

DATA VISUALIZATION AND DISCOVERY FOR BETTER BUSINESS DECISIONS

By David Stodder



Research Sponsors

Adaptive Planning

ADVIZOR Solutions

Esri

Pentaho

SAS

Tableau Software

DATA VISUALIZATION AND DISCOVERY FOR BETTER BUSINESS DECISIONS

By David Stodder

Table of Contents

Research Methodology and Demographics	3
Executive Summary	4
Data in the Eye of the Beholder.	5
Increasing Expectations for Visual Excellence	5
Matching Visual Interfaces to User Requirements	6
Who Develops and Deploys Visualizations?	10
Business Benefits, Barriers, and Objectives.	12
Visualization and Performance Management for Business Objectives .	13
Implementation Practices for Better Decisions.	16
Geospatial Analysis and Visualization	17
Provisioning Data for Visual Access and Analysis.	19
In-Memory Computing for Visual Analysis and Discovery	19
Dashboard Strategies and Data Visualization	21
Visualization Functionality and Chart Types.	25
Most Popular Visualization Types	26
Vendor Products.	28
Recommendations.	32



About the Author

DAVID STODDER is director of TDWI Research for business intelligence. He focuses on providing research-based insight and best practices for organizations implementing BI, analytics, performance management, data discovery, data visualization, and related technologies and methods. He is the author of TDWI Best Practices Reports on mobile BI, customer analytics in the age of social media, and BI/DW agility, as well as TDWI Checklist Reports on data discovery and information management. He has chaired TDWI conferences on BI and big data analytics. Stodder has provided thought leadership on BI, information management, and IT management for over two decades. He has served as vice president and research director with Ventana Research and was founding chief editor of *Intelligent Enterprise*, where he served as editorial director for nine years. You can reach him at dstodder@tdwi.org, on Twitter @dbstodder, and on LinkedIn at linkedin.com/in/davidstodder.

About TDWI

TDWI, a division of 1105 Media, Inc., is the premier provider of in-depth, high-quality education and research in the business intelligence and data warehousing industry. TDWI is dedicated to educating business and information technology professionals about the best practices, strategies, techniques, and tools required to successfully design, build, maintain, and enhance business intelligence and data warehousing solutions. TDWI also fosters the advancement of business intelligence and data warehousing research and contributes to knowledge transfer and the professional development of its members. TDWI offers a worldwide membership program, five major educational conferences, topical educational seminars, role-based training, onsite courses, certification, solution provider partnerships, an awards program for best practices, live Webinars, resourceful publications, an in-depth research program, and a comprehensive website, tdwi.org.

About the TDWI Best Practices Reports Series

This series is designed to educate technical and business professionals about new business intelligence technologies, concepts, or approaches that address a significant problem or issue. Research for the reports is conducted via interviews with industry experts and leading-edge user companies and is supplemented by surveys of business intelligence professionals.

To support the program, TDWI seeks vendors that collectively wish to evangelize a new approach to solving business intelligence problems or an emerging technology discipline. By banding together, sponsors can validate a new market niche and educate organizations about alternative solutions to critical business intelligence issues. Please contact TDWI Research Director David Stodder (dstodder@tdwi.org) to suggest a topic that meets these requirements.

Acknowledgments

TDWI would like to thank many people who contributed to this report. First, we appreciate the many users who responded to our survey, especially those who responded to our requests for phone interviews. Second, our report sponsors, who diligently reviewed outlines, survey questions, and report drafts. Finally, we would like to recognize TDWI's production team: Jennifer Agee, Michael Boyda, and Denelle Hanlon.

Sponsors

Adaptive Planning, ADVIZOR Solutions, Esri, Pentaho, SAS, and Tableau Software sponsored the research for this report.

Research Methodology and Demographics

Report Scope. Strong data visualization and graphical discovery analysis are essential for users to realize benefits from large, complex, and diverse data volumes. Early business intelligence dashboards broke ground by giving many users easy-to-use graphical interfaces for accessing and analyzing data. Now, sophisticated charts enable users to advance their understanding. They can discover hidden data relationships within a range of internal and external sources, including geospatial data, and improve self-service actionable insight. This report examines organizations' experiences with data visualization and discovery practices and technologies and recommends best practices for improving decision making and analysis.

Survey Methodology. In February 2013, TDWI sent an invitation via e-mail to business and IT executives; VPs and directors of BI, analytics, and data warehousing; business and data analysts; IT application managers; and other BI/DW professionals, asking them to complete an Internet-based survey. The invitation was also delivered via websites, newsletters, and publications from TDWI. The survey analysis drew from a total of 453 respondents. Of these, 343 completed every question. Answers from respondents who answered enough questions for their input to be valuable are included in the results. Thus, some questions have different numbers of responses.

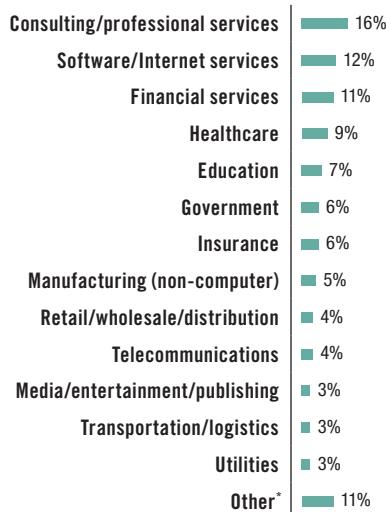
Survey Demographics. The largest percentage of survey respondents are business executives and sponsors/users (48%); included in that group are business analysts (12%) and data analysts or scientists (15%). Forty-two percent are data and IT professionals, with VPs and directors of BI, analytics, and data warehousing (16%) and BI developers (15%) making up the largest segments in this second group. Respondents from consulting and professional services organizations made up the largest industry segment (16%), with software/Internet services (12%) and financial services (11%) next highest. Most respondents reside in the U.S. (55%), followed by Europe (19%), but other regions account for 26%.

Other Research Methods. TDWI conducted telephone interviews with business and IT executives, VPs of BI/DW, business and data analysts, BI directors, IT application managers, and experts in data visualization and visual data discovery. TDWI also received briefings from vendors that offer related products and services.

Position

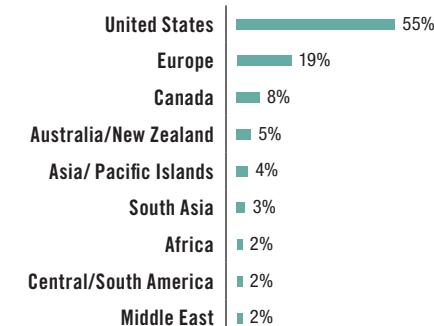


Industry



* "Other" consists of multiple industries, each represented by 2% or less of respondents.

Geography



Number of Employees



Based on 453 survey respondents.

Executive Summary

Tools and practices for data visualization, data discovery, and visual analysis are enabling “nontechnical” users to make effective use of data and reduce their time to insight.

Far from mere “eye candy,” data visualization is critical to fulfilling widely held goals for expanding organizations’ analytics culture and driving more decisions with data. Across organizations, employees who are subject matter experts in areas such as marketing, customer service, online engagement, finance, and more need to interact with data and analyze it for significant patterns, trends, and anomalies. Yet, most of these professionals would hardly consider themselves “business intelligence users,” much less professional data scientists or data analysts. Tools and practices for data visualization, data discovery, and visual analysis are enabling these “nontechnical” users to make effective use of data and reduce their time to insight.

Data visualization sits at the confluence of advances in technology, the study of human cognition and perception, graphical interfaces, widespread adoption of standards for rich Internet applications, and the continuing expansion of interest and experience in analytics and data discovery. Data visualization can contribute significantly to the fruitful interpretation and sharing of insights from analytics, enabling nontechnical SMEs to perform data discovery in a self-directed fashion. Implementation of chart engines and the growth in the number and variety of visualizations available in graphics libraries are supporting new sophistication in visual analysis, allowing users to go beyond simple bar and pie charts to express more advanced insights about quantitative information.

