

HOW TO TELL A BETTER STORY THROUGH
VISUALIZATION

SUSTAINING EMPLOYEE SATISFACTION
AND PRODUCTIVITY THROUGH GRAPHICS

DATA*
GUIDE TO
Data Visualization

— IN —
2019

HOW MOBILE VISUALIZATION IS
TACKLING SHARED PROBLEMS

TRANSFORMING DATA INTO INSIGHT
TO ENHANCE DECISION-MAKING

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Introduction to data visualization

Data visualization, in one form or another, has been around for decades – possibly even centuries. It has long been clear that presenting statistics, ideas or histories in graphic form helps an audience understand and act on data that might otherwise seem unwieldy or inaccessible.

But the visualization of data itself is changing and evolving at a faster rate than ever, thanks to advances in computerization and programming that have taken place in recent decades. Today, tools from companies like Tableau Software, Tom Sawyer Software, AnyChart, Plotly and many, many others are not just dealing with facts and figures generated and delivered by humans.

The growth of big data – complex, high-volume datasets – is making major demands on visualization. These data partly come from the growth in connectivity that makes any human being with a connected device a source of information – on location, time of calls, call frequency and much more.

However, these data are also a result of the growth in Internet of Things (IoT) applications, which will increasingly supply useful information in vast quantities of often small amounts. This information could come from sensors on oil rigs, on supermarket shelves, in parking spaces, in farms – the list is as long as you care to make it. If effectively managed, the information could improve productivity, response times, traffic flows, harvests and more – if they can be presented in graphic form that can be seen, understood and analyzed more easily than raw data.

And, increasingly, they can. But this is not the only trend driving visualization. This is a fast-evolving area that promises much and, increasingly, needs to as end-user demand changes. This exclusive ebook from Innovation Enterprise aims to outline some of trends driving data visualization use and development and where they might take data visualization in the coming months and years.

What is data visualization & where is it going?

As data visualization software company Tableau Software puts it, quoting IDC, in 2020, the world will generate 50 times the amount of data it did in 2011 and will have 75 times the number of information sources. Within these data are huge opportunities for human advancement. But to turn opportunities into reality, people need the power of data at their fingertips. While this is partly a pitch for Tableau's tools, it also happens to be true. Analyzing data has to be not just fast and easy, but visually clear and accessible to most people. However, there's going to be a lot more to analyze in the coming years.

This ebook takes a closer look at upcoming and ongoing trends in data visualization solutions and innovations, and how transforming data into insight can enhance decision-making. It also includes insights from some of the participants at Innovation Enterprise's Data Visualization Summits in Boston, London and San Francisco, as well as at our DATAx global series of events, including Pfizer, Volvo Group, the Scottish Parliament and Food & Water Watch.

Top data visualization trends for 2019

Putting data on the map

One of the oldest forms of data visualization is right now becoming part of data sharing in a very new way.

Cartography – maps to most of us – have long been capable of interactivity and are going to become even more interactive. Location data is joining forces with available information on housing, income, crime, education, pet ownership – you name it.

It's not a new concept, but the ability to zoom in and out of maps and to build customized and even evolving maps, relevant to your business or service, will become much more intuitive and make finding location-relevant detail faster and easier than ever before – and more appealing to less technical users.



1



2

Better, briefer storytelling

Data visualization tells a story. If that can be leveraged to bring complex data to less tech-savvy end users, the humanization of data visualization will make great strides. And as companies learn to build simple stories from complex data, the growth opportunities will be in accessibility and mass-market reach. And these stories will be space saving. One of the selling points of good data visualization is that it takes up less space on your screen and takes less time to absorb than data in list or conventional story form. A graph in a quickly and easily digestible form that addresses key points is often part of a new story. It could eventually be the story.

A graph on every mobile

We're certainly not there yet, and probably won't be in 2019, but data visualization is a racing certainty to have a role on mobile phone screens. However, there is still a very obvious question to answer: How do you access, use and above all create this information using thumb-based inputting on a very small-screened device?

More than ever before, end users are reading the news and accessing web content on their phones; so, of course, the data they're looking at should be compatible with how they're viewing it. And this doesn't just apply to everyday consumers. If data visualization is meant to make better use of time, accessing data on a phone in a context where no other device is available, and reading or editing a graph or chart on the move, are both going to be essential aids to business efficiency. Embracing the mobile audience is the future and many vendors are now working on adapting their entire desktop experiences to comfortably fit the comparatively tiny world of smartphone screens. Apple's acquisition a few years ago of mobile data visualization startup Mapsense for \$30m was an early example of a lot of jockeying for position in this space. Expect a lot more activity in 2019.



