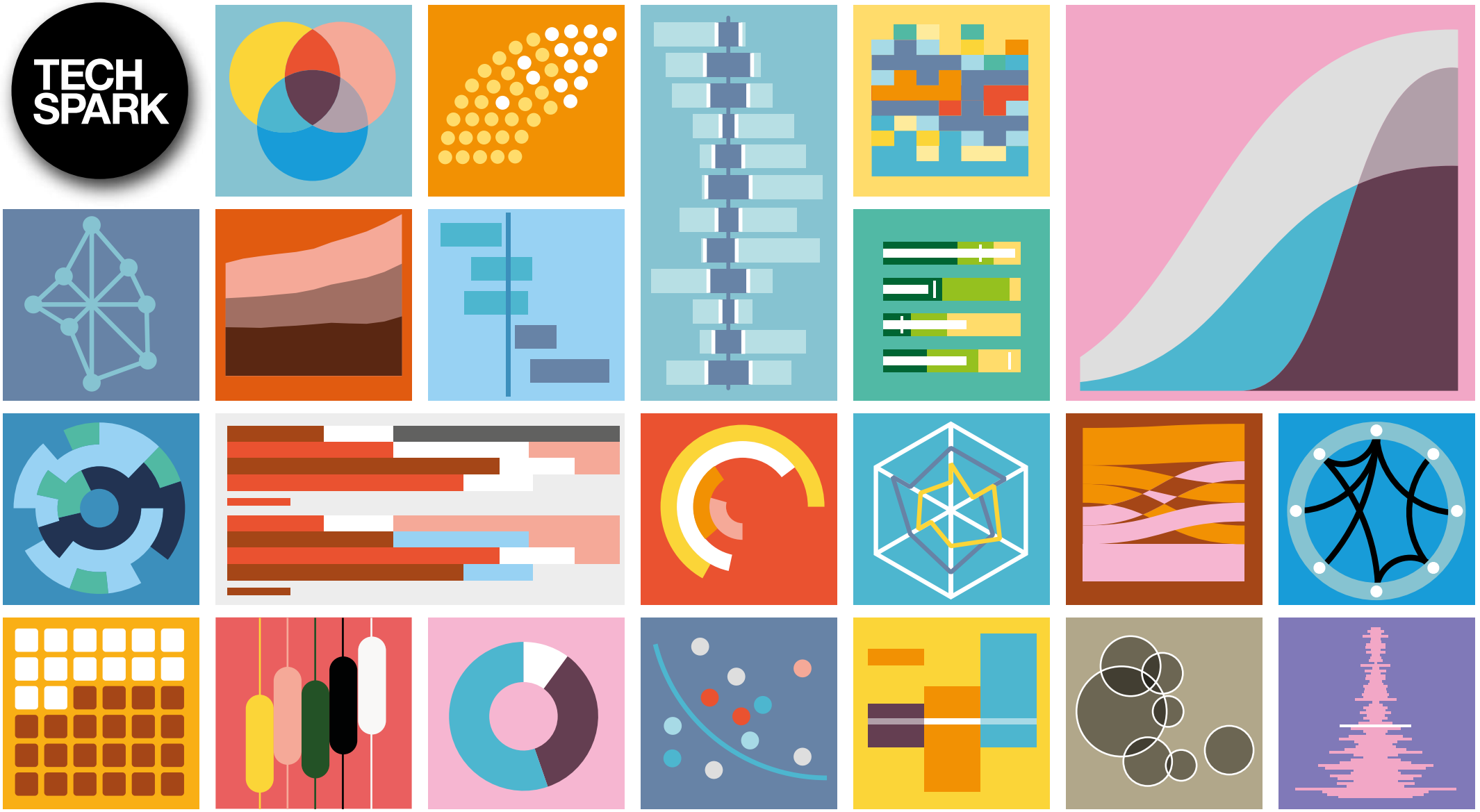
TECH SPARK



Visualizing the Invisible

The power of data visualization in finance

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The Data Visualization Issue

Fact 01

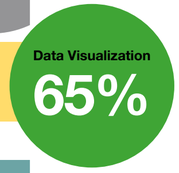
The human brain can process entire images that the eye sees in as little as 13 milliseconds.

Fact 02

About 80% of the information we take in comes through our eyes.

Fact 03

The human brain processes images 60,000 times faster than words.



Fact 04

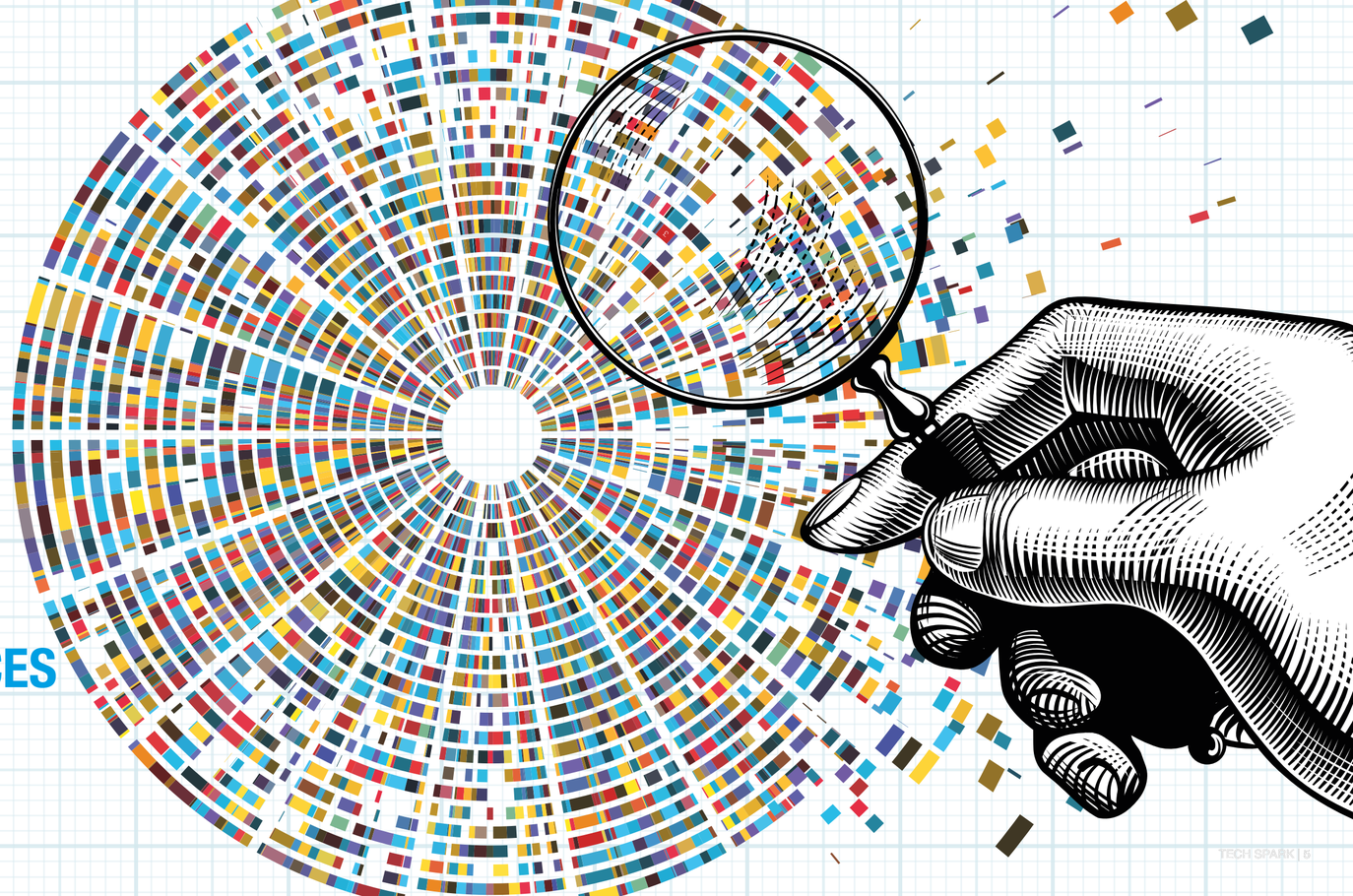
After 3 days,10% of heard information can be recalled. With data visualization, recall is up to 65%.