This TDWI Best Practices Report focuses on how organizations can use data visualization, visual analytics, and data discovery to improve decision making, collaboration, and operational execution. The report provides analysis of an in-depth research survey and user stories to reveal current strategies and future plans for data visualization and analysis. The report offers recommendations for successfully evaluating and deploying data visualization, data discovery, and visual analysis technologies to achieve shorter time to insight for users across the enterprise.

Users need data visualization for a variety of BI and analytics activities, including reporting, scorecards, operational alerting, and data discovery and analysis. Rather than just giving users “new toys” to play with, organizations should examine how they can match visualization technologies and practices to user requirements. Across the board, however, a key element in the success of visualization is data interaction; users need broad capabilities for manipulating data, including to drill down, cross cut, slice, and dice data directly from graphical interfaces.

For many organizations, dashboards take the center stage for data visualizations, especially for BI reporting and performance management. Many users would like to consolidate views of multiple sources and types of information into their dashboard workspaces. One new source of interest is geographical information. Although using maps to enhance corporate data (and vice versa) is not yet widespread, organizations in a growing number of industries are interested in geospatial analysis as an addition to their visualization repertoire. Mobile device adoption is likely to accelerate interest in visualizations offering location information and geospatial analysis; frontline employees in sales, service, and support will use these technologies to enhance customer interactions.

Data visualization and discovery can help reduce the time users lose when they have difficulty accessing, reporting, and analyzing data.

TDWI Research finds that organizations are pursuing a range of potential business benefits with their current and planned implementations of data visualization and discovery technologies. Operational efficiency is the top benefit sought, according to our research; organizations seek to implement data visualization and discovery to reduce the time users lose when they have difficulty accessing, reporting, and analyzing data. With self-directed capabilities for uncovering root causes as well as other insights from data, organizations will be able to move away from gut feel and common wisdom and use data to drive innovation in strategy and operations.

Data in the Eye of the Beholder

Data visualization is one of the great innovations of our time. From the moment most of us wake up in the morning, infographics and other visual representations of data fill our lives. Whether these visualizations are presented as part of our work, to enrich our enjoyment of sports, to deepen our understanding of current events, or to track household expenses, we encounter graphical images of data every day and try to make sense of them. Quantitative communication through graphical representation of data and analytical concepts is essential to surviving amid the deluge of data flowing throughout our world.

Visual representations of data are increasingly part of public discourse. Leading media organizations such as *The New York Times* use advanced data analysis and innovative computer graphics to dazzle readers with infographics and provide insights into news stories that would otherwise be buried in text. Data sets made available by the U.S. federal government (see data.gov) and industry sources allow individuals to create and share graphical interpretations of data on their own, often in blogs and social networks. “Graphics reveal data,” wrote Edward Tufte in his seminal work *The Visual Display of Quantitative Information*. “Indeed graphics can be more precise and revealing than conventional statistical computations.”

Humans are born to perceive meaningful patterns, outliers, and structures in what they see. Our processing of information is guided by how it is presented, including attributes such as color, size, texture, density, movement, and more that activate our visual sensitivity. Psychologists and brain scientists have studied extensively how humans respond to graphical stimuli and how we use short- and long-term memory to bring previous experiences to bear on the processing of information. These studies are becoming increasingly important as professionals in all walks of life, including physicians, pilots, financial services specialists, law enforcement and military personnel, and more depend on data visualization to make decisions and discover new insights to drive strategy. “We acquire more information through vision than through all of the other senses combined,” according to Colin Ware, in his book *Information Visualization*. “The 20 billion or so neurons of the brain devoted to analyzing visual information provide a pattern-finding mechanism that is a fundamental component in much of our cognitive activity.”

Increasing Expectations for Visual Excellence

Graphical interaction with data is fast becoming the expected norm for the full spectrum of users, from executives to frontline personnel. Visualization is therefore a key concern for business intelligence and data analysis professionals because it affects how data is provisioned for users and the value they gain from it. Good data visualization is critical to making smarter decisions and improving productivity; poorly created visualizations, on the other hand, can mislead users and make it more difficult for them to overcome the daily data onslaught. Users can lose confidence in their business intelligence (BI) systems if they are unable to understand or trust what they see.

This TDWI Best Practices Report focuses on data visualization, visual discovery practices, and technology implementation. Through graphical interfaces such as dashboards and portals, users have been steadily moving away from static reports and data tables and toward interactive workspaces that allow them to manipulate data through a growing library of charts and other visualizations. Visual data discovery, a key subject of this report, has accelerated the transition toward easy-to-use, self-service visual analysis. As users interact with data visually, they see and then want to explore data relationships between and across standard business and demographic sources, and are increasingly

Quantitative communication through graphical representation of data and analytical concepts is essential to surviving amid the deluge of data flowing throughout our world.

Visualization affects how data is provisioned for users and the value they gain from it.

likely to want to integrate non-relational sources such as geospatial data. This report will discuss the significance of this trend.

Although the seeming ubiquity of BI dashboards would make it appear that data visualization must be commonplace, the reality is that most organizations are in the early stages of adoption and are still learning what users need. TDWI Research finds that only 7% of the 453 respondents to the survey for this report are “very satisfied” with their ability to view and interact with data visually so that they can communicate information effectively and make decisions based on information through graphical means. Almost a quarter (23%) said they are “not satisfied,” and about one-third each are somewhat satisfied or somewhat dissatisfied. This report will discuss many of the factors that affect user satisfaction.

Matching Visual Interfaces to User Requirements

Visualization is important for all types of BI and analytics applications, whether they are deployed to individuals, departments, or at an enterprise level. Users’ requirements can be diverse; some need simple interfaces that emphasize actionable information, while others demand more complete analytics capabilities, including many of the slice-and-dice, drill-down, and roll-up features of online analytical processing (OLAP).

To sharpen our research view of what organization are doing with visualization and how they are meeting user requirements, we asked respondents which types of activities they are currently implementing or are planning to implement with their data visualization technologies. We identified these activities as falling into three common types, discussed next. We will refer back to these three main activities throughout the report:

- Display/snapshot reporting (including scorecards)
- Operational alerting
- Visual discovery and analysis

Display or Snapshot Reporting (Including Scorecards)

Because users examine snapshots to identify changes in data over time, they must be provisioned and presented consistently.

Many organizations are implementing dashboards to display basic reports, including on mobile platforms. Snapshot reports are typically scheduled rather than requested on demand, although some users create snapshots manually. The results are often stored for users in a cache or database as a “snapshot” of a certain point in time. Because users examine snapshots to identify changes in data over time, they must be provisioned and presented consistently so that the trends and comparisons drawn are valid. The viewing format, including the use of animation or other options for richer visualization, can depend on the user’s application platform or whether the request is made through a Web browser that supports industry standards such as AJAX, HTML5, and Microsoft Silverlight.

Scorecards, which are often used with corporate performance management methodologies, help orient personnel toward achieving particular goals. Key performance indicators (KPIs) and other metrics help personnel measure and manage progress toward the goals over time. Scorecards can provide essential context for looking at historical trends and projecting future results. Innovative organizations let their interface designers loose on scorecards to create graphical representations that replace standard data tables and charts with gauges, widgets, dials, race cars, or other imagery to inspire employees in the context of their roles and levels of accountability.

Dashboards and scorecards should allow users to drill down to at least one if not more levels of data to gain a detailed view behind the KPIs, metrics, and visual objects. Users should be able to spot anomalies easily and recognize where performance is out of line with expectations. More mature and successful dashboard implementations will allow users not only to drill down into data, but also to perform various types of analysis to explore patterns or determine the root cause for why numbers are out of line with expectations.

Three out of five (57%) of respondents to the TDWI Research survey are currently implementing display or snapshot reports and/or scorecards; 31% are planning to do so, and 9% have no plans for them (see Figure 1). Among the 7% of respondents noted earlier who are very satisfied with their ability to view and interact with data visually, 77% are currently implementing visualization for these types of activities.

Are users in your organization currently implementing or planning to implement data visualization technologies for the following activities?

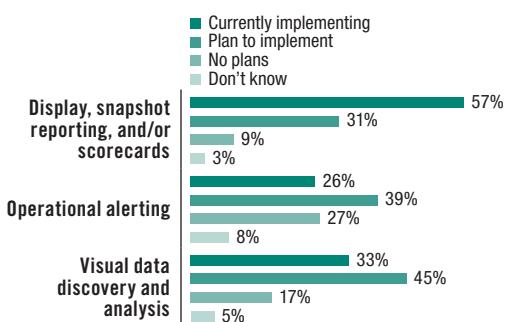


Figure 1. Based on answers from 453 respondents.