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Top data visualization trends for 2019

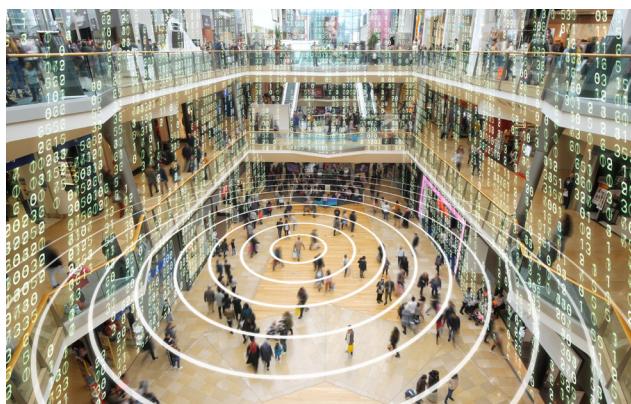
VR?

4

Virtual reality is much discussed in a number of contexts – but for data visualization is it anything more than just a nice idea? 3D data visualization is already happening. And the results from data visualization can be applied to contexts in which virtualization is relevant (medical operations, for example). But the benefits of taking a walk around a graph are less clear than those of, say, AI, in making sense of data.



5



Everything, everywhere

Mix and match isn't quite the right term but there has been a lot of talk about the ability to mix data from different sources in an easy way. The idea is to use techniques to collect both structured and unstructured data, integrate it into a single place, and enable users to interact with it for analysis and discovery.

6

Beware!

Where could all this activity lead us? Well, one less welcome possibility is misuse of data. If illustrations can tell a story well, they can surely be manipulated to tell a biased or false story. Keeping data visualization honest is going to be a response to what will be a less welcome trend as data visualization becomes easier to manage and use.



How automated data visualization tools can help sustain employee satisfaction and productivity

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By putting detailed information into the hands of not only the HR department, but all HR decision-makers, such as line managers and even the board, organizations can become far more proactive. Everything from planning training courses to accurately assessing individual performance becomes grounded in genuine, actionable insights. The goal with this level of data analysis isn't to create more work for people; it's to create a better workplace for everybody.

Takin Babaei, Product Marketing Director,
Business Analytics, Oracle

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Many companies don't understand their employees or use their talents effectively. Even today, in a world where, in theory, we understand businesses and management better than we ever did, finding the right employee for a given post is still not guaranteed. Employee satisfaction, development and engagement, meanwhile, are often left to chance. But such an attitude – simply hoping for the best – can lead to lower productivity and the departure of frustrated employees. Can data visualization help?

Most organizations have a vast amount of usable information about their workforce. Not just personal information such as age, gender, educational background, and professional skills and qualifications, but unstructured data such as surveys and clickstreams or employee and manager feedback. Employees create data every time they file expenses or fill in timesheets, do overtime or log onto HR portals, get a pay rise or take on a new role, and take holiday or sick leave.

Often, however, employers have either not captured that information, or if they have, have done little with it.

Big data applied to visual analytics can give employers the resources they need to explore workforce trends, investigate the root cause of issues, find out how successful initiatives really are (do fitness subsidies

work? What incentives are actually popular and why?) and maintain a workforce strategy that delivers quantifiable business impact.

Through visual analysis of a variety of workforce data, businesses are able to quickly and reliably learn a great deal about their people. It also means that instead of using gut instinct, they can actually see whether the right employees are being rewarded in the right way, or at the right time. They can analyze whether benefits are taken advantage of and by which groups within the workforce. They can then refresh them, if necessary, to attract or retain particular groups. They can better recognize if employees are encountering problems or if their skills are not being used effectively, or which pockets of the business experience more employee churn than others.

By exploiting the power of visual analytics, the company's business leaders are able to proactively identify potential issues, address them before they become problems, and ensure they have the right resources when and where needed.

By putting detailed information into the hands of decision-makers, organizations can become far more proactive. Everything from planning training courses to accurately assessing individual performance becomes grounded in genuine, actionable insights.

