible for data visualization and dashboard design. Furthermore, he has many years of project experience in the areas of UI/UX design, generative data visualization and design thinking.

At M2 he gives workshops on the basics of design, data visualization and data storytelling.





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