Operational Alerting

Many BI and visual discovery tools offer alerting functions. These are designed to notify personnel of particularly important changes in the data or when situations arise that demand immediate attention. Color is often used for alerts on dashboards. Some tools enable users to perform visual analysis to discover why an alert condition exists, such as if sales have decreased for a certain product line. Although alerts are often set ahead of time to be coordinated with KPIs and business rules, some tools allow users to custom-tune alerts for particular data changes and their preferred visualizations.

Operational alerting, as the term implies, is an important ingredient in emerging operational intelligence systems. These systems focus on monitoring activities in business, distribution chains, manufacturing, networks, IT systems, and more for problems, threats, and other critical developments. Alerts signify that monitors have uncovered something important in (often) real-time data or event streams; some systems provide analytics for determining root causes and the best way to address situations.

TDWI Research shows that only about one-quarter (26%) of respondents are implementing data visualization technologies for operational alerting. More (39%) are planning to do so, while 27% have no plans (see Figure 1). This could reflect the current immaturity of the emerging operational intelligence field.

Operational alerting is an important ingredient in emerging operational intelligence systems.

Visual Discovery and Analysis

Visual analytics enables business users to interact with data and engage in analytical processes through visual representations.

Business analysts, data analysts, and a growing segment of nontechnical users across organizations want to go beyond the limits of reporting and predefined metrics to examine data and discover interesting relationships, patterns, and answers to their “why” questions. When practices for analytical reasoning, test-and-learn inquiry, and advanced computation are fused with data visualization, the result is “visual analytics.”

Visual analytics enables business users to interact with data and engage in analytical processes through visual representations supported by powerful computer graphics engines, and often integrated, in-memory storage of data that facilitates rapid updates of multiple visualizations based on users’ interaction. Visual functionality for filtering, comparing, and correlating data can then be integrated with the users’ analytical application functions for forecasting, modeling, and statistical, what-if, and predictive analytics.

The term “visual data discovery” is essentially synonymous with “visual analytics”; in industry usage, it applies to tools and practices that make it easier for nontechnical business users to interact with data. The tools enable users to engage in self-service data analysis through visual representations rather than the tabular results delivered by standard BI queries. Visual discovery frees users from the typical BI constraints of predefined questions and known types of answers, such as the sales figures for a given region. Users have the freedom to look for insights that numbers such as sales figures alone can hide.

However, rather than give users a complete blank slate, most visual data discovery tools guide users in selecting the right visualizations or even automate the selection. Some tools include predictive modeling capabilities to direct users to examine what is most important going forward. Predictive modeling complements visual discovery, especially when there are large data sets to examine with many dimensions and variables.

Visual data discovery and analysis will be discussed throughout this report; the purpose here is to offer brief definitions. As was shown in Figure 1, one-third (33%) of respondents to the survey for this report said that they are currently implementing data visualization for discovery and analysis, and 45% are planning to do so. This finding suggests that we are still in the early stages of deployment of such tools. Not surprisingly, within the segment of respondents mentioned earlier who indicated that they are very satisfied with their ability to view and interact with data, 70% are currently implementing data visualization for discovery and analysis.

The user story on the next page illustrates how Dartmouth College has used visual analysis to shorten the path to insight and improve focus on high-priority donation prospects.

USER STORY

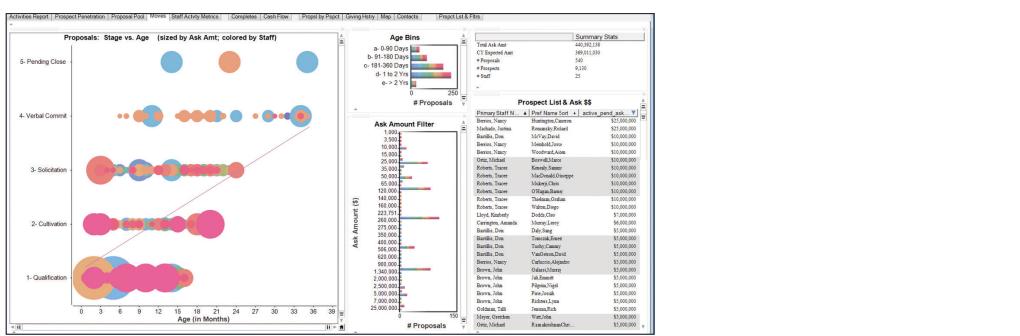
DARTMOUTH SHARPENS FUNDRAISING FOCUS WITH VISUAL ANALYSIS.

Fundraising from alumni sources has long been critical to the economics of colleges and universities. Alumni fundraising becomes even more important as costs rise and facilities require upgrades. Colleges and universities must be smarter about how they research and identify prospects in alumni rosters. By analyzing records that go back decades as well as external demographic sources, institutions can discover who might have the right combination of wealth, inclination, and affinity to be motivated to give back.

Dartmouth College, one of the premier higher education institutions in the U.S., captures a broad range of information about its alumni—from when they were undergraduates and engaged in sports or other on-campus activities to the progress of their careers, travels, and advanced degrees. Its large Ellucian Advance donor, prospect, and events management system database contains information on about 120,000 constituents. “Our responsibility is to go through all that information to pull out prospects who have the highest probability to give back, either in general or for specific campaigns such as funding a capital project,” said Michael Foote, director of Research and Prospect Management at Dartmouth College.

In analyzing the data, Foote said that Dartmouth wanted to avoid the usual “cycle of pain”: that is, giving requirements to an IT reporting group, waiting for programmers to do manual lookups and build reports, discovering that the results were not quite what was needed, and then having to resubmit the request and start the cycle over again. Dartmouth deployed ADVIZOR Solutions to automate the linking together of separate, siloed data tables and a visual presentation of the results. “Within seconds, I can immediately see how many in the class of 1978, for example, are in a particular field of work, how many of those participated in football, what their giving history has been, and so on,” said Foote. “I can initiate other types of analysis myself.”

Dartmouth uses ADVIZOR's business analysis software to visualize relationships in the data and find outliers—"the folks we may have missed," Foote said, due to improper coding or other data cleansing issues. Foote's team has been able to build demographic profiles of individuals at different giving levels and use predictive analytics built into the software to mine the data, analyze variables, and attach scores to statistically measure wealth, inclination, and affinity. "We built a model based on a target group of current high donors and then applied that model to everyone else in our database. This has helped us ensure that our prospect managers are focused on the right alumni at the right time."



Dartmouth's scatterplot chart shows proposal status by age, color-coded by primary staff member name. It also includes a bar chart filter that allows users to locate proposals in the pipeline by "ask amount" totals. Note the large number of proposals in the "qualification" stage that are more than 6 months old.

Who Develops and Deploys Visualizations?

As more users show an interest in analytics, organizations are facing the question of whether nontechnical users can perform analytics on their own or if the organization needs to hire more specialists, including data scientists. A key objective of implementing visual analytics and discovery tools is making it easier for nontechnical users to create visualizations and perform some analytics on their own, with less IT intervention.

TDWI Research finds that in nearly two-thirds of organizations surveyed, IT personnel develop and deploy charts, graphs, maps, and other visualizations for users to implement (see Figure 2). Business analysts, however, are the second most prevalent, with 54%; this indicates that visualization development and implementation is fairly common outside of IT. Business analysts can use visualizations for strategic and operational planning, business model analysis, project planning, and other responsibilities.

The percentage of power users who will be implementing visual discovery and analysis is likely to grow.

The third largest group is power users (45%). These often self-selected but indispensable figures in business departments and divisions have long performed advanced BI and analytics tasks for the benefit of others in their groups. They appear to be continuing in this role for data visualization at nearly half of those organizations surveyed. The percentage of power users who will be implementing visual discovery and analysis is therefore likely to grow in coming years.

Who in your organization develops and deploys visualizations (e.g., different types of charts, graphs, or maps) for users to implement? (Please select all that apply.)