Sources: <https://blog.brightscout.com/data-visualizations-can-boost-organizations-productivity/>
<https://www.oracle.com/uk/solutions/business-analytics/features/data-visualization-helping-businesses-build-a-better-workplace.html>
<https://www.oracle.com/uk/solutions/business-analytics/features/data-visualization-helping-businesses-build-a-better-workplace.html>

Charles Haggas, Founder, Brightscout

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Transforming data into insight to enhance decision-making

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As human beings, we're prone to subjective bias when visualizing data. By that I mean that people whose job it is to visualize data must be cautious of presenting the data in a way that supports preconceptions about it. Transforming data into insight may reveal trends or conclusions that were not expected. This is one of the most important guidelines for me: to use graphics to successfully communicate what is difficult or impossible to see when looking at a nonvisual representation of the data without fitting it to a predisposed belief. In the same way that Michelangelo believed his sculptures were already complete within the marble block, good data visualization will chisel away superfluous material to uncover truth in the data

Katherine Fraser,
Manager, Data Analytics & Visualization, Volvo Group

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It seems inarguably true that data visualizations are a real asset in breaking down complex statistical data and helping employed and employee to make real-time business decisions. They break information down into logical and meaningful parts and help users to avoid information overload by keeping things simple, relevant and clear.

The obvious primary benefit is speed. Faster response times can be ensured at all levels of a company if all staff members have vital data at their fingertips that allow them to organize their tasks more effectively. Being able to share key statistics showing the effectiveness (or otherwise) of past marketing campaigns or key market trend analysis at the touch of a button with a colleague or client in real time cuts waste and boosts timely decision-making (which is also, incidentally, a driver for user-friendly data visualization on mobile devices).

Data visualization also simplifies and renders useful the tsunami of information available to companies from their customers and audiences. Even when there are legal restrictions on some forms of data access, much highly informative data is still available. Customer mailing addresses, buying patterns from social media, mobile apps, websites and CRM interactions are being generated every single day in the digital world. Data visualizations give a big picture view but also enables a user to see the details when needed. They simplify data so that users are able to cherry-pick the relevant data they need.

Easier pattern visualization is the next stage in transforming data into insight to enhance decision-making. Seeing where data has been is useful. Seeing where it is going is even better. Data visualization is a much easier way to see new paths and to identify new patterns and trends (as every industry from agriculture to fashion is keen to do).

Enhancing collaboration, it goes without saying, is a major boon data visualization can offer businesses. If every department has access to relevant information at the same time, everyone in a company will be on the same page and collaboration can improve.



Insider view

Lily Boyce, Data Visualization Designer for nonprofit organization Food & Water Watch

Innovation Enterprise: How, in your experience, does the technical business of marshaling fact and figures translate through data visualization into storytelling?

Lily Boyce: Data visualization allows the reader to follow a story based on the way the facts and figures are presented. You can show a reader a graph, but in order for them to get anything out of it, you must provide context on why that graph is relevant and interesting. Sometimes that's as easy as the way the title is worded, and sometimes there needs to be accompanying content. There's always a story to be told within facts and figures, and it's up to us to tell it.

IE: And how – and why – does data visualization create a better user experience?

LB: The human brain is incredibly adept at taking in visual information. A good data visualization streamlines the process of understanding by playing to this capability through best practices like color theory and hierarchy. The user experience is undoubtedly improved when the information is presented in a clear and compelling way.

IE: How does your work with data visualization for Food & Water Watch differ from that of, say, a company selling products or services?

LB: Working with an advocacy nonprofit is definitely a unique angle for data visualization. We're not selling a product, but we are hoping to inspire people into action, whether that's donating to the organization, signing a petition or calling their representatives. In a way, the content strategy is similar to that of marketing – we need good copy, a communications strategy and compelling figures – but the content itself couldn't be more different. My visualizations are closer to journalism, in that they reveal truths and tell a story.

IE: What does getting an audience engaged in your visualizations entail? How can an emotional response be beneficial?

LB: The data itself needs to be impactful and engaging, but it's up to the designer to make that connection in the visualization. When examining a dataset, I always ask: "Why would this be important to an individual?" You can't get your audience engaged if you don't know your audience. You have to know who you're speaking to and design the visualization in a way that they will understand and relate to. An emotional response creates a desire to act – whether that's sharing the piece, or donating money, or buying something, or making a personal decision based on the information.

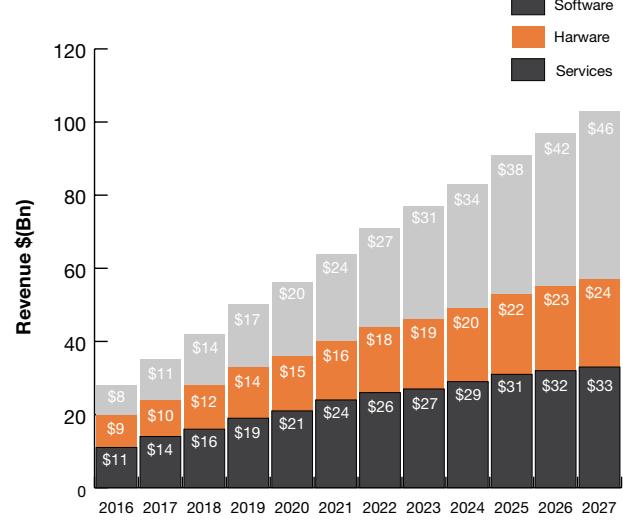
IE: Regarding visualization best practices, can data visualization be misused and how do you tell a good, emotionally engaging story without potentially misleading people?

LB: Data visualization can absolutely be misused. We all have biases, and designers and data analysts are no exception. When telling a story, you have to make sure the data speaks for itself and that you're not drawing conclusions that aren't there. It's also important to remember that visualizations don't exist in a vacuum. There's always a broader context to the data, and to ignore or omit information is to mislead the reader.

IE: And finally, as a designer, what are your hopes and expectations for the evolution of data visualization tools in the coming years?

LB: There have been some really incredible advancements in web tools in the past couple of years and I'm hopeful they'll only get better moving forward. The ability to create interactive visualizations has been made more and more user-friendly, which is great for the field. I'm excited about services like Flourish which make more complex charts such as chord diagrams easy to automate. I'd love to see these kinds of web tools evolve with more and more layers of customization.

**Big Data Revenue Worldwide
by major segment 2016–27 (\$bn)**



Source: Statista



Case Study: The impact of AI on data visualization

There's a synergy between visualization and AI, explains Peter Henstock, Machine Learning & AI Technical Lead at Pfizer.

"You have big data. It might have 100 different dimensions and 1 million rows. What do you do with it?" You could, he suggests, apply a statistical or machine-learning model to characterize the relationships among variables. "But each model has its own nuances and involves different assumptions that have to be made. And, with that size of data, it's really difficult to make these assumptions and check them." Visualization can help you at every stage. It helps you understand what the nuances are, find outliers, select an appropriate method, check the validity of the assumptions, and even communicate the results. Thus, visualization can guide AI strategy.

But the opposite relationship is also true since we can leverage AI techniques to visualize data. We all like our scatter plots and bar charts, but what if you have 100 dimensions of data? "No one is going to look at 100 different plots," says Henstock. "Even if you did, you're still missing the interactions or combinations of variables – and that would require thousands of scatter plots. AI also allows us to summarize the data through clustering the data to find patterns or reducing the dimensionality of the data to enable better visualizations. AI research is also focusing on how you can reduce the volume of figures and find out which ones are important or interesting based on how people in the past have used them or other measures of utility. You can highlight the interesting ones for the user and help them wander through the data strategically to save time."

AI is helping users to gain value from information from more and more sources every day. Updated preferences on Amazon add millions of new bits of information every

day. Through recommendation engines, the information guides better marketing of suggested purchases. Intrusion in a network to change votes in an election can happen in milliseconds and at multiple time points. AI can identify the aberrant behavior and lock it down. AI can do these things automatically. Visualization helps identify the patterns and show people exactly what's happened and where for future prevention.

There's more. You could use big data to predict fashion trends. Or how information from weather satellites, soil testing and water monitoring can improve planting of crops. Data from thousands of pictures of railroad tracks at hundreds of time points can make sure they're at the right integrity. Data from car sensors can help assess road quality. Data relating to stocks, medicine, marketing and more can improve investment, healthcare and promotional campaigns.

AI 'tames' the data and visualization allows you to understand it. Together, they can transform and display data in a way that can make it easier to manage so you can extract long-term trends and short-term trends, and make predictions for the next cycle.

As Henstock puts it: "The ability to analyze, model and understand data provides incredible insight to help us understand the past and improve the future. The target is continually changing because the variables keep changing, but AI and visualization together are enabling a transformation of entire industries."





Data visualization for mobile

Despite recent advances in pen- and/or touch-enabled mobile devices, and the rapid adoption of these devices in everyday life, we are far from leveraging the full potential of mobile devices in satisfying the growing demand for visual access to data.

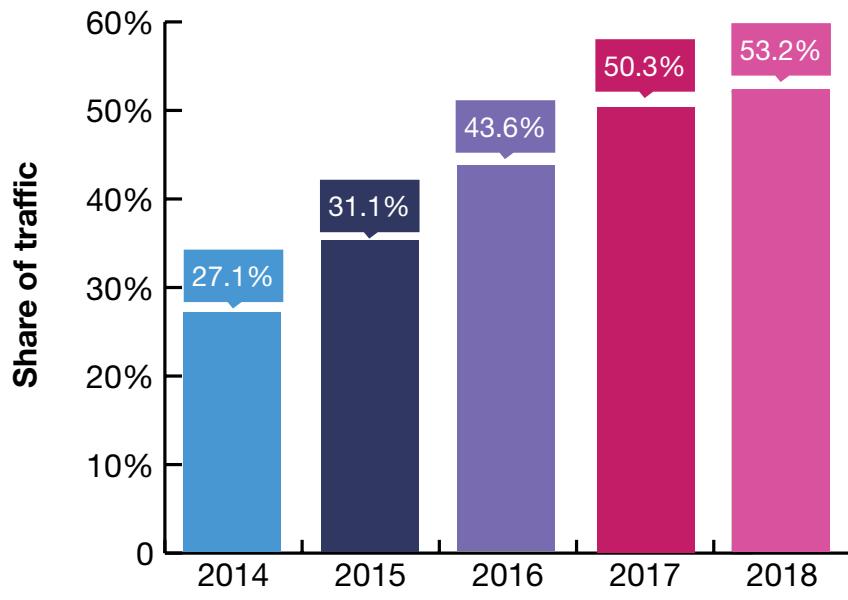
And yet applications for monitoring personal health, finance and travel data are now designed solely for mobile use, or at least with a mobile-first mentality. Many journalism outlets now prioritize their mobile readership. News articles containing static or interactive visualization should comply with this mentality. However, usage examples alone are not enough to determine how to design better data visualization tools for mobile devices.

Some visualization research is addressing visual encoding choices, such as the challenge of encoding temporal uncertainty

on small devices. Others have explored the space of touch interactions for popular chart types and data exploration on tablets, and ways to leverage the position and orientation of mobile devices to support the exploration of 3D representations of data. Another interesting recent research direction examines opportunities for combining multiple mobile devices as spatially distributed, tangible visualization views or in combination with large display walls.

Mobile self-tracking and data collection apps increasingly use data visualization to enable people to visually access their data without relying on a desktop or laptop. Mobile apps can visualize sleep patterns in terms of sleep duration and quality for a given time frame on a mobile device. Others enable diabetic patients to collect and display their data along a timeline, allowing them to reflect on and manage their conditions. In addition, OmniTrack employs a visualization dashboard featuring different charts for the

Percentage of all global web pages served to mobile phones 2014-18



Source: Statista

various data types that the app collects. Many self-tracking devices such as activity trackers and blood pressure monitors have associated mobile apps that leverage data visualization. However, despite the increased prevalence of visualization on mobile devices, we are missing a consolidated set of best practices and ways to evaluate mobile data visualization.

Both mobile visualization researchers and practitioners are tackling shared problems, such as how to adapt and optimize data representations to small displays; how to support novel and effective interactions with small data representations; and how to best use mobile devices in a device ecosystem and with multiple collaborators. Furthermore, new challenges continue to emerge as data visualization techniques are adopted and used for novel mobile apps. In addition, new mobile device form factors and hardware capabilities will emerge in the coming years.

The drastic reduction in screen size from a PC to a smartphone is going to be one of the biggest problems. Best practices for print or large-screen graph presentations are unsuitable: chart titles, axis labels, and other graph elements on a small screen are clutter rather than useful information. Nonetheless,

there is no shortage of tips on how effective data visualization on mobile devices can be accomplished. Here's one set of recommendations that attempts to match the need for mobile visualization with a few necessary compromises:

- By stripping down graphs that are typically made for print and large screen presentations to their bare bones, you will be able to reduce chart clutter and help your users to better comprehend the presented information.
- Take full advantage of the interactions available on mobile devices (portrait/landscape screen shapes, pinching, zooming and tapping to improve interaction or call up more information).
- Weigh the pros and cons of various graphing libraries available to the developers: Is the type easy to read? What light conditions could users be working with? Are the pop-ups helpful? Are multiple datasets easy to distinguish?
- You could even conduct a usability test with the graph and measure the Standard Usability Score (SUS) to help ensure that visualized data meets users' needs effectively.

Insider view

Katherine Fraser, Manager, Data Analytics & Visualization Volvo Group

Innovation Enterprise: Does data visualization in 2018 require specialist training and knowledge, or can it be made accessible to relatively nontechnical users?

Katherine Fraser: This depends on whether you're talking about consuming data visualizations or creating data visualizations. Being able to tell a story with data requires a diverse set of skills including the ability to gather, cleanse, and relate data (this typically means coding, such as SQL and R), the graphic design eye to be able to choose the chart type, layout and colors that most effectively convey the information, and the creativity to come up with the best way to reveal insights. While there are tools today that are targeted toward business users and allow a nontechnical person to easily create a graphic, employing a trained visualization person will yield better results. And better data visualizations mean they are easily accessible for anyone to see and understand.

IE: What data visualization tools are available? Are there compatibility issues across different toolsets?

KF: You can use many different tools to create pictures with data. In the hands of a skilled visualization person, even general office productivity applications like Excel and Visio can be used to make nice graphics. Today, there are many different products targeted more specifically at creating data visualizations. Tableau has always been focused on making beautiful charts. QlikView is another common choice for creating dashboards made up of different chart types. I'm a big fan of Microsoft Power BI because it's powerful, yet easy to use and supports custom visuals. Any BI tool — SAP Business Objects and Lumira, GoodData, MicroStrategy, Pentaho — will allow you to visualize the data you bring in. Compatibility isn't really an issue since the real work is done prior to visualization, gathering and shaping the data. And once the data is prepared, you can import it into any tool to present it graphically.

IE: What role can automated data visualization tools play in helping to sustain a high level of business intelligence and employee productivity?

KF: Automation could mean a couple of different things in the context of data visualization tools. In a more traditional sense, an automated tool might send alerts when predefined thresholds are reached or might email graphical reports to a list of consumers. In another context, a visualization tool might try to choose and display charts automatically based on an intelligent reading of the data. AI can be used to interpret the data and guess at what kinds of analysis are useful in deciphering the information. Both types of automation can be advantageous but depend on the quality of the tool. Too many false positives and users will start to ignore automated alerts. And misreading the data produces useless automated analytics. I think we'll see improvements on automation in the future as machine-learning algorithms get better at finding insights in datasets.





Data visualization in government

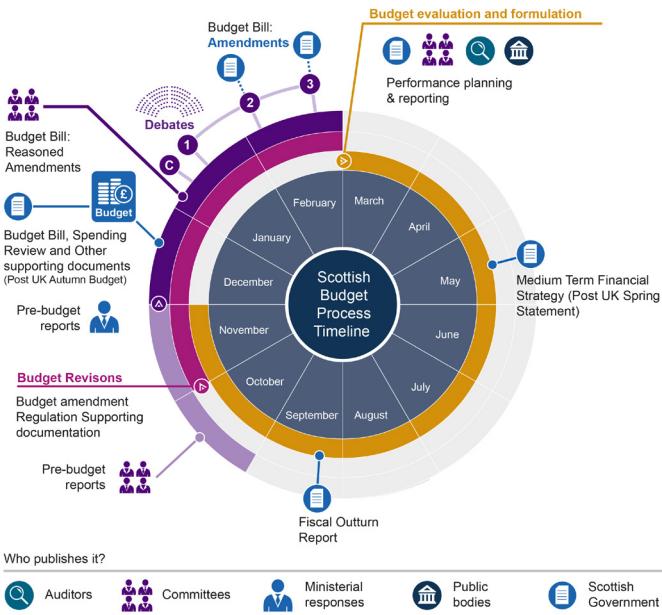
Data visualization is all about gaining a deeper understanding of collected data through visual means. It is a valuable tool in both the private and public sector because, whether it be to make a larger profit or figure out the best way to allocate resources to citizens, you first need to know what the data is indicating.

Andrew Aiton, data visualization manager for the Scottish Parliament, offers an insight into how the Scottish Parliament is using visualization to better the lives of the Scottish people.

Innovation Enterprise: How does the role

of data visualization manager at the Scottish Parliament differ to similar positions at private organizations, and what does the role entail?

Andrew Aiton: It is probably quite similar in terms of the work, producing and overseeing the production of content. However, where it probably differs is that we work in a political environment. The Scottish Parliament Information Centre (SPICe) is there to provide factual, accurate and timely information and analysis to Members of the Scottish Parliament (MSPs) in support of parliamentary business. We therefore have rigorous processes in place to ensure that what we produce is objective and impartial. When working for cross-party parliamentary



committees, I sometimes have to make changes, at the committee's direction, to ensure that all MSPs' political stances are accommodated.

IE: What are some of the ways data visualizations have directly helped or led to societal changes in Scotland?

AA: MSPs are responsible for making the law of the land and we have a unique role in providing them with impartial research support and analysis. How we present data and information, and the accessibility of that has an important role to play in influencing their thinking and the direction of policy. We recently produced some visuals for the Economy, Jobs and Fair Work Committee for their inquiry into the gender pay gap. One of the key concepts to come out of the inquiry was the "leaky pipeline" – the points in a woman's life where she is discouraged to pursue a career in science, technology, engineering or maths. We produced a visual to explain this concept, allowing MSPs to reinforce the point visually in their report. During a parliamentary debate on the report, the deputy convenor highlighted the visual saying, "if people do not look at anything else in the report, looking at the infographic on [the leaky pipeline] is worthwhile". So, we are seeing evidence of our work being valued by MSPs and used to emphasize key areas where they consider policy action is required.

IE: As a data manager for the Scottish Parliament for more than five years, you recently made the switch to data visualization manager; what can you tell us about what led to that switch and what are some of the most significant changes you've noticed since you changed roles?

AA: The switch came off the back of a report that I helped to produce, which looked at how the Parliament could make better use of data visualization. For the report, we spoke to all our internal offices in the Parliament, and a wide range of external experts in the public and private sectors. The key message internally was that staff wanted to do more data visualization and to do it better. So, we proposed setting up a

small, flexible, dedicated team for producing visualizations. As well as the change in my role, we are also introducing a range of other staffing changes and developing new templates and guidance. The main difference is that now my role focuses solely on data visualization and the implementation of the recommendations in the report. This involves going out and speaking to people to promote data visualization and the benefits it can provide.

IE: Who is your work predominantly directed toward and what type of data do you find yourself dissecting?

AA: Our main customers are the MSPs and their staff. But all our reports are available to the public on the Parliament's website, and we tend to find journalists using our material more and more. As data manager for the Financial Scrutiny Unit within SPICe, I mainly looked at economic and demographic data to produce briefings and inquiry responses. But in my new role, I will have a much wider remit, as I will be producing work on all subject areas in the Parliament, which could be areas like health, culture or climate change.

IE: What do you think are the greatest challenges facing any data visualization professional working in the public sector?

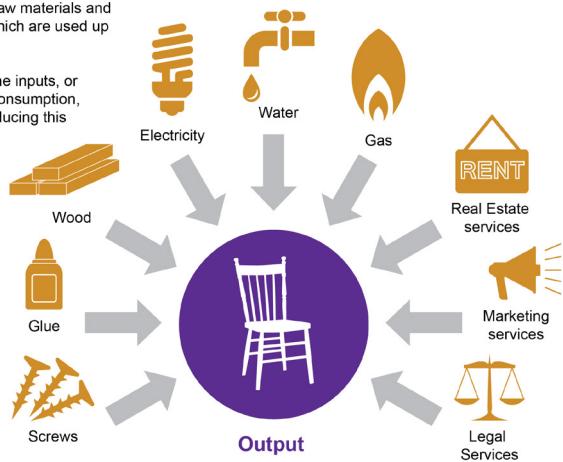
AA: As part of our report on the future of data visualization in the Parliament we went out and spoke to colleagues in other public-sector organizations. One of the most highlighted issues was that they find it difficult getting funding. This includes getting access to professional software and resources. But most have got around this issue by making use of open source software and resources like Inkscape, R or the Noun Project. But this brings other challenges as there are security issues when using programs like R, which means that they may not get the most out of these programs.

Output – Intermediate consumption = GVA

Intermediate consumption

is the cost of raw materials and other inputs which are used up in production.

The value of the inputs, or intermediate consumption, going into producing this chair are £30.



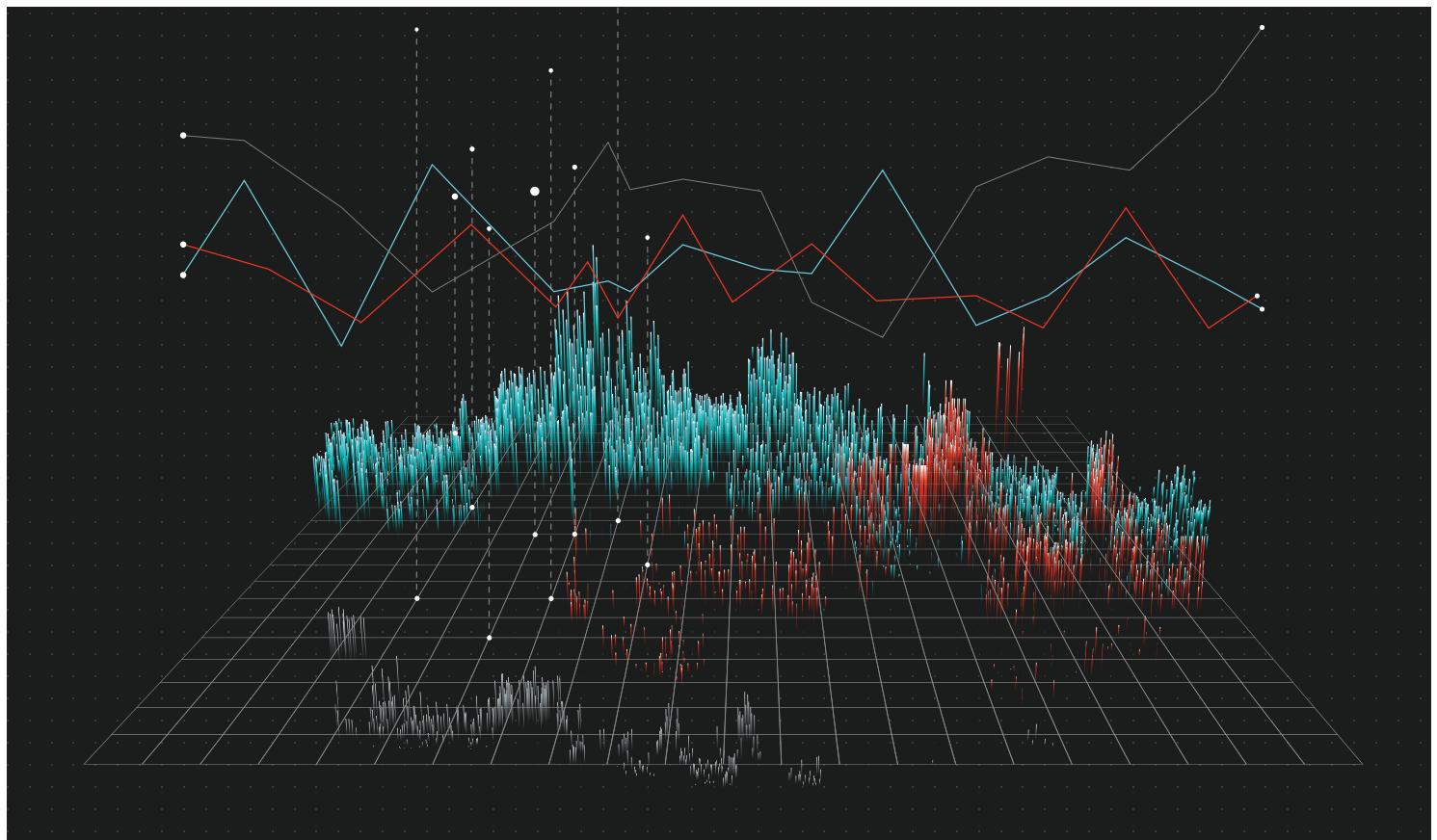
is the goods or services which are produced.
In this case the chair is the output and is worth £50.

This means that the GVA from this chair is:

$$\text{£50} - \text{£30} = \text{£20}$$

Summary

You can find examples of data visualization techniques in charts and graphs dating back hundreds of years. However, like any data-or-design-based discipline (and this combines both), data visualization is evolving faster than ever. Processing power is behind advances that are allowing us to consider uses for data visualization that would have been barely imaginable 20 years ago. Today data visualization is finding a role in everything from medicine to marketing, and from journalism to banking – as the diverse backgrounds of the many speakers at our data visualization summits indicate. And as big data – driven by the IoT and online customer insights, among many other sources – gets bigger, it needs to be understood and managed. Combining AI to manage all this data with the ability of data visualization to present it clearly has enormous potential to influence our use of big data and the decision-making we base on it. But we must never forget that data visualization is telling a story. If that story isn't accessible and engaging, much of the vast promise of data visualization could be undermined. A picture really is worth a thousand words – if it's presented in a clear and compelling way.



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