

White Paper

written by

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Data Visualization

Interactive, multidimensional, and animated data-representation tools can help improve business processes and the bottom line.

As business decision-makers, we use data to identify opportunities, trends, and areas of concern in our respective businesses. Most data reaches us in the form of tabular reports, and we find it challenging to quickly and effectively absorb the information, spot patterns, identify aberrations, and see hidden relationships. Fortunately, though the volume of data that we deal with is ever expanding, data-visualization tools have been evolving to the point that they can now transform large quantities of complex data into meaningful visual representations that incorporate the science behind human perception and cognition. As the old saying goes, a picture is often worth a thousand words, or in this case, a thousand rows of data.

Data-visualization applications render large quantities of data in the form of basic charts, graphical indicators, scorecards, dashboards, advanced visualizations, animations, and virtual reality environments. By automating the fundamental aspects of data analysis, they help information audiences identify trends and patterns in data that are often not apparent in traditional tabular representations. Managers have found these applications very effective for viewing business activity at a glance. Hardcore spreadsheet users love the tools because they can do in two seconds what used to take them 20 minutes. And many claim that data visualization often answers questions they didn't know they had.

Data visualization has the potential to increase the effectiveness and efficiency of a broad range of business processes. As the corporate champions of business analytics, the CFO and key finance business-unit liaisons should champion the use of data-visualization techniques throughout the business. First, ensure that basic data-visualization capabilities are being leveraged by business performance management processes. Second, leverage the technology to increase the efficiency and effectiveness of specific finance processes. Third, encourage other corporate functions to leverage the technology to increase the efficiency and effectiveness of their business processes.

Basic Charting

The most common and basic form of data visualization is basic charting. Pie, bar, and line charts help the audience quickly identify general upward and downward trends as well as identify groups within the data that are performing differently than other groups. These basic charts are typically used to display the relative performance of key business dimensions such as market segments, product groups, geographic regions, and business units. Instead of looking at a tabular list of numbers, the audience can literally see how data relates to other data. By effectively highlighting exceptions, these charts allow the audience to spend more time pursuing an opportunity or resolving a problem and less time trying to discover or define it. Most online query and reporting tools generate these charts automatically, thereby reducing the time that end users spend manually creating charts in offline tools such as spreadsheets.

Graphical Indicators

Graphical icons, colored symbols, stoplights, gauges, and other performance meters are being used to provide audiences with a rapid visual overview that shifts focus to the information of greatest interest and reduces the time otherwise spent studying an entire screen of information. This has been particularly useful in enhancing scorecard reporting systems that once simply presented an at-a-glance view of a tabular list of key metrics.

Scorecards and dashboards increasingly incorporate basic charts to display summary information and as a way to present additional information once the user selects a particular metric. For example, confronted with a summary metric indicating that revenues are flat year-to-year, a supporting bar chart can quickly communicate which regions are growing, declining, or flat.

Advanced Visualizations

Advanced data-visualization applications provide sophisticated graphical representations. Whereas a bar or pie chart represents a simple series of data