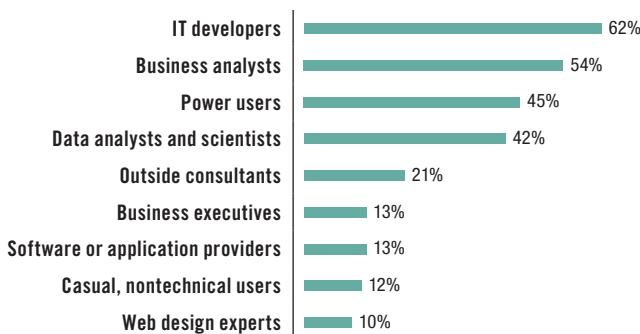


Figure 2. Based on answers from 453 respondents; respondents could select more than one answer.

Executives do not develop visualizations, but do highly value them. Figure 2 shows that business executives—the dominant users of BI tools in many organizations—do not commonly develop and deploy visualizations; only 13% of respondents said that they do so. However, TDWI Research finds that executive management highly values visualizations for display or snapshot reporting, and/or scorecards; 81% of respondents said that visualizations for these activities are important for executives (see Figure 3). Somewhat less critical are visualizations for executives' operational reporting and visual data discovery and analysis; just 27% and 37% of respondents indicated that visualizations are important to executives for these activities, respectively. Once again, it is possible that this is because dashboards for reports and scorecards are more mature in organizations compared to visual operational reporting, analytics, and data discovery.

Figure 3 offers a view of the relative importance of visualizations for different types of users for the three primary activities identified in this report. Nearly two-thirds of respondents (64%) said that visualizations are important to marketing and market analysis users for visual data discovery and analysis. In many organizations, the marketing function is the first to adopt new tools for analytics and discovery to improve insight into customer behavior and use data discoveries to fine-tune campaigns. Half of respondents (50%) said that visualizations for these activities are also important to users in finance, which is evidence of the increasing role of discovery analytics for CFOs and other managers seeking a broader and deeper view for corporate financial management.

Visualizations are important to marketing and market analysis users for visual data discovery and analysis.

Compared with most other departments, visualizations for operational alerting are the highest priority for IT, network, and computer security management (53%). Managers in these functions require real-time alerts regarding threats, performance, and resource utilization problems; data visualizations can provide faster recognition of actionable information and help administrators respond proactively to negative trends. Customer service and support (46%) is another function where operational reporting is critical. Rather than waiting out the lag for business or data analysts to provide contact center managers with historical reports, visual operational intelligence can enable managers to see and respond to customer concerns in real time.

For users in the following functions in your organization, which of these main data visualization activities are important? (You may choose more than one answer per row.)

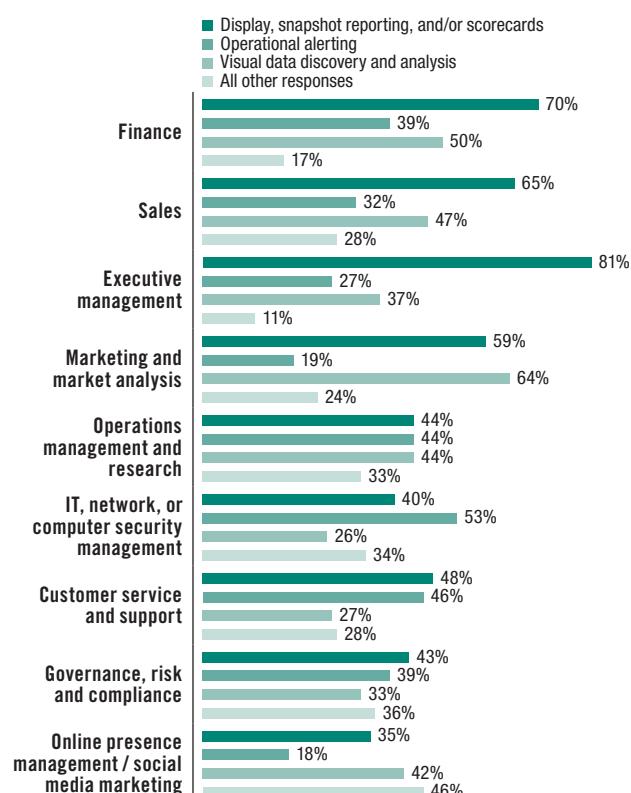


Figure 3. Based on answers from 432 respondents; respondents could select more than one answer per row. Organization functions are listed in order of most total responses.

The user story below illustrates how visual reporting enabled OLX to respond more effectively to the challenges of rapid business growth and increasing volumes of data.

USER STORY

OLX DEPLOYS VISUAL BUSINESS INTELLIGENCE TO GUIDE RAPID GROWTH.

OLX, a fast-growing “Craigslist for the rest of the world” online classified advertising site, is luring investors from around the globe as it picks up speed. Based in Buenos Aires, OLX is active in more than 105 countries and is strong in Latin America and Asia; it supports more than 40 languages. With more than 125 million unique visitors per month worldwide, OLX is generating up to one billion page hits per month, according to Francisco Achaval, manager of business intelligence at OLX. In addition, since the website allows users to design and personalize advertisements and display them in their social networking profiles, the big data analytics opportunities are enormous.

As tempting as the diverse, non-relational data is, the first step for OLX has been to bring its already considerable relational data velocity under control by building a data warehouse to support its main key performance indicators. OLX has been implementing Pentaho Business Analytics and data integration software to provide users with visual, actionable data so that “business users in different areas of the company can, in a self-service fashion, make changes based on the insights they are getting,” said Achaval.

“The challenge has been not so much the number of metrics as the number of member dimensions that business users want to touch,” Achaval explained. With OLX’s supply and demand business data model, the metrics are fairly straightforward for the supply of items, demand in terms of number of customer users, and the conversion to sale. But, with 105 countries, 700 categories, and more than 4,000 cities to analyze, aggregating the data can be daunting. Visualization has been critical to the analysis because “while it may be easy for a BI analyst to understand what’s happening in the numbers, to explain this to business users who are not versed in BI or OLAP, you need visualization.”

OLX is embarking on projects to automate how the company uses KPIs and analytic insights to respond more quickly. “We want to be able to automatically launch campaigns if we see that demand is low in a certain city or category.” The company is also preparing to tackle big data to enable visual analysis of its variety of unstructured data sources.

Business Benefits, Barriers, and Objectives

CEOs and other top executives at industry-leading organizations are also demanding faster data insights.

Reducing time to insight is a critical objective for enhancing visualization capabilities in BI, data discovery, and analytics applications, no matter which of the three main visualization activities is the primary focus. Today, it is not only line-of-business (LOB) operations managers who need actionable insight from low-latency data; CEOs and other top executives at industry-leading organizations are also demanding faster data insights. They are directing the creation of real-time decision support “cockpits” that feature advanced data visualization.

From the central location of a cockpit, executives can view high-resolution screens with dashboard reports and analytics that let them monitor whether projected trends for customer demand, market share, profitability, and other measures are playing out as expected. Executives in marketing are also implementing cockpits to monitor the performance of campaigns across multiple channels and to analyze sentiment expressed in social media.

Operational efficiency is the foremost benefit sought. TDWI Research finds that improved operational efficiency is the business benefit that most organizations surveyed (77%) hope to gain from deploying data visualization and visual analysis technologies (see Figure 4). Poor information flow to employees who are directly responsible for process efficiency and optimization is the Achilles' heel of many organizations. Employees are often delayed in operation execution when they have to look for the right information across siloed applications and interfaces. Dashboards that can consolidate information for easy-to-use reporting and analysis will contribute to operational efficiency.

Faster response to business change (62%) is the second most common priority among respondents. Leaders in most organizations understand that if they can analyze data and feed insights sooner and more frequently to decision makers, they will realize advantages over firms that are locked into slower decision cycles. Self-service visual data discovery and analytics can relieve decision makers of many steps in the traditional dance with IT to gain access to data and develop new reports and visualizations. The third highest potential business benefit cited by respondents was the ability to use visualizations to identify new business opportunities (59%).

Which of the following are the most important business benefits that your organization seeks to gain from deploying data visualization and visual analysis technologies? (Please select all that apply.)