In This Issue...

Unlocking the potential of your data is an art and a science, but it doesn't have to be overwhelming. With a basic understanding of how different datasets should be visualized, along with a few fundamental design tips and best practices, you can create more accurate and effective visualizations. In this issue, we provide some of our thoughts and guidance around data visualization for finance.

THE GREATEST VALUE OF A PICTURE IS WHEN IT FORCES US TO NOTICE WHAT WE NEVER EXPECTED TO SEE.

JOHN W TUKEY 1977



Why Data Visualization?

As humans we respond to, and process, visual information better than any other type of data. In fact, the human brain processes images 60,000 times faster than text, and 90% of information transmitted to the brain is visual. We are visual by nature and can use this expertise to enhance data processing and improve the effectiveness of information organization and interpretation.

Our ability to scan, recognize, recall and interpret helps us to understand more accurately and at speed. The human brain is an amazing pattern-recognition tool, and it can detect changes in size, color, shape, movement and texture, very efficiently. We unconsciously perceive the world, constructing meaningful things and objects by combining the individual parts.

Some of the main benefits of visualizing data include:

Answering a question
Visualization can provide a quick, high-level summary of the main information contained in the data.

Posing new questions
Quite often the initial data investigations can lead to more questions and further exploration.

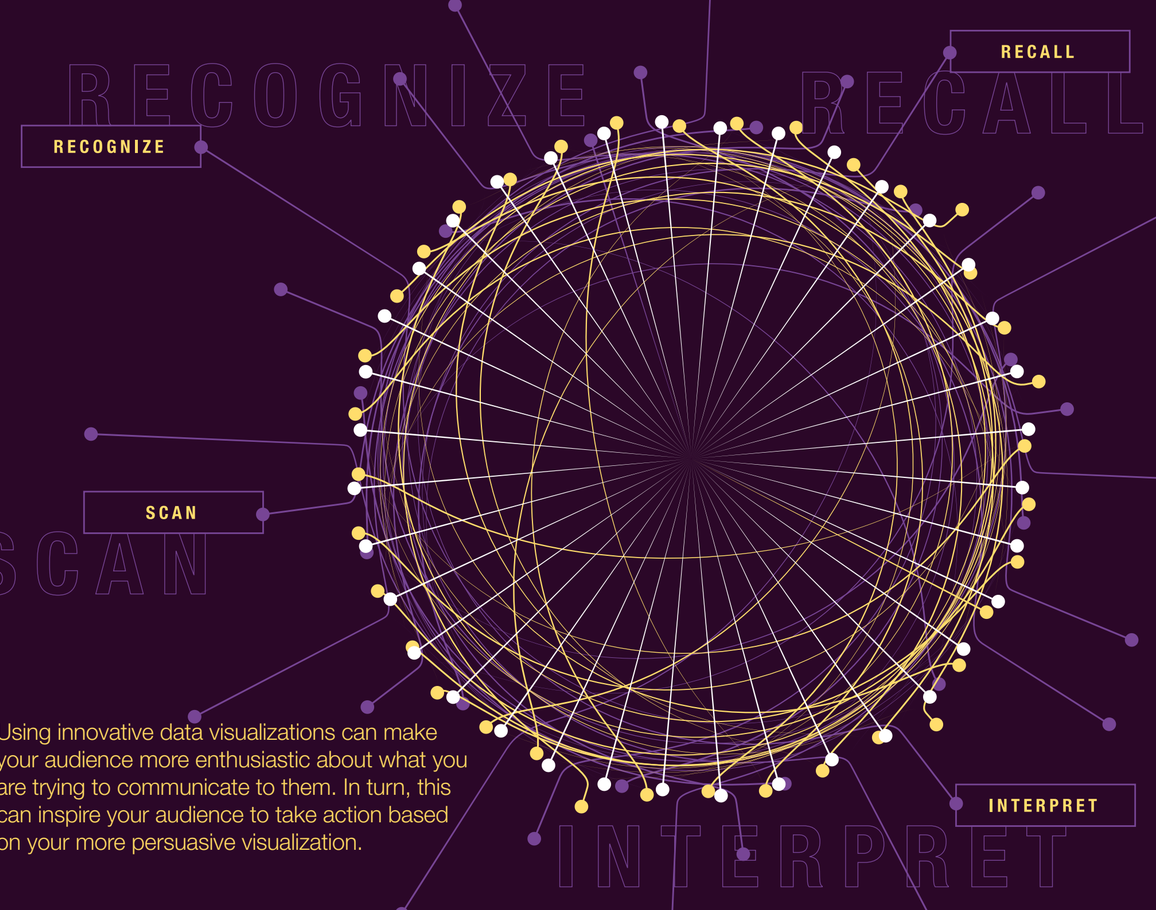
Exploring and discovering
Sometimes the data shows some unexpected patterns and outliers — data points which are well outside the normal data range. Exploring these data points can lead to new discoveries.

Communicating information
Graphical representations of data are more effective as a means of communication than long textual files. A story can be told more efficiently, and the time taken to understand a picture is a fraction of the time required to understand the textual data.

Supporting decisions
Visualization can provide quick answers and improve situational awareness. In turn, this can lead to faster and more timely decisions.

Increasing efficiency
A well-designed chart can save a lot of time otherwise needed to read pages of numbers and long textual reports. This time can be better spent on making sound business decisions.

Inspiring
Sometimes you may come across a visualization that really appeals to you or presents the data in a different and more effective way, challenging your own practice. It can be useful to use this inspiration to enhance the way you present the data.



Using innovative data visualizations can make your audience more enthusiastic about what you are trying to communicate to them. In turn, this can inspire your audience to take action based on your more persuasive visualization.

Charting in Finance

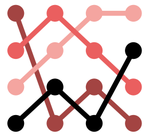
Which chart?

Working with lots of different financial datasets can be overwhelming and trying to decide on the right chart to display data, even more so. What data should you be tracking? What actually matters? What's the best type of visualization to provide insights and actionable information? Couple this with time pressures and the need for an accurate visual representation, and its hard to know where to start.