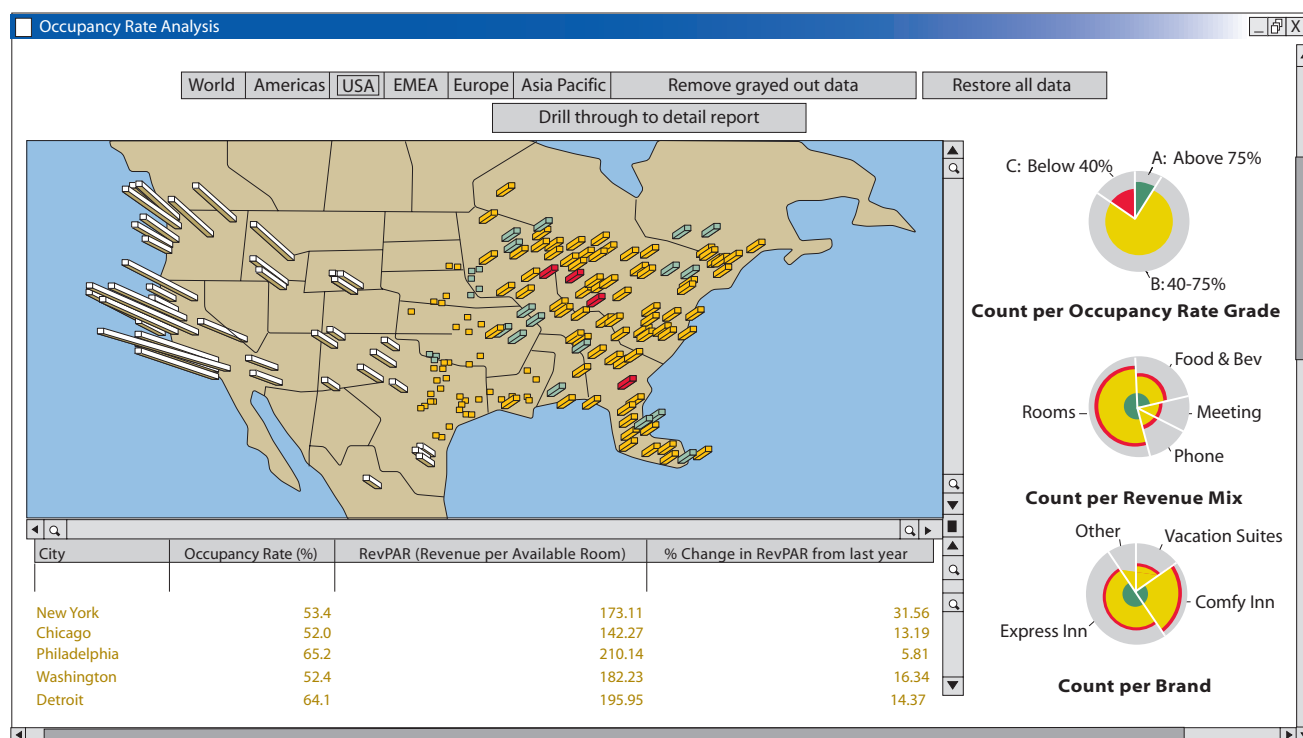


figure 1 Geospatial Maps

Source: ADVIZOR Solutions

points, advanced visualization applications can display more than a half-dozen dimensions per graph object. These graphical representations extend beyond traditional bar, and line charts to include multidimensional charts, histograms, scatter plots, constellation graphs, geographic maps, floor plans, spatial images, statistical control charts, and heat maps among other graphical images. No longer encumbered by tools such as basic query report writers and pivot tables, which can be challenging and inefficient to use when many data attributes are involved, companies are unlocking valuable information about customers, products, markets, sales reps, employees, and financial performance. (See Figures 1 and 2.)

Animations

Animation adds another easily consumed aspect to visualizations. Watching data change over time gives both a velocity and direction to the values it represents. Knowing your current sales and expenses is a good thing. Knowing whether they are increasing or decreasing and at what rate can be critical to the business.

Immersive Visualizations

Much like a virtual-reality video game, immersive data-visualization solutions place the audience in a virtual environment containing three-dimensional representations of complex data. The environments range from desk-size to wall-size to room-size systems and combine visualization, computational, data management, and projection technologies. Immersive data visualization is being used extensively in the areas of research and product development where users benefit from hands-on interactivity with virtual models, prototypes, and data sheets. Imagine flying through multidimensional sales or cost data sets to identify trends, patterns, and outliers. The business analyst's desk job may never be the same.