Figure 4. Based on answers from 424 respondents; respondents could select more than one answer.

Skills and budget shortages are the biggest barriers. We asked respondents to name the most significant barriers to adoption of data visualization and analysis. The top three were lack of skilled personnel or training, not enough budget or resources, and difficulty identifying or quantifying hard returns. The barrier indicated by the smallest percentage of respondents was insufficient computing or networking for visualization, followed by scalability to serve increasing numbers of intended users.

These results suggest that the biggest perceived barriers are not about whether organizations have the technology infrastructure to support data visualization and analysis. Even data quality is not a topmost concern; only about a third of respondents said this was a barrier. The greatest concern centers on whether employees will have adequate knowledge and skills to make effective use of the tools and whether deployment can be justified from a business perspective.

The greatest perceived barrier centers on whether employees have adequate knowledge and skills to make effective use of the tools.

Visualization and Performance Management for Business Objectives

Organizations have a variety of information objectives guiding their implementation of data visualization and visual analysis technologies. In Figure 5 (page 15), we can see how respondents to the TDWI Research survey view 10 objectives that are priorities for most organizations. More than half (55%) said that improving performance metrics and measures is very important, and another 33% said it was somewhat important. Nearly the same percentages indicate that enhancing users'

Employees closer to their areas of responsibility often know the most about the data, but they lack the tools to interact with it effectively.

self-directed BI and data discovery is a high priority (54% and 31%, respectively). TDWI Research finds that these two objectives are increasingly related.

Performance management metrics and scorecards, usually presented to employees through dashboards, have been somewhat successful for aligning decisions and actions with strategic and financial objectives. The most difficult parts of performance management are often defining the KPIs and then ensuring that users have access to valid data to implement the measures. Managers and employees who are held accountable for certain metrics and measures need actionable information so that they can make positive changes or alert upper management when additional resources are needed. Because they are closer to their areas of responsibility, they often know more about the data than corporate management does, but they lack the tools to interact with it effectively. Self-directed BI and data discovery could be helpful in giving such employees the tools they need to perform.

The user story below offers an example of how visual analytics and discovery plays a key role in performance management.

USER STORY

VISUAL DISCOVERY DELIVERS THE BIG PICTURE FOR FINANCIAL ANALYSIS AT AAPA.

Reducing time to insight is critical for many organizations, but sometimes not all departments and divisions get the tools they need to make this happen for their concerns. Executives and customer-facing groups such as marketing, sales, and service usually come first. Finance and business management users are often left to use spreadsheets and siloed back-end accounting systems, with custom coding required to supply data for analysis. If these users implement more sophisticated budgeting, forecasting, and planning applications, these are often removed another step further from the data.

However, with data analysis becoming ever more essential to financial performance management, business and finance managers are beginning to implement tools that enable them to easily drill down into the data behind key performance indicators and scorecards in their budgeting, forecasting, and planning applications. Visual discovery can decrease time to insight for performance management. With self-service capabilities, the tools can reduce users' dependency on IT to custom-build visual reports and code access to data.

Integrated tools have been a boon for the American Academy of Physician Assistants (AAPA). Based in Alexandria, Virginia, the Academy is the national professional society for physician assistants (PAs); it advocates and educates on behalf of the profession and the patients PAs serve. AAPA works to ensure the professional growth, personal excellence, and recognition of PAs. Shyam Desigan, CFO and SVP of IT at AAPA, implemented the cloud-based Adaptive Planning suite, which includes the visual discovery tool Adaptive Discovery. AAPA uses the suite to integrate its visually interactive dashboards and scorecards with planning, budgeting, and forecasting processes. Users can automate access from visualizations to data in the Academy's back-end Microsoft Dynamics SL financial management and accounting system.

"I can point my cursor at a particular number, such as the cash-flow variance, and drill down from the visual discovery graph right in to the transactions to see the variance," Desigan said. "I describe it like a camera. Visual discovery gives the global view; as part of the integrated suite, we can use it to pan around or zoom in to get a more close-up, granular view of data in the back-end system." Desigan said that the visualization is particularly helpful for seeing how things are moving, the variances in budgets, and other key trends. "The integrated tools cut out a lot of the prep work to get data; developing visual graphs is automated."

Users need visualization to create a single view of information. Figure 5 shows that organizations put a high priority on using data visualization to create a single, graphical view of information; 50% see this as very important and 34% as somewhat important. Organizations implementing advanced dashboards are able to provide mashups of data from multiple sources, both internal and external, including news and social media feeds. Such dashboards can improve employee productivity where staff currently find it necessary to jump from report to report and across different applications to gain a complete view.

Managers and employees who need to increase their level of data analysis require integrated access to information as well as tools for easier implementation of advanced analytics, according to TDWI Research. For some users, advanced analytics can mean OLAP; for others, it includes activities such as testing, training, scoring, and monitoring predictive models that involve many variables. Machine learning, neural networks, and other statistical, quantitative, or mathematical modes of deeper data analysis may also be part of an advanced analytics effort.

Nearly half (47%) of respondents said that they hope to implement data visualization and analysis technologies to improve the ease of use of advanced analytics; one-third said it was somewhat important. Visualization for big data analytics is also a priority for many; a significant percentage (41%) find it very important (and 29% find it somewhat important) for visualization and visual analysis to help them detect patterns and trends in big data sources. Less important currently is using visualization for improving analysis of text and unstructured data. Just under one-quarter (23%) said this was a very important objective, while 26% said it was less important and 22% said it was not important at all. It is likely that this is due to the general immaturity of text and unstructured data analysis in most organizations.

For some users, advanced analytics can mean OLAP; for others, it includes activities such as testing, training, scoring, and monitoring predictive models that involve many variables.

How important to users in your organization are each of the following objectives for implementing data visualization and analysis technologies?

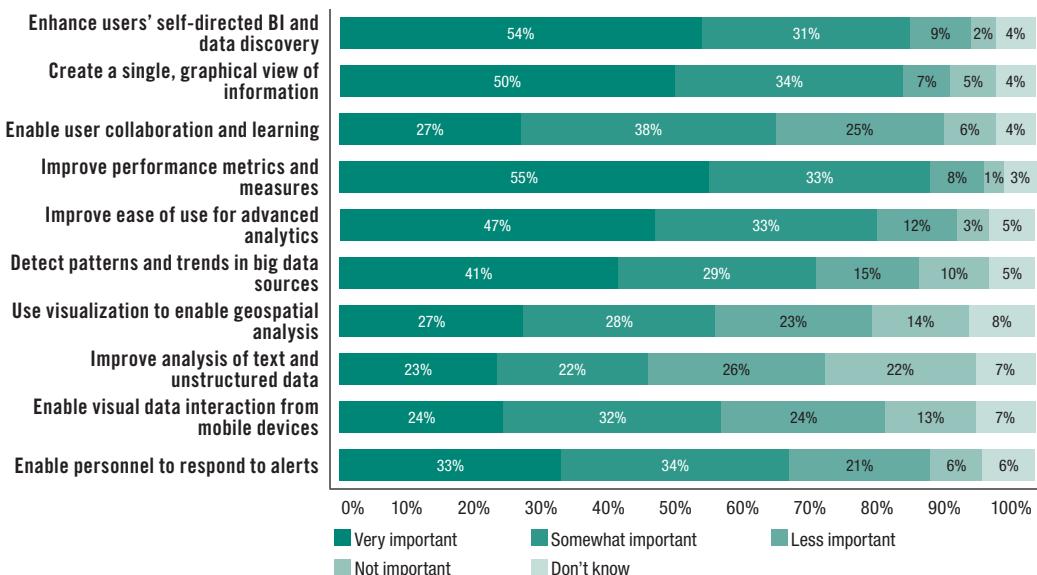


Figure 5. Based on answers from 416 respondents; respondents could select one answer per row. Selections are ranked by number of responses.

Implementation Practices for Better Decisions

With these business benefits, barriers, and objectives in mind, we can now turn to implementation issues and look at how organizations can use visualization to arrive at better decisions. Increasingly, implementation success rises and falls with users, not IT; dashboards, visual analytics, and discovery tools are giving users more control, enabling them to progress further on their own rather than depend on IT. This is important for large organizations where IT application backlogs are a problem; it is also a significant benefit for small and midsize firms that do not have extensive IT support for visual reporting and analysis. However, as always, with the advantages come new challenges.