We have compiled a list of common charting types which will help you make some of those decisions based on whether you want to compare, see a distribution, analyze trends or understand data relationships.

Ranking & Comparing Data

When you need to order data based on its value or importance.



Bar chart (row version)

Standard bar charts display the ranks of values much more easily when sorted into order

Bar chart (column version)

The orientation chosen can enhance and make clear the story you are trying to tell

Vary slope

Shows ranking variance across data (e.g., over time or between different categories)

Stacked bar chart (column or row version)

Allows you to add another dimension of data insight

Paired bar chart (column or row version)

Allows you to add a variation of the same data next to itself. A good example may be previous years

Lollipop (column or row version)

Useful for showing when things are growing or leading and the style can emphasize the data a lot more

Dot plot

Ideal for showing related data with different start/min and end/max points across multiple categories

Strip plot

Strip plots are like scatter plots but are continuous and often contained within a category

Ordered symbols

Used to show big differences between categories where seeing the fine detail is not so important

Bump chart

Used to show the differences in rank over a given time period

Correlated Data

Shows the relationship and correlation between two or more different data points.

Column & line

Shows the relationship between quantity/amount (bar) and a rate or benchmark

Bubble chart

Similar to a scatterplot but with a data point third dimension of point size (indicated by the circle size)

Scatter plot

Shows the relationship between two or more datasets based on individual points on the x/y axis

Connected scatter plot

Similar to a scatter plot but with a time dimension that shows change

Heatmap

Gives you a helicopter view of the data which allows you to identify patterns quickly

Deviated Data

Shows the (+ or –) from a baseline reference point.

Spine chart

Shows opposing deviations from a central point spine (e.g., buy/sell)

Diverging bar

Shows negative and positive values on a chart in sequence

Diverging stacked bar

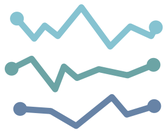
Shows both negative and positive values plus any in-between areas

Positive/negative filled line

Alternative visualization to a diverging bar chart where the top or bottom data points are joined by lines, and the shaded area represents the entire data

Time-Based Data

Shows changing trends over time either intra-day movements or long-term time series.



Line chart

The usual 'simple' way to show a change over time

Sparklines

Shows change in a measurement, such as temperature or stock market price over time, in a simple and highly condensed way

Horizon

Shows metric behaviour over time in relation to a baseline or horizon

Candlestick

Shows day-to-day activity, these charts show opening/closing and high/low points of each day

Area chart

Used to visually represent quantities that change over time

Fan projection

A chart that joins a line graph for observed past data, and a range area chart for future predictions

Priestley's timeline

Commonly known as a Gantt chart, it is used to cover a vast period of time, highlighting key date points

Circle timeline

Usually displays discrete values of varying size across multiple, different categories

Vertical timeline

Displays time on the Y axis rather than the X axis and works well for portrait-based screens such as mobile

Streamgraph

A chart that displays cumulative areas over time rather than individual values

Straight timeline

Milestone/date-based timeline associated with displaying historic events

Arc timeline

Similar to a straight timeline this chart has a 'jump' dimension to show significant events

Calendar heatmap

A visual way of showing temporal patterns (daily, weekly, monthly)

Renko charts

Used in financial technical analysis to measure/plot price changes

Step chart

A stepped line chart can be useful when you want to show the changes that occur at irregular intervals

Flow-Based Data

Shows volumes or intensity of movement between two or more states or conditions.

Sankey

Shows the major transfers or flows within a system. They are helpful in locating dominant contributions to an overall flow

Waterfall

Helps in understanding the cumulative effect of sequentially introduced positive or negative values

Chord

A graphical method of displaying the inter-relationships between data in a matrix

Network

This type of visualization displays relationships between entities

Distributed Data

Show values (highlighting non-uniformity) in a dataset and how often they occur.

Barcode plot

Ideal for displaying all data in a table, they work best when highlighting individual values

Box plot

Shows multiple distributions by displaying the median (center) and range of data

Violin plot

Used with complex distributions (data that cannot be summarized with simple averages)

Population pyramid

A way for showing distributed and comparative data such as age and sex population distribution, effectively. Back-to-back histograms

Histogram

The usual way to show statistical distribution – gaps between columns are tight to highlight the 'shape'

Cumulative curve

Shows how unequal a distribution is: y axis is always cumulative frequency, x axis is always a measure

Frequency polygons

Displays multiple distributions of data. Use a maximum of three or four datasets

Beeswarm

Emphasizes individual points in a distribution. Points can be sized to an additional variable

Hexagonal binning

Shows data points that start to overlap and plots density, rather than points

Dot density

Uses dots to show the presence of a feature or phenomenon

Data Magnitude

Shows relative size comparisons ('counted' numbers).

Mekko chart

Shows the size and proportion of non-complicated data at the same time

Pictograms

A very visual way of representing data and best used with whole numbers or values

Parallel co-ordinates

Shows multiple values and benefits from highlighting important values

Bullet

Shows a measurement against the context of a target or range

Group symbol

Ideal to show count data or highlight individual elements within a dataset

Whole v Part

Displays how a single entity can be broken down into its component elements (parts).

Stacked column

A simple way of showing part-to-whole relationships. Works best with a few components

Pie chart

A popular way of showing part-to-whole data but displaying no more than five segments

Donut

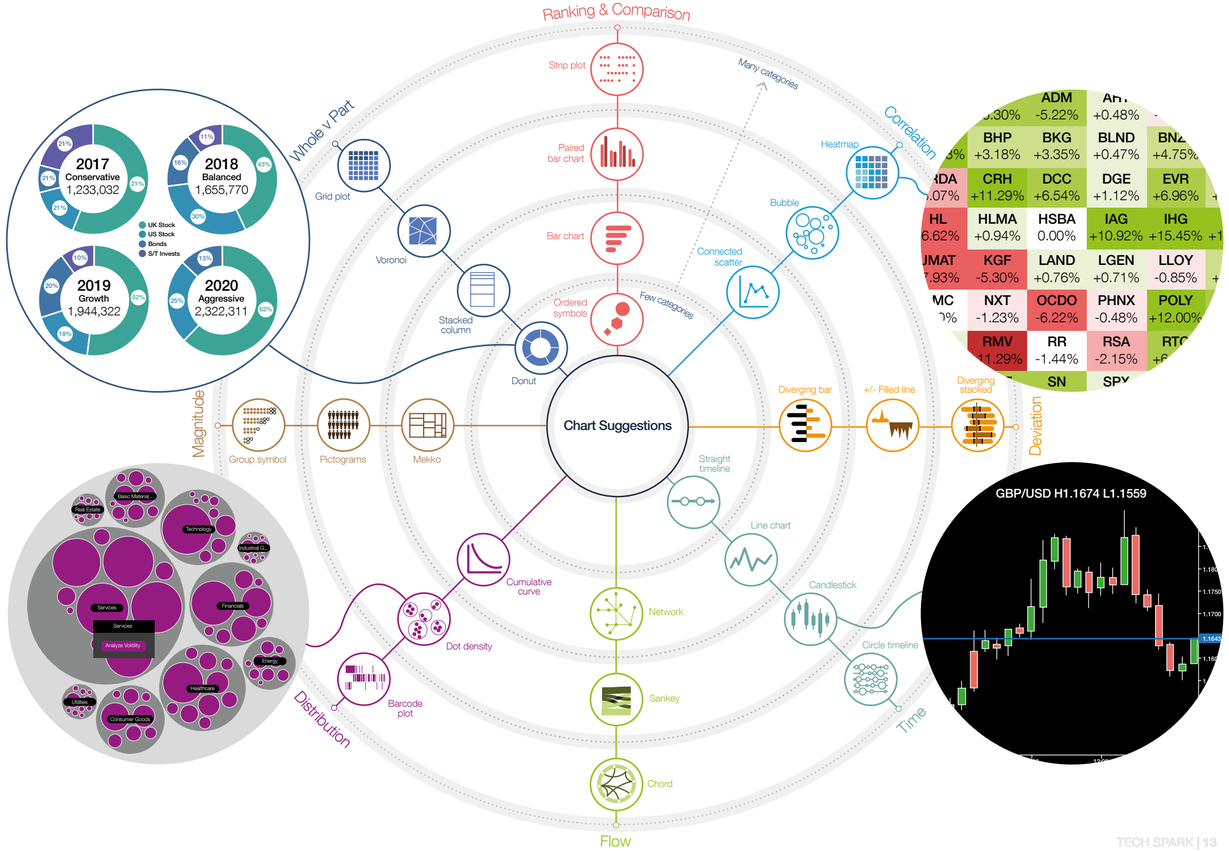
Like a pie chart, the center can be used to include more information about the data (e.g., total)