Interactive Capabilities

Interaction is the key to providing a full information experience. Whereas traditional reporting environments present static pie and bar charts, interactive visualization applications allow the user to directly interact with the chart or image to study the underlying data and

discover new information. Charts or images can be rotated to reveal the most insightful view of information. Portions of an image can be brushed over with a mouse to reveal context-specific information about a data point, including the data value and various dimensional attributes such as geographic location, demographic group, organizational entity, etc. Scroll bars can be used to move left, right, up, and down to view data points that would otherwise be off the screen due to the limitations of traditional bar and line charting tools. This allows a user to view data for all of the 50 states without having to view separate charts containing subsets of data for perhaps groups of 10 states. Filter planes allow the user to isolate data points above a threshold value, much like mountain peaks rising above low-level clouds. This draws the audience's attention to the values of greatest interest. These capabilities are analogous to a visual query where users can select subsets of the data, zoom in to detail, filter unwanted values, and drill down into areas of interest, much as they would with a programmed query but without the need

to decide in advance which dimensions of the data to focus on. This direct interaction with the visualization allows the user to shift focus from query writing, report formatting, and user-interfaces to information discovery and analysis.

The linkage of information across display elements through color-coding and synchronized context represents one of the most powerful advanced interactive capabilities. This presents a richer comparative context, making it easier to consume information and relate back and forth between images as the user makes various analysis choices that affect the information they are viewing. In Figure 3, the user selects a particular region, U.S. East, on a summary three-dimensional bar chart of U.S. sales; selects a specific product, adhesives, on a pie chart of U.S. East sales by product; and views the sales and expenses of various adhesives products on a companion bar chart.

Another advanced interactive capability allows the user to launch other programs by simply clicking on a data point in a visualization image. If you are viewing recent sales data for a number of customers, you might click on one

customer and kick off a program that will forecast the customer's future purchases. The context of the data point is carried over to the appropriate program to generate the forecast, and the output can be rendered as another image on the screen.

Applications

The application of visualization tools is limited only by one's creativity in identifying areas where large amounts of information might be more easily understood via graphical means. Business decisions generally require an assessment of multidimensional qualitative and quantitative information. Visualization applications have been used to facilitate these assessments across a broad range of business decision-making processes.

- Marketing managers are viewing multi-dimensional demographic analyses to identify demographic groups and are viewing geospatial maps to identify where the next group of customers might be located.
- Sales managers are viewing purchase volume, revenue, and discounting information to quickly identify high-revenue

customers and profit-maximizing sales representatives.

- Human resources managers are using three-dimensional geographic maps to identify where employees with specific skills are located, to understand how skill levels and salary levels compare across the business, and to assess the correlation between employee turnover and spending on training.
- Supply-chain planners are viewing peaks and lulls in material requirements, inventories, and supply to adjust sourcing and purchasing decisions.
- Operations managers are using geographic maps to compare plant production volumes and profitability.
- Quality managers are viewing images of products that map warranty claims and quality issues to specific product components.
- Process managers are using statistical control charts to identify events or transactions that lie outside an acceptable tolerance range.
- IT staff are using visualization for application, network, and security management to