KPI definition and delivery is the most prevalent activity currently deployed for users through implementation of data visualization and visual analysis technologies.

One of the most potent benefits is better communication. Our research makes it clear that performance management continues to be a vital initiative and that the associated dashboards are intended to be the centerpiece. In Figure 6, we can see that KPI definition and delivery is the most prevalent activity currently deployed for users through implementation of data visualization and visual analysis technologies (60%). Second and third highest are snapshot report creation (45%) and alerting/monitoring activity (44%). For all three of these activities, visualizations are critical in providing actionable insight; they enable executives, managers, and other users to focus on the situation at hand rather than having to tease out facts from data tables, ratios, and formulas.

Which of the following business analysis, reporting, and alerting activities are currently deployed for users in your organization through implementation of data visualization and visual analysis technologies? (Please select all that apply.)

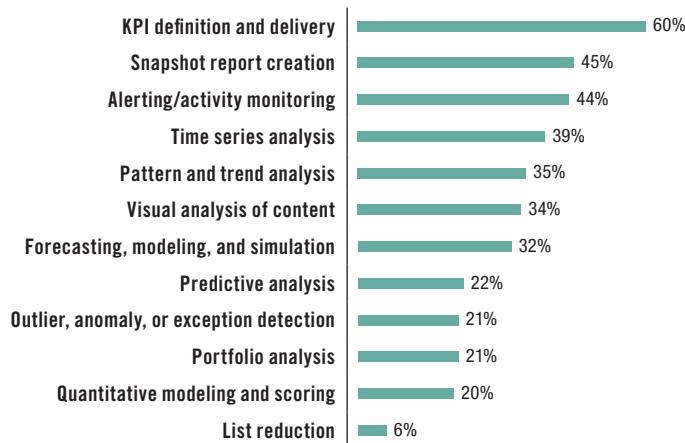


Figure 6. Based on answers from 408 respondents; respondents could select more than one answer.

Visualizations enable new forms of collaboration on data. Many tools allow users to publish charts, not only in dashboards for viewers to share, but also through e-mail and collaboration platforms such as Microsoft SharePoint. Dashboards can deliver context for visualizations by providing annotations and related charts, since one chart often cannot tell the whole story. Other means of storytelling, including animation or video and audio files, may be part of the collaboration.

Storytelling is important because visualizations are usually—and often, intentionally—left open to interpretation. Different viewers can draw different interpretations, which they can investigate by drilling down into the data. Some charts may hide the importance of certain factors, while others might exaggerate them. This ambiguity makes it important for executives, managers, and users to work with visualizations as tools to engage in a productive dialogue about metrics and measures. Organizations can use visualizations to overcome the “one-way street” limitations often cited as the bane of performance management and standard BI reporting.

Some charts may hide the importance of certain factors, while others might exaggerate them.

Time series analysis is an important focus. A significant percentage of respondents implement visualizations for time series analysis (39%). Users in most organizations need to analyze change over time, and they typically use various line charts for this purpose. Some will also apply more exotic visualizations such as scatterplots for specialized time series analysis, including examining correlations over time between multiple data sources. Visualizations for pattern and trend analysis, often related to time series analysis, are employed by 35% of respondents.

Time series, pattern, and trend analysis complement predictive analysis. Organizations want to use history to forecast what will happen next and identify what factors will cause patterns to repeat themselves. Almost a third (32%) of respondents use visualizations for forecasting, modeling, and simulation, and 22% are doing so for predictive analysis. Again, visualizations can improve vital collaboration on predictive analysis among different subject matter experts, who can share perspectives and help the organization adjust strategies to be proactive. The organization will anticipate events and be prepared with the most intelligent way to respond.

Geospatial Analysis and Visualization

The ability to superimpose data visualizations on top of maps is already a powerful asset for firms in industries such as real estate, energy, telecommunications, land management, law enforcement, and urban planning. As more location-based data from geographical information systems (GIS) becomes available, organizations in many other industries are also becoming interested in analytical capabilities. Retail firms, for example, can use the combination of business data and maps to determine where to locate stores; healthcare organizations can better understand patient behavior and disease patterns; insurance firms can use location analysis to improve risk management; and marketing functions in a variety of firms can overlay customer information and demographics on maps to sharpen messaging to different neighborhoods.

As more location-based data from geographical information systems becomes available, organizations in many industries are becoming interested in analytical capabilities.

Although just under half (49%) of organizations surveyed are not currently implementing geospatial analysis, a significant percentage are implementing visualization for activities such as geographic targeting (35%), routing and logistics (14%), and finding nearest locations. Nearly a third (31%) of respondents seek to integrate geospatial with other types of analysis. The ability to visualize corporate data and advanced analysis such as time series along with location information can help organizations add a new dimension to business strategy and operational intelligence. Mapping visualizations can be enhanced with data to become geographical heat maps; these might show the most or least profitable sales territories or where customers are having particular kinds of service problems.

The user story on the next page describes how visualization and location analysis increased the success of retail store launches.

USER STORY

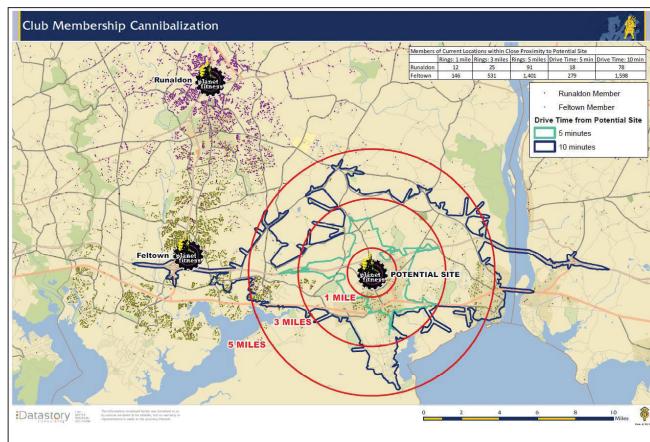
PLANET FITNESS USES VISUAL GIS ANALYSIS TO FIND THE SWEET SPOTS FOR RETAIL.

Where should we locate a new store? What kinds of customers will come, and how far are they willing to travel? How will new zoning laws affect our strategy? Answering these questions can be critical to the success of retail organizations, and questions of a similar nature often confront decision makers in real estate, business and industrial development, healthcare services, city planning, and more.

Rather than having to look at data silo by silo, GIS analysis can help decision makers by giving them a single mashup view of relevant data within the context of maps. “All of this comes together to paint you a picture of a story that is in fact already there in the data,” said Matt Felton, president of Datastory Consulting. “But if you don’t have the right lens to see it, you can’t see it.”

Datastory Consulting, an offshoot of the Maryland-based commercial real estate firm MacKenzie, is helping Planet Fitness use the Esri ArcGIS platform to sharpen its strategy for locating new facilities. Planet Fitness has been growing fast; it has more than 600 low-cost health club locations in the U.S. With GIS analysis playing a key role, the company has been active in Maryland, opening 20 locations in just the first quarter of 2013. Working closely with John Schultz, senior vice president and principal at MacKenzie, which has a brokerage relationship with Planet Fitness, Datastory enables Planet Fitness to bring multiple variables to bear on finding location “sweet spots.” Through visual data interaction with “cloud maps”—what Datastory calls its rich, online data mashups of different sources shown on GIS maps—Planet Fitness decision makers can consider options even as new and ongoing developments take place in the location scenario.

“The cloud maps work as a collaboration tool to track current locations, the potential sites Planet Fitness is considering, and changes that affect the status of all sites,” said Felton. Decision makers can apply variables and attributes in the cloud maps and update the status of potential sites as they become more or less interesting, as construction begins on chosen locations, or as other milestones in the process of opening a site occur. “Deals get done smarter and faster, with a clearer perspective, after looking at data and sometimes thousands of variables to narrow down to sites with the highest potential,” Felton said.



Geospatial analysis of the potential for Planet Fitness club membership cannibalization among facilities in the same region.