Voronoi

DIsplays points in areas—any point within each area is closer to the central point than any other region

Grid plot

Ideal for showing percentage information. Works best when used on whole numbers



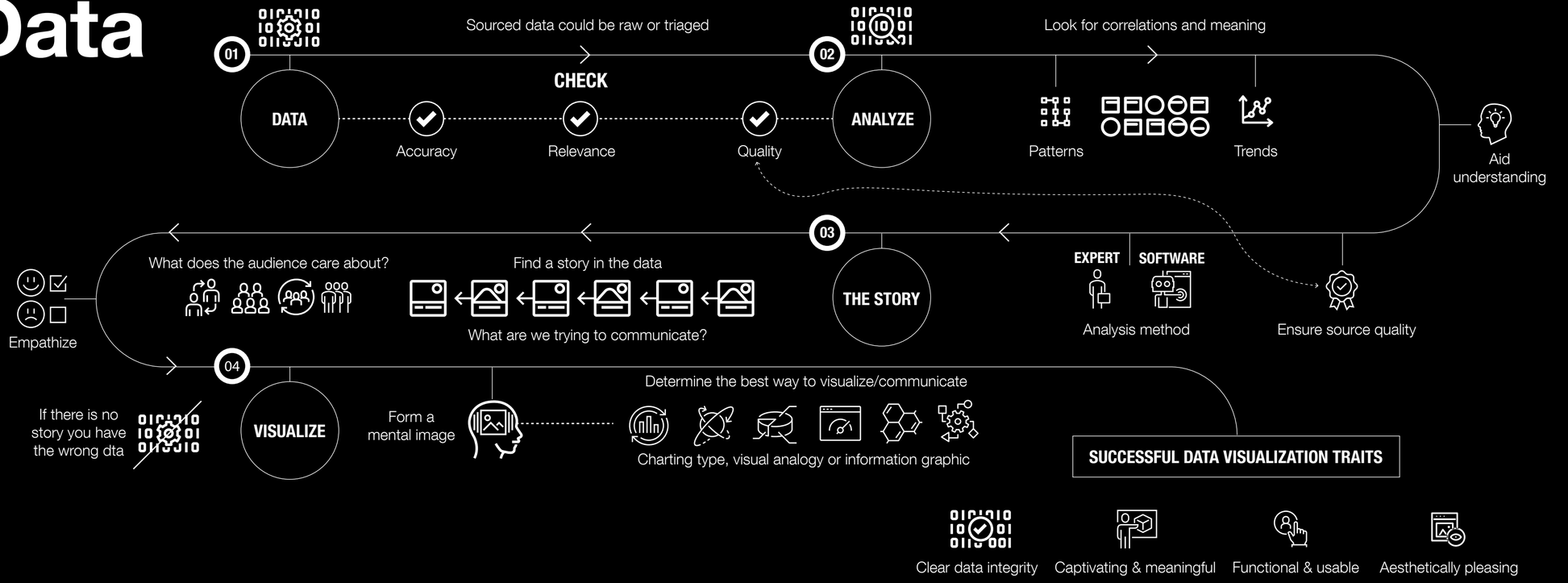
Presenting Data Graphically

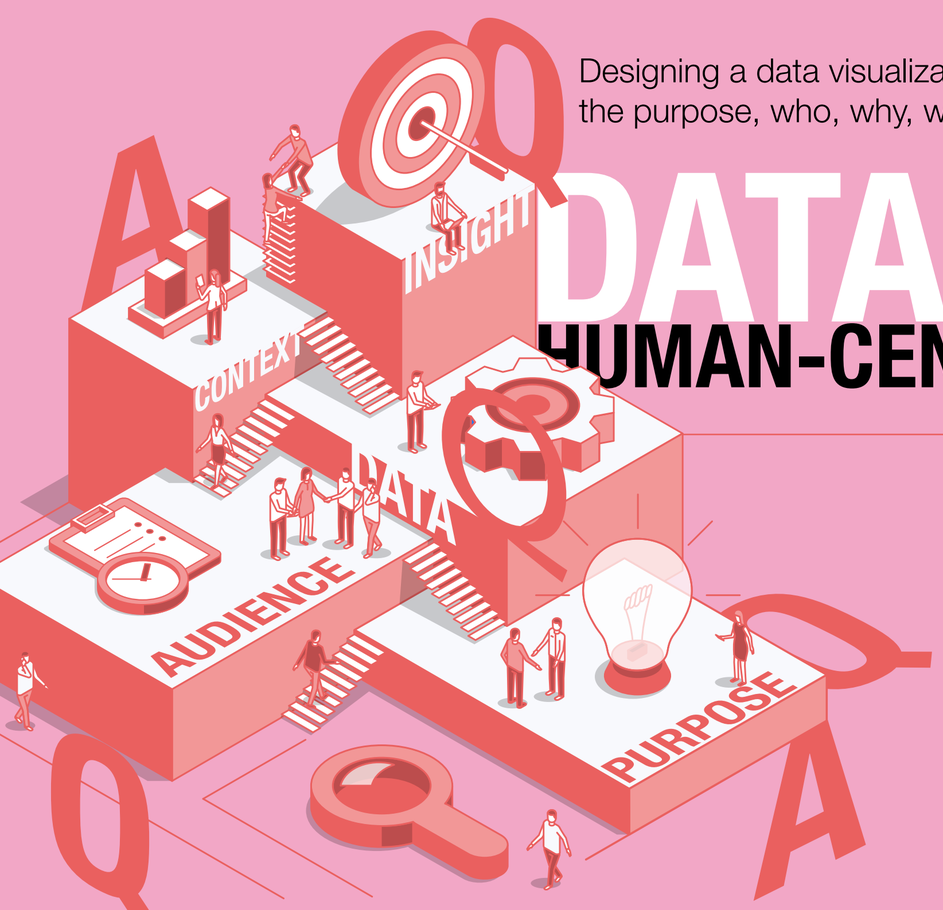
Data visualization is one of the best ways for our brains to analyze and comprehend data. By placing data in a graphic form, the decision-maker can more easily understand the significance of the data, compare multiple pieces of data, or even set goals and objectives based on the data.

The importance of data visualization in interpreting data — key facts:

- The human brain processes entire images that the eye sees for as little as 13 milliseconds
- About 80% of the information we take in comes through our eyes
- The human brain processes images 60,000 times faster than words
- After 3 days, only 10% of information heard can be recalled.
  With data visualization, recall is up to 65%

As organizations deal with more complex datasets that have scores of variables and subsets, data visualization is even more instrumental in our making sense of it. The world is becoming more complex, and organizations that adapt accordingly will be the ones most likely to prosper. That said, the process of making sense of complex data and presenting it graphically is pretty straightforward. With the right subject matter experts it's possible to end up with groundbreaking insights based on the right analysis, spotting the right story to tell and visually delivering that story in a meaningful way. The diagram opposite illustrates the process.





Designing a data visualization goes beyond just the aesthetic you need to keep it human-centered and think about the purpose, who, why, where and when they will use the visualization. Below are a few things to consider...

DATA VISUALIZATION

HUMAN-CENTERED REFLECTION, KEY QUESTIONS

PURPOSE

What are you starting from – a user need, a dataset, a request from a client or internal department?

What problem are you trying to solve and how will this visualization help?

What are the key goals you want to address with the visualization?

What is the nature of your intention? To make a point, support a story or provide exploration?

AUDIENCE

Who is the target user for this visualization?

What will the user be looking for and what will they do with their insights?

What cultural-, domain-, or industry-specific needs does your user need to be able to interpret the visualization (if any)?

How will you measure if the visualization has worked and the user is satisfied?

DATA

How complex is the data and has it been triaged/cleaned?

Is the data real time or static and how will it be updated?

How will the data be accessible for different user needs?

Is there an obvious series of patterns or stories being told through the data?

CONTEXT

Where will the visualization live (online, in reports, printed, an article or blog post)?

How will the user utilize the visualization and is it meant to be explored?

Is the visualization static or dynamic, passively consumed or interactive?

DATA VISUALIZATION TOOLS IN FINANCE

Historically, banks have relied on IT and third-party consultants for data management, data aggregation and decision support. But, increasingly, financial institutions are turning to data visualization tools to help them aggregate, analyze and gain insight from their data.

According to Qlik, a business intelligence and visualization software provider, data visualization tools are being used by thousands of financial institutions across the globe, including 47 out of the top 50 financial institutions.

In the *Big Data @ Work* survey conducted by IBM, 71% of the 124 respondents from the financial sector reported that use of big data and analytics (including data visualization) creates a competitive advantage for their organization.

Financial institutions, ranging from commercial banks to asset managers and insurers, use data visualization to address a variety of market needs, such as regulatory compliance, portfolio analysis, benchmarking and model development.

It's easy to get lost with the unprecedented amounts of data being created, stored and shared. As organizations seek to derive greater insights and present their findings with clarity, the premium placed on the right visualization framework will only continue to increase.

Data visualization is constantly changing and as new technologies and techniques push the boundaries of data, your organization should be flexible enough not only to adapt to these new requirements, but also remain pragmatic in your selection of visualization techniques.

We have identified four groups of tools across the industry:

ENTERPRISE BI TOOLS

looker

Cloud-based BI platform designed to explore and analyze data from multiple sources in real time.

Power BI

Provides a suite of business analytics tools that allows you to connect multiple data sources, simplify data prep and run sophisticated visualizations.

Qlik

Hosts a comprehensive portfolio of solutions that provide advanced analytics across the spectrum of BI needs.

+ableau

Allows users to simply and quickly connect, visualize and share data from a PC to their iPad across a suite of visualization products and services.

THOUGHTSPOT

Enterprise BI and big data analytics platform that is used to explore, analyze and share real-time business insights.

Google Data Studio

Turn your data into customized dashboards and reports without coding. It provides prebuilt connectors to several database sources.

DEVELOPER TOOLS

D3.js is a JavaScript library based on data manipulation documentation. D3 combines powerful visualization components with data-driven DOM manipulation methods.

HIGHCHARTS

HighCharts is a chart library written in pure JavaScript that makes it easy and convenient for users to add interactive charts to web applications. This is the most widely used chart tool on the web, and business users require a commercial license.

ECHARTS

Echarts is an enterprise-level chart tool from the data visualization team of Baidu. It's a pure JavaScript chart library that runs smoothly on PCs and mobile devices, and is compatible with most current browsers.

Leaflet

Leaflet is a JavaScript library of interactive maps for mobile devices. It has all the mapping features that most developers need.

Vega is a set of interactive graphical grammars that define the mapping rules from data to graphic, common interaction grammars and common graphical elements. Users can freely combine Vega grammars to build a variety of charts.

deck.gl

Deck.gl is a visual-class library based on WebGL for big data analytics. It's developed by the Uber visualization team.

Chart.js

Chart.js is a tiny open-source library that supports just six chart types: line, bar, radar, polar, pie and doughnut. It's one of the most popular open-source charting libraries to emerge recently.

NON-DEVELOPER TOOLS

chartblocks

Online chart builder that allows you to build basic charts very quickly and pull in data from multiple external sources.

Datawrapper

Simple, online tool for making interactive charts.

infogram

Helps simplify the creation of engaging charts, infographics, maps and reports.

juiceanalytics

Next-generation platform for building data stories.

plotly

Creates leading open-source tools for composing, editing and sharing interactive data visualizations via the web.

RAWGraphs

Open-source, data-visualization framework that simplifies the visualization of complex datasets.

visually

Combined gallery and infographic generation tool that offers a simple toolset for building data representations.

AI/ML-DRIVEN TOOLS

IBM Watson

Smart data analysis and visualization service in the cloud that helps quickly discover patterns and meanings in datasets.

ngit

Uses artificial intelligence to fill the gap between dashboards and stories for immediate insights.

rapidminer

Platform for data science teams that unites data prep, ML and predictive-model deployment.

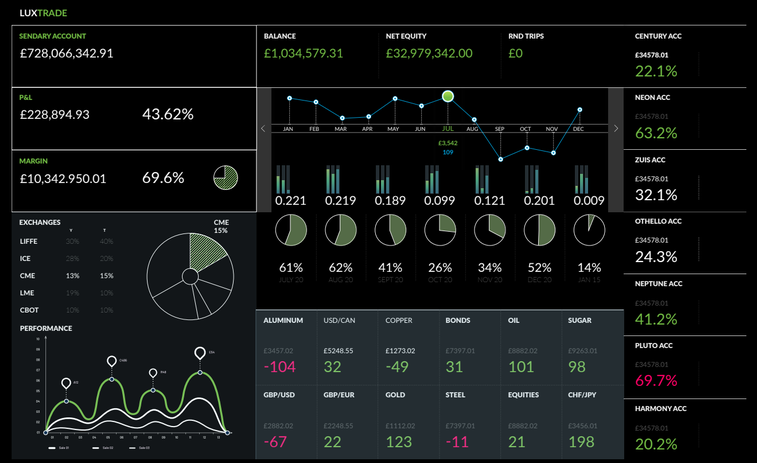
DataRobot

Data science company that allows business scientists of all skill levels to build and deploy accurate ML models quickly.

Amazon QuickSight

First BI service with pay-per-session pricing and ML insights for everyone.

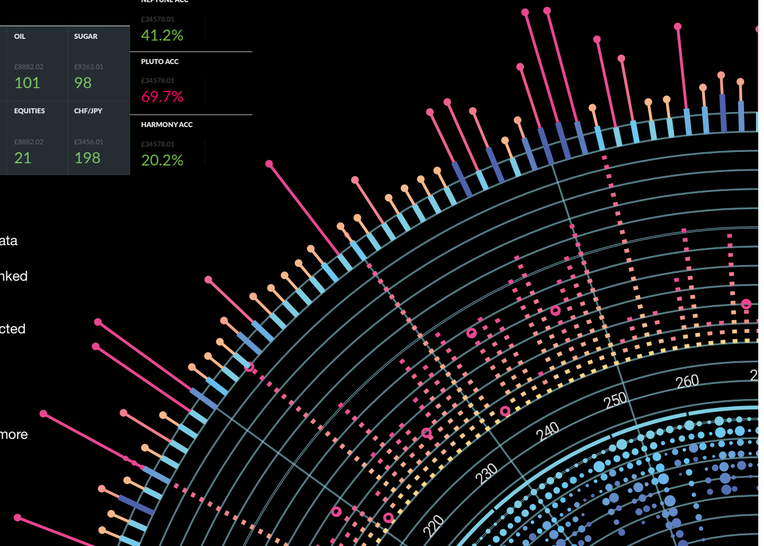
A Visualization Hub Example



Business transformations driven by data visualization could include real-time, data quality dashboards, a comprehensive view of risk across the organization, and self-service analytics that cater for business users and decision-makers. Data dashboards allow practitioners to easily pinpoint portfolio outliers and identify potential data-quality issues. Data from multiple systems and sources can be linked via a data-visualization tool which serves as a hub for customer intelligence.

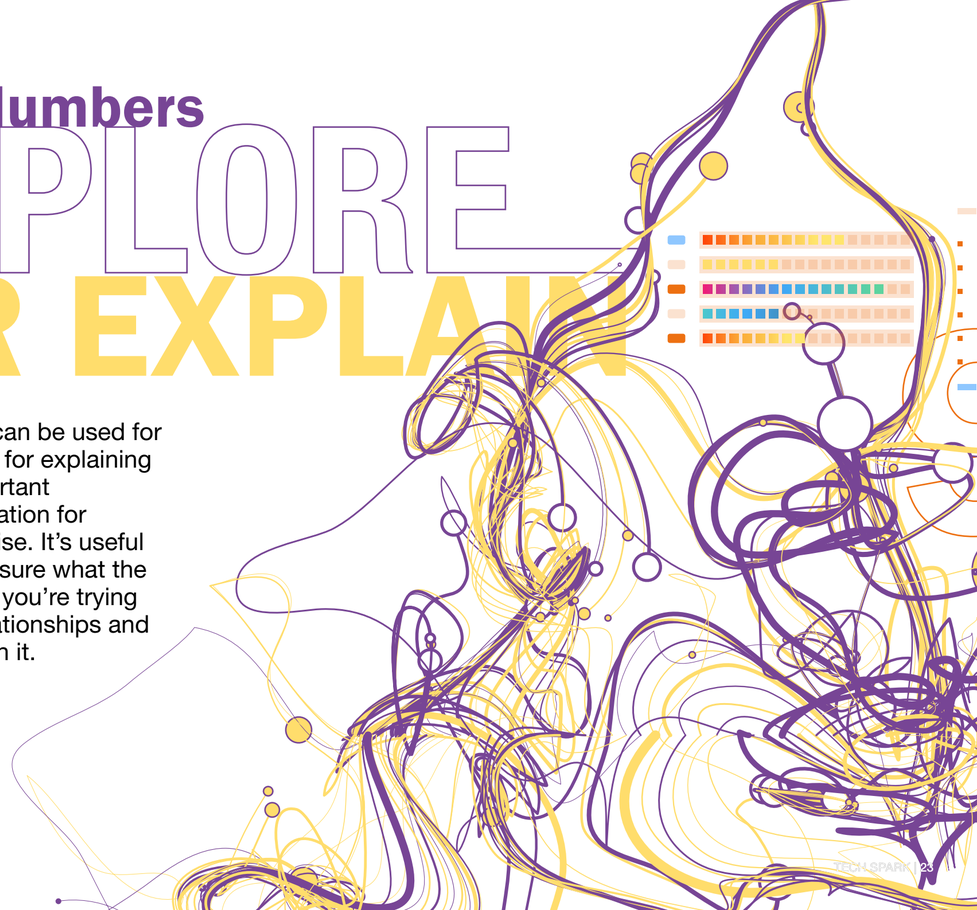
The hub facilitates reporting at the enterprise-level rather than across disconnected lines of business, breaking down silos and producing new business insights. IT dependency and long service-request queues will be a distant memory, as business users will have direct access to empowering data and analytics for decision-making, root-cause analysis and reporting.

Last but not least, self-service data visualization will free resources to work on more important business goals.



Big Numbers EXPLORE OR EXPLAIN

Data visualization tools can be used for both data discovery and for explaining data to others – an important distinction. Data visualization for exploring can be imprecise. It's useful when you're not exactly sure what the data has to tell you, and you're trying to get a sense of the relationships and patterns contained within it.



Data Visualization for Exploration

Data visualization for exploring is best approached in such a way that allows it to be iterated quickly and experimented upon, so that you can find the valuable information and disregard the noise.

Data Visualization for Explaining

Data visualization for explaining is best when it's most transparent. The ability to pare down the information to its most basic form makes it easier for the decision-maker to understand. This is the approach to take once you understand what the data is telling you, and you want to communicate that to others.

Technology

Advances in technology over the past 20-plus years have made this task much easier, more effective and more efficient. We can now incorporate terabytes and petabytes of data, both internal and external to our organizations, at the touch of a button. We can pull in our actuals, in real time, to help make better, smarter, faster decisions to help our business partners and organizations thrive.

Managing Audience Expectations

An important part of this process is determining what is most appealing and enlightening to your audience, by considering the following elements:

- What information is important to your audience?
- How much detail does your audience need?
- What actions can be taken with your discoveries?
- How do learned insights and foresights affect current actions?
- What additional information can be produced to amplify reach?

The Three Tiers of Visualizing Data

3

Different users need different views of the same data. We have found that the data hierarchy and visualization style are the main indicators for differentiating these views. When designing financial applications we tend to see three tiers of data and information aimed at these different user groups.

Tier 1 (the big org picture – wide and broad)
Personalized high-level executive summary dashboards. Provide a monitoring view often with a RAG status (often aimed at c-level).

Tier 2 (the departmental view)
A deeper dive into business streams or organizational areas such as payments, customers, incidents, breaches and KPIs. Can also be temporal/time-based or scenario.

Tier 3 (the individual view – narrow and deep)
Drills down to some of the specific data often displayed in data grids and provides insights into how some of the patterns/insights in tiers one and two have been generated.

A classic example of where these tiers are valuable is as follows:

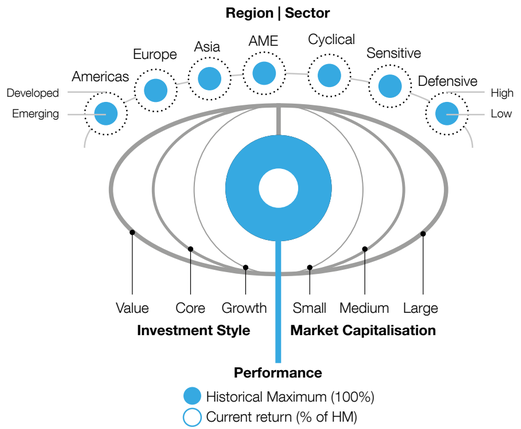
A relationship manager might want to know which of the portfolios she covers are at risk of redemption.

Senior management would like to know the firm-wide view of accounts at risk, trends and coverage for those accounts.

A client may want to drill deeper into their portfolio to see which funds are performing better than others to discuss longer-term objectives with their RM.

From an individual presentation to a firm-wide risk perspective, the narrative needs to adjust and tilt to meet the needs of the different users.

Playing with Patternization for Visual Recall

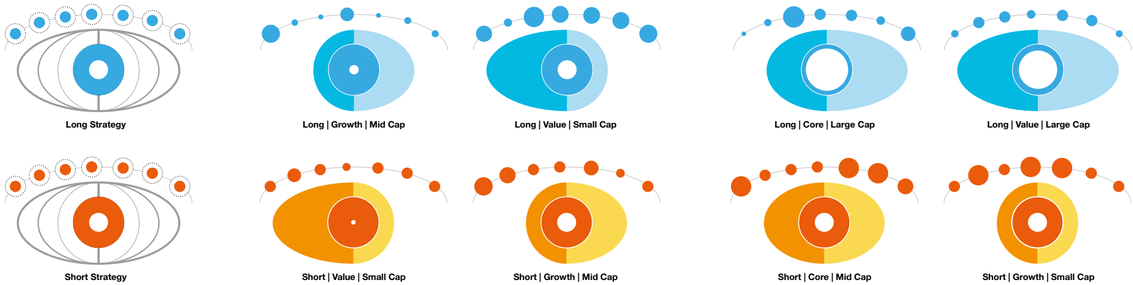


Patterns are everywhere and even when they're not obivous, we try and make sense of them. It's part of our evolution to use pattern recognition to help us survive. Our skill at pattern recognition enables us to capitalize on opportunities and cope with challenges.

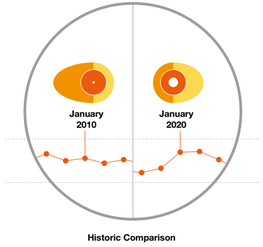
Data visualizations rely on pattern recognition. A chart interprets measurable values as a visual image. In turn, this allows us to recognize patterns for the purposes of making comparisons, identifying outliers, etc. Using recognized patterns can help us identify and remember information that otherwise would be too complex to interpret in one go. A way to do this is to connect datasets to everyday objects we recognize. And once we understand the visual framework, we can decode the information quickly. An interesting example of this was devised by Herman Chernoff in 1973 called *Chernoff Faces*.

Chernoff Faces display multivariate data in the shape of a human face. The individual parts of the face (eyes, mouth, nose) represent values of the variables by their shape, size, placement and orientation. The idea behind using human faces is that humans easily recognize faces and notice small changes. This helps people to see patterns, groupings and correlations. The concept of the Chernoff Face applied to finance was explored by Julie Rodriguez and Piotr Kaczmarek in their book *Visualizing Financial Data*. They devised a Chernoff Fish to represent multivariate financial data. A variation on this idea, the Chernoff Eye, is illustrated opposite and shows how changing the data values changes the visual representation of the eye.

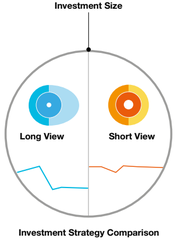
The point of Chernoff Faces is to display multiple variables at once by positioning parts of the human face, such as ears, hair, eyes and nose, based on numbers in a dataset. The assumption is that we can read people's faces easily in real life, so we should be able to recognize small differences when they represent data. It's debatable how well they work but, debate aside, they're interesting for exploring data visually.



Playing around with the concept of Chernoff Faces using an eye pattern provides some interesting results, but they need further exploration to determine how useful this type of visualization could be.



Exploring Chernoff visualizations using investment data



Bank's Data Visualization

The Business Problem

The monthly management information (MI) reporting format was problematic on several levels. Basic issues included:

- Time-consuming to prepare
- Difficult to read and compare data
- Trend analysis was not easy
- Multiple visualization styles used in reports

DXC Luxoft MI Solution

- Clarity and transparency
- Better decision-making
- Optimized reporting workflow
- Predictive trend analysis
- Tailored reporting
- Visibility across the business
- Consistent visualization style and usage

Eliminated manual analysis and provided tailored reporting

01.

Evaluate the Need to Change
Study current situation:
- Understand reports and usage
- Understand how results are reported monthly
- Learn how reports are currently generated – from which groups and products

Identify key issues:
- Hard to compare monthly data
- Information overload
- Data does not relate to other data
- Difficult to spot red flags
- No temporal visibility across the business
- High-level views require a lot of manual work
- No clear way to interrogate data
- No way to tie incidents like breaches to overall data

Determine scope of PoC:
- Establish reporting categories across products

Format:
- Determine required views

02.

Apply Correct Solution
The solution provided:
- Clarity and transparency
- Better decision-making
- Optimized reporting workflow
- Predictive and trend analysis
- Tailored reporting
- Visibility across the business

03.

Our Unique Customer Focus Created:
- A digital and fully clickable solution which enables the bank to navigate through an interface to build custom reports for their monthly meetings. We built red-flag highlighting into the system for ease of use, and the rapid spotting of potential problems and risk areas
- A showcase video of the data journey with the bank, allowing them to share data visualization internally with stakeholders and key members of their organization

04.

Achievement
- Eliminated cumbersome manual analysis and provided tailored MI reporting that met the client's needs

Leading Retail Bank

Visualizing Risk Data
The monthly management information (MI) reporting format was problematic on a number of levels:
- **Time-consuming to prepare**
- **Difficult to read and compare data**
- **Takes time to do any trend analysis**
- **Multiple styles and types of visualizations**

12 Week Discovery
Segment: Investment Professionals and Reporting Managers

Challenge

To improve a leading retail bank's monthly MI reporting format. The client challenged DXC Luxoft to cut preparation time, improve readability and data comparison, speed up trend analysis and reduce the number of styles and types of visualizations.

Solution

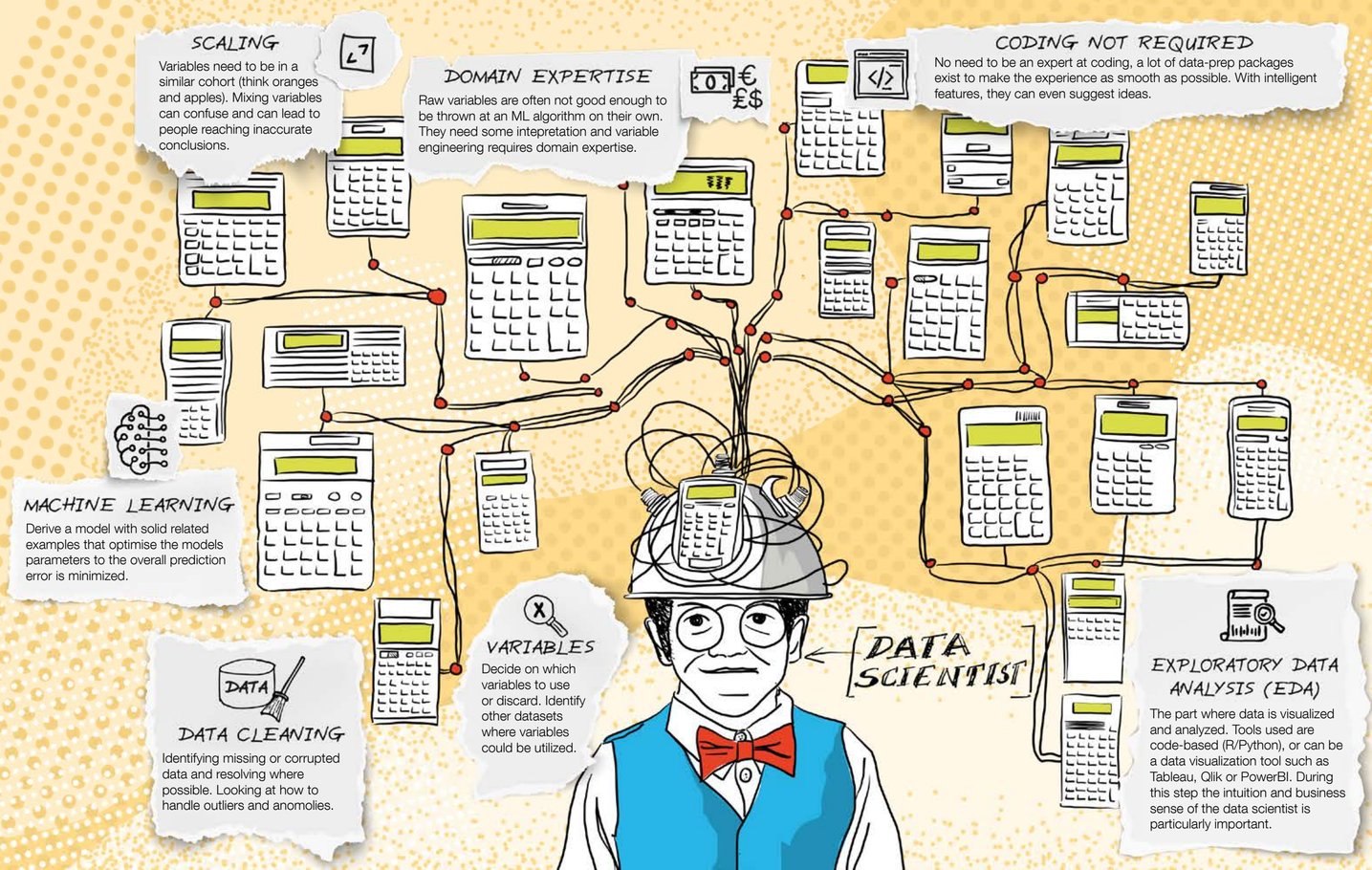
Our clickable prototype enabled the client to navigate through the interface easily, building custom reports for their monthly meetings. We built-in red-flag highlighting for ease of use and the rapid spotting of potential problems and high-risk areas. The accompanying showcase video of all the key journeys allowed our client to share progress with their internal stakeholders and other key members of the business. Core technologies: User-Centered Design (UCD), Agile development, Sketch and Zeplin (design), and Justinmind (prototyping).

Results

Enabled the visual representation of available data, creating tailored reporting that provides:
- Clarity and transparency
- Better decision-making
- Optimized reporting workflow
- Predictive trend analysis
- Visibility across the business
- Consistent visualization style and usage

A Data Scientist Can't Be Replaced with Software

A common joke is, "Data scientists spend 80% of their time collecting and cleaning data. They spend the remaining 20% complaining about collecting and cleaning data". But what do they actually do and why there are no tools to replace their skills?



Contributors

Nathan Snyder
Head of BCM Consulting, EMEA

Nathan Snyder is head of Banking & Capital Markets consulting for Luxoft EMEA. He focuses on helping Financial Services organizations capitalize on business opportunities through technology and operational change. Nathan has worked with tier one-three banks in London and New York.

Luis Cameroon
Principal Consultant

Luis has been designing and developing high-performing, scalable and innovative web-based applications for clients in the Financial, Energy and Media industries for more than 15 years. He's fascinated by human-computer interaction and is a keen proponent of user-experience design.

Phil Cranfield
Director

Phil Cranfield has over 20 years' experience of leading IT projects for clients in the Banking & Capital Markets, Insurance, Utilities and Retail industries. Phil has worked at Luxoft for 6 years, structuring a wide range of client engagements to deliver complex IT programs in line with strategic goals and initiatives.

Andy Hall
Creative Director

Andy Hall is Luxoft Excelian's creative director. A large proportion of his 25 years' user-centered design experience has involved helping organizations apply user experience, information design and other creative techniques to drive design innovation. Andy specializes in solving complex Financial Services problems.

Paul Hewitt
Senior Director

Paul Hewitt leads the Data, Analytics and AI/ML practice for Financial Services. His global responsibilities include handling full-scale AI and ML projects in conjunction with the various worldwide delivery teams, as well as managing R&D on behalf of clients, and providing proofs of concept.

Hiren Patel
CX/UX Director

Hiren Patel has worked closely with clients in the Banking & Capital Markets (BCM), Telecommunications, Insurance and Technology industries for over 14 years. In his current role as Customer & User Experience Director, he leads the digital experience design services for our BCM consulting practice. A long-term advocate of user-centered design, Hiren developed our LeanUX framework, enabling clients to visualize and deliver tangible solutions, faster.

> **The goal of data visualization is** to turn data into information and information into insight.
>
> **Carly Fiorina, CEO Hewlett Packard, 2004**

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