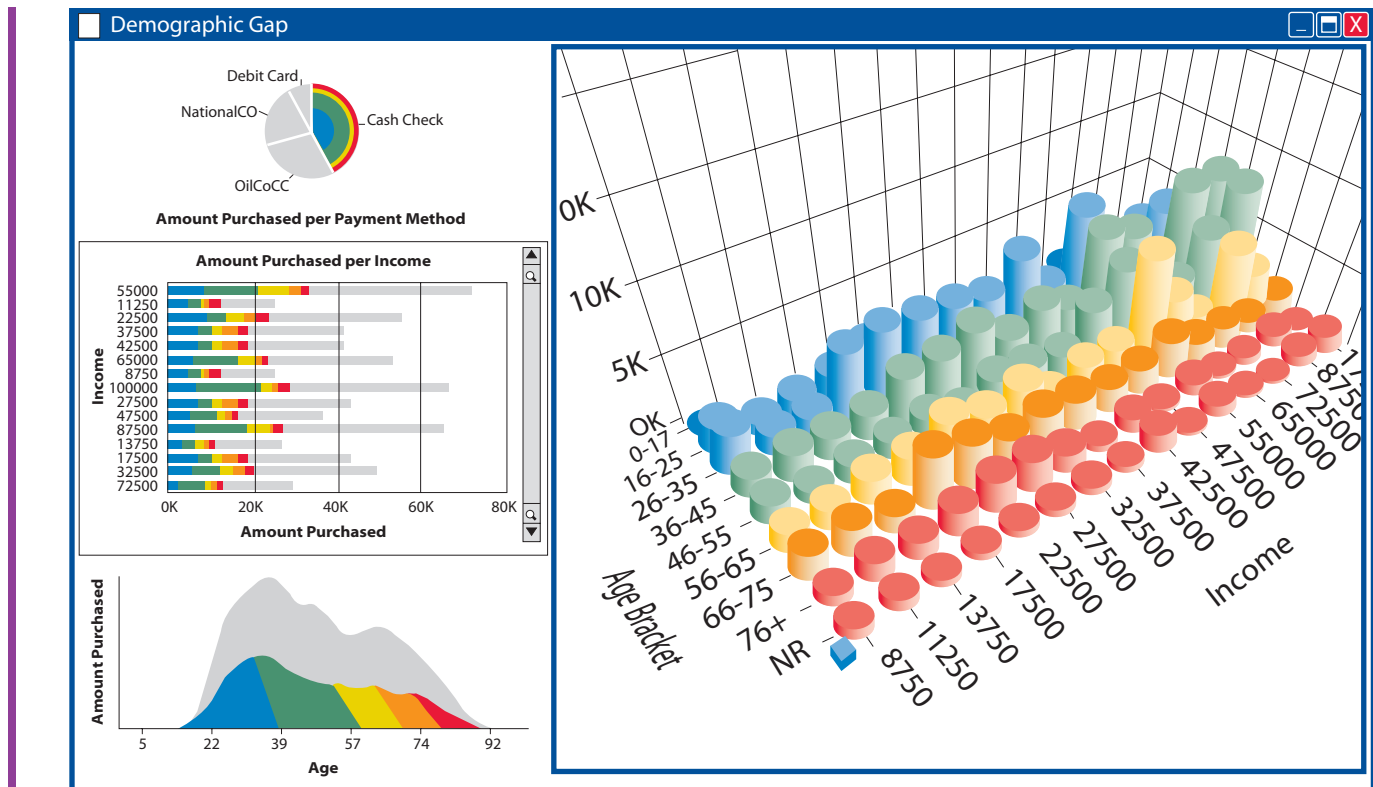


figure 2 Three-Dimensional Charts and Multiple Chart Types on a Single Screen

Source: ADVIZOR Solutions

rapidly identify root causes of problems amid millions of log messages and alarms.

- Executives, business managers, and business analysts are viewing multidimensional representations of financial data.

There is a tremendous opportunity to leverage visualization applications across the finance organization.

- Finance transactional processes can be made more effective and efficient by using visualization techniques to identify unusual deviations in payables, receivables, and employee expense reimbursements.
- Accounting and external reporting process integrity can be increased by using visualization applications to gain greater visibility into underlying accounting and financial details and to identify fraudulent activity.
- Internal audit activities can be improved by leveraging visualizations to more efficiently pour through reams of reports and data.
- Decision-support processes can be made more efficient through the use of visualizations that encourage a graphics-first, tabular-data-second mentality, facilitate line management self-service, and reduce the inefficiencies of data gathering, query writing, and report formatting.
- Planning and forecasting can be significantly enhanced with visualization providing a quick means to understand changes in the market and their impact on the business plan. What-if analysis directly through the visualization enables management to dynamically evaluate alternative scenarios.
- Risk and portfolio management can leverage visualization as an efficient means to rapidly comprehend a large amount of forecast data and rapidly identify and isolate anomalies in the portfolio.
- Customer and product profitability analysis can be improved by using visualization to identify the key variables driving profitability.

Data visualizations have also been used to visually review the output of sophisticated data-mining analyses. Data mining is the exploration and analysis, by automatic or semiautomatic means, of large quantities of data in order to discover meaningful patterns.

Data mining uses advanced mathematical, statistical, and computational techniques, and visualization often plays a role in making the output clearer to business decision-makers.

- Telecommunications carriers are viewing usage patterns and switching traffic to identify fraud and service theft, such as illegal cellular phone and calling card usage.
- Insurance and financial service firms are viewing transactional data patterns and demographic dimensions to detect fraud.
- Product managers are viewing mappings of product purchases to understand which products tend to be purchased together.

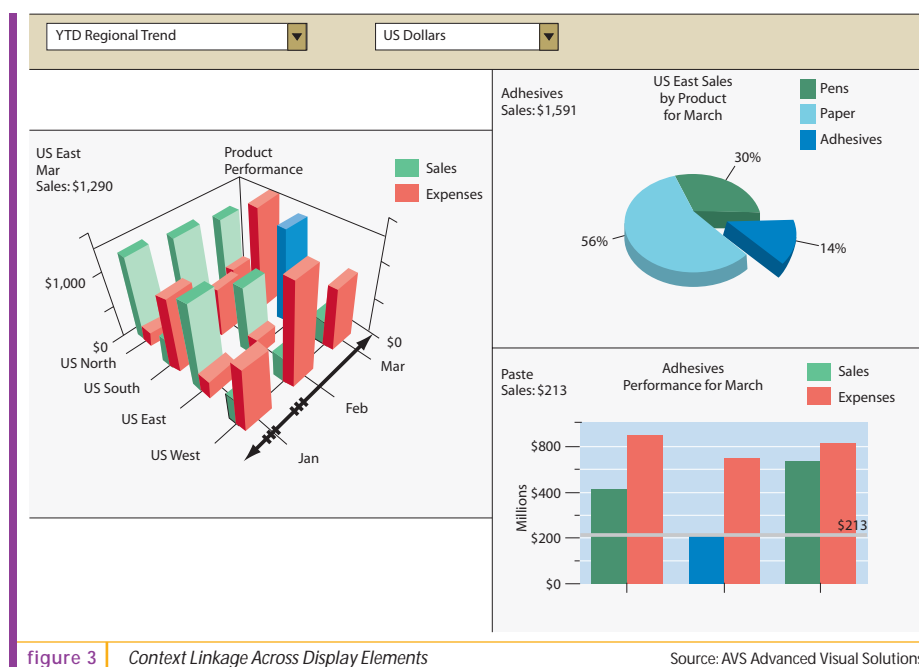
Dashboards as Analytical Tools

Advances in visualization technology are increasing the strength of dashboards as analytical tools, thereby helping users understand not only what is happening in the

patterns on the fly. Dashboards are also being enhanced through tight integration of visualizations with supporting business-intelligence reporting environments. This integration allows users to move seamlessly from summary-level visualizations to lower-level detailed visualizations and even detailed source data in the form of traditional tabular query reports. No longer does the executive or analyst necessarily need to turn to another system to better understand summary-level information.

Selecting the Visualization

It is essential that an appropriate visualization tool and visual representation are chosen for the application and intended user audience. Data-visualization tools offer many seductive advanced features. The tool should deliver the analytic capability that is required while not



business, but also why it is happening. Linkage of information across display elements through color-coding and synchronized context allows the user to analyze data in one dashboard without needing to drill down through multiple screens and multiple interfaces (Figure 4). This provides a richer comparative context and results in an easier workflow, more intuitive analysis, and a greater ability to explore

overwhelming or intimidating the user. It is important to recognize when a spreadsheet's relatively mundane graphing function might be all that is needed. The chosen visual representation is also critical. As much as charts can add value over spreadsheets, the right chart can add value over the wrong one. Imagine using a bar or pie chart to display support-center call volumes. Contrast this with