Provisioning Data for Visual Access and Analysis

In most organizations, users need to tap multiple data sources to fuel visual reporting, analytics, and discovery. Business environments are dynamic, with mergers, acquisitions, and restructuring adding new sources to the mix. Big data trends are increasing interest in accessing “sub-transactional” raw data, often held in Hadoop files, to detect patterns and understand behavior.

At the same time, data aggregations and summaries remain critical for supporting visual reporting and analytics so that users can see specific time periods and frame other areas of interest without getting overwhelmed by the data deluge. Along with providing access to Hadoop files, many modern visual reporting and data discovery tools enable users to create aggregations as the need arises rather than having to suffer the delays of requisitioning them ahead of time from IT developers. In a number of leading tools, this is accomplished through an integrated in-memory data store where the aggregations are done on the fly from detailed data stored in memory.

Data aggregations and summaries remain critical for supporting visual reporting and analytics.

TDWI Research finds that enterprise data warehouses, BI reporting and OLAP cubes, spreadsheets, and analytic databases are the most important data sources for visual analysis and data discovery, according to survey respondents. Nearly three-quarters of respondents also regard access to departmental data marts as important. Analytic databases, somewhat of a new technology category, are considered very important by 46% of respondents and at least somewhat important by 24%. Analytic databases are purpose-built for analytics rather than OLTP; through columnar organization, compression, and other techniques, they can improve speed and performance for visual analytics and discovery. Some analytic databases use Hadoop internally for data storage.

Interestingly, significant numbers of respondents said that the least important sources for visual analysis and data discovery are NoSQL databases and Hadoop files. Just under half (44%) said that these sources are not important, while only 10% said they were very important and 14% said they were only somewhat important. Evidently, these sources have not yet become the mainstream.

Operational source systems and transaction applications are not forgotten. Along with access to traditional BI, data warehousing, and data mart sources, many users require direct access to OLTP and application data. More than a third (37%) of respondents said that access to ERP, CRM, and other applications is very important, and 27% said it was somewhat important. Nearly the same percentages of respondents indicated that their organizations need direct access to operational source systems.

In-Memory Computing for Visual Analysis and Discovery

Although in-memory computing for analytics is a hot industry topic, TDWI Research finds that overwhelmingly, the physical location of data accessed for users’ visual analysis and discovery is on a database or file on disk (76%; see Figure 7). The second most prevalent source is spreadsheets on desktops or workstations (57%). Use of in-memory computing, however, does garner a healthy amount of interest; one-third of respondents are implementing in-memory on different servers or systems from where the visualization types are rendered, and 26% are doing so on the same machine.

Sixty percent of respondents are using in-memory computing to help render visualizations.

In your organization, where physically does data that is accessed for users' visual analysis and discovery reside? (Please select all that apply.)

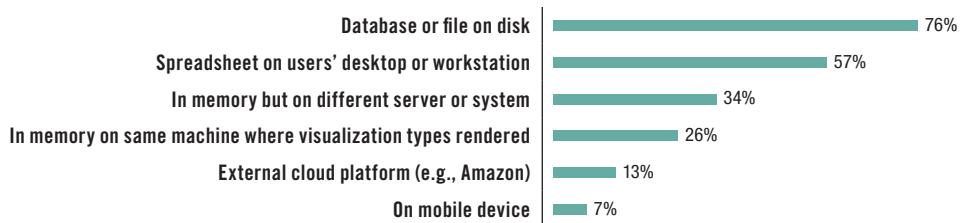


Figure 7. Based on answers from 393 respondents; respondents could select more than one answer.

Adoption of 64-bit operating systems has made it easier for developers and users of BI and analytics systems to exploit very large memory and bring powerful functions closer to the data. With in-memory computing, the traditional I/O bottleneck constraint—where queries have to read information from tables stored only on disk—becomes less of a factor. Users can perform, on their own, types of analysis that would be too slow with disk-dependent systems and limited in scope because not enough data is available. In-memory computing could therefore be an advantage for complex, highly interactive analytics or in circumstances where it would hurt the performance of operational data sources to go against live data.

Several leading visual discovery and analysis tool providers include an in-memory data mart as part of their applications. These integrated offerings load data from a variety of disk and spreadsheet sources into memory for display and analysis. By integrating this data automatically, the applications avoid the need for additional IT setup and management.

However, in-memory computing is not a silver bullet, nor is it the right approach in all cases. As data volumes rise, management of the memory space can become an issue. Organizations also have to consider how frequently they need to update the data in memory. Data management issues can arise if users are essentially creating in-memory, siloed data marts that then become difficult to update and maintain from a data quality perspective.

Most respondents give the speed of data access and selection for data visualizations a middling grade.

Overall, TDWI Research finds that most respondents give the speed of data access and selection for data visualizations a middling grade, with just over a third somewhat satisfied and just under a third somewhat unsatisfied. Only 6% are very satisfied; however, this segment is implementing in-memory computing at a higher rate. Nearly two-thirds of these respondents are working with data in memory but on a different server or system from where visualization types are rendered; 42% of these respondents have data in memory on the same machine.

The user story below describes the potential XL Group sees for implementing visual analytics on big data sources.

USER STORY

XL GROUP TAPS VISUAL ANALYSIS TO IMPROVE INSIGHTS AND ENHANCE COLLABORATION.

In a data-driven world, business innovation depends on a strong bond between subject matter experts who know the business and data analysts and scientists who have expertise in finding patterns, trends, and correlations in the data. In many organizations, however, the two cultures live separately; without a common language, communication and collaboration are difficult. As a result, organizations can be slow to realize potential competitive advantages and may miss shifts in customer demand.

New big data sources are creating “powerful and potentially transformative analytical opportunities” at XL Group, according to Kimberly Holmes, head of strategic analytics. XL, through its subsidiaries, is a global insurance and reinsurance company that offers property, casualty, and specialty products to firms throughout the world. The internal and external big data sources are giving business and data analysis teams much larger data sets than they have ever had, in order to support decision makers who analyze risk and develop strategic and potentially profitable new products. “Our mandate is to develop decision-making tools using a broader set of data and advanced analytics to enable business leaders to make better decisions.”

By implementing advanced analytics, XL is “testing conventional wisdom and pushing beyond hindsight and one-way analysis,” said Holmes. A critical objective of the implementation is “minimizing the challenges of conveying complex relationships in the data to decision makers.” XL is in the early stages of implementing SAS Visual Analytics to “bridge the gap between the business decision maker’s expertise and that of the analyst.” SAS Visual Analytics, which XL is deploying as a hosted system, offers advanced visualization backed by an in-memory analytics engine.

“Visual analytics is a way of enabling business leaders to explore data and look for patterns without having an extensive education in data analysis,” Holmes said. “If the business leader is working alongside the analyst and leading the exploration of the data, it will lead to deeper understanding of the data and the business. This collaboration is easier with visual analytics because the business leader can see the story in the data.”

Dashboard Strategies and Data Visualization

It seems hard to imagine BI applications today without dashboards. From an industry perspective, it is easy to take for granted the pairing of these two technologies. Dashboards provide the front-end workspace that enables users to access and visualize their data without having to get their hands dirty with queries and code. Meanwhile, BI and data warehousing systems work behind the scenes to handle queries, metadata, data integration, and other data management duties.

However, TDWI Research finds that dashboards are not as ubiquitous as they might seem. Half of respondents to the research survey said that one-quarter or less of users in their organizations are implementing dashboards for any of their BI and/or analytics applications. Only 5% indicated that 75–100% of their users are implementing dashboards; 27% said between 50–75% are using them.

Dashboards are not as ubiquitous as they might seem.

Thus, the research tells us that regarding dashboard implementations, there is room to grow. For example, Figure 8 shows that only a quarter of survey respondents said that frontline employees such as those in sales and service are users of dashboards in their organizations. TDWI Research finds that the majority of respondents report only mild satisfaction with how easily users can understand visual analytics presented in their dashboards. This could be one reason why organizations have not yet expanded the use of dashboards to the majority of their users.

Executives are the dominant users of dashboards. In Figure 8, we can see that business executives and management users (77%) are in the majority as the primary users of dashboards or similar visual data analysis, access, and reporting workspaces. Our research suggests that they are primarily consumers of snapshot reports and scorecards prepared by IT developers, business analysts, and power users—more so than visual analytics and discovery. After business analysts (58%), line-of-business (LOB) and departmental managers form the third largest segment (55%). Survey respondents who said LOB and departmental managers are users of dashboards identified improved operational efficiency and faster response to business change as the business benefits most desired from deploying data visualization and visual analysis technologies.

Who are the primary users of your organization's dashboards or similar visual data analysis, access, and reporting workspaces for users? (Please select all that apply.)

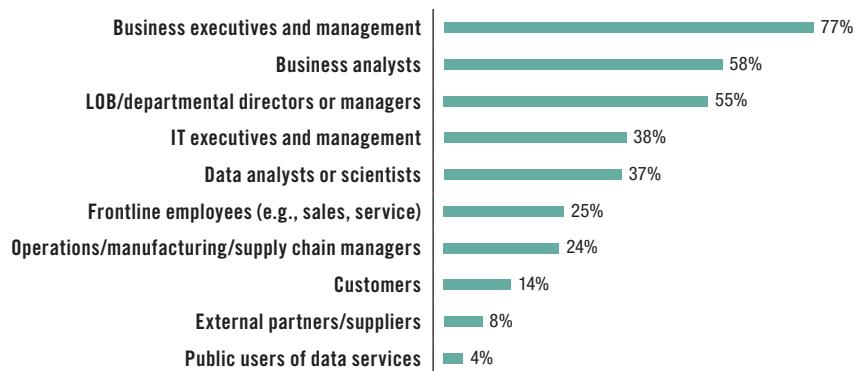


Figure 8. Based on answers from 388 respondents; respondents could select more than one answer.

Mobile Dashboards: Not Yet in Sync

Mobile devices—smartphones and tablets—continue to represent one of the hottest growth areas in technology. BI tools running on mobile devices have matured to offer more interactive and actionable applications and Web browser-based services that users can tailor to their interests and needs. HTML5 and similar standards have enabled developers to create browser-based services that enrich mobile dashboards with multimedia content. Previous research by TDWI has found that the majority of organizations see mobile BI and analytics as important to their overall strategy for the expansion of BI and analytics to more users.¹ The combination of easier deployment plus strong interest in mobility has BI deployment on mobile devices outpacing deployment on standard desktops and workstations in many organizations.

TDWI Research finds that in most organizations, users' dashboards and visualizations are not accessible from all mobile platforms.

Organizations face dashboard disconnect between mobile and desktop platforms. TDWI Research finds that in most organizations, users' dashboards and visualizations are not accessible from all mobile platforms. They are no more accessible from tablets than from smartphones. At more than half (55%) of respondent organizations, dashboards and visualizations cannot be created or updated from mobile devices; only 13% report that they have this capability. Nearly half also said that in their organizations, dashboards and visualizations on mobile devices are not integrated with those accessible from other platforms.

Of course, some perspective is required: most organizations are still in the early stages of deploying BI and analytics applications and services on mobile platforms. They must also address data governance concerns regarding data access from mobile devices. To this point, our research finds that the majority of organizations do not yet have a mobile strategy for dashboards and visualizations; only 14% indicated that they have a fully settled strategy.

Satisfaction with Dashboards: Room for Improvement

Figure 9 provides a look at the level of satisfaction users have with a range of dashboard (or similar portal or GUI) capabilities and qualities. “Very satisfied” levels are generally low across the board; the highest percentage is for data drill-down and interaction for KPIs and metrics (12%, with 34% somewhat satisfied). The good news is that more than half (56%) are at least somewhat satisfied with the clarity of their dashboard’s business purpose.

More than half of respondents (53%), however, are somewhat dissatisfied or worse with self-service customization of look, feel, and scope. This indicates that many dashboards are not giving users the flexibility that they need. As further evidence of this weakness, about half of respondents (51%) are somewhat dissatisfied or worse with their ability to update or add new information from their dashboards. A similar percentage (54%) are dissatisfied with their dashboard's adaptability to new business conditions. Organizations are clearly in need of tools and practices that will allow their dashboards to be more adaptable to dynamic business requirements and more capable of giving users scope for self-service customization.

More than half of respondents are somewhat dissatisfied or worse with self-service customization of look, feel, and scope.

How satisfied are users in your organization with the following capabilities or qualities in their dashboards or similar graphical user workspaces?

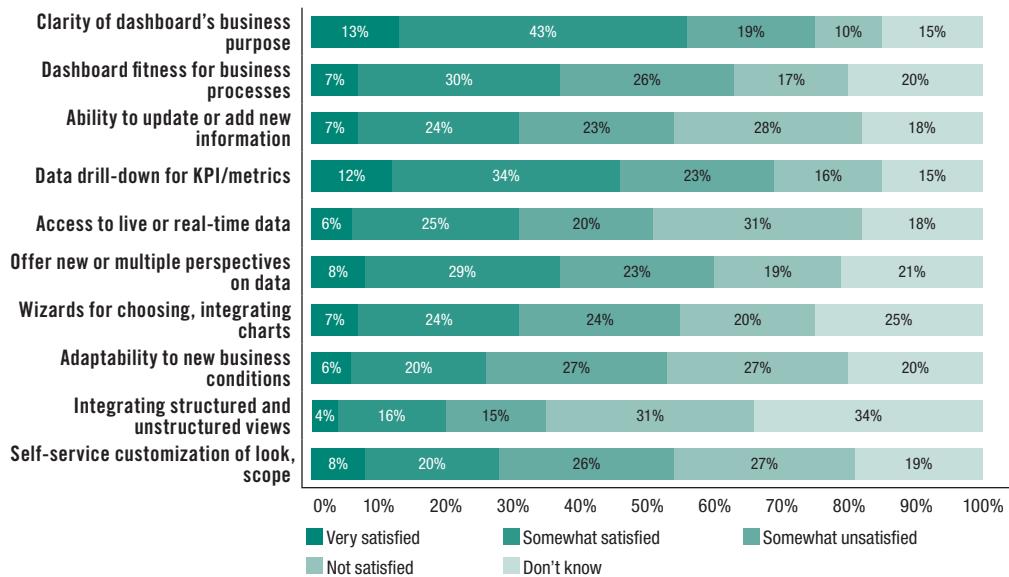


Figure 9. Based on answers from 374 respondents; respondents could select one answer per row.

The user story below illustrates the role dashboards and self-directed visual analysis can play in helping a small business to grow by using data effectively.

USER STORY

VISUAL DATA DISCOVERY ENABLES LUCKY VOICE TO “PUNCH ABOVE ITS WEIGHT.”

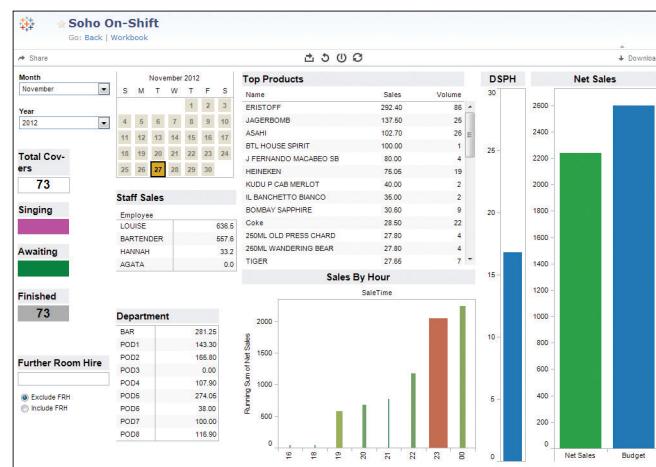
“Spreading happiness through unforgettable singing experiences” is the mission statement of Lucky Voice, founded in 2005 as a provider of private-room karaoke venues and now expanding to offer online experiences and software technology for use by other companies. Lucky Voice is enabling closet singers in the UK—and beyond, via the Internet—to overcome shyness, enjoy a few drinks with friends, and let out the inner crooner. “It’s serious in a business sense but not serious in that we’re just selling fun,” said Nick Thistleton, co-founder and managing director of Lucky Voice.

Thistleton has been driving Lucky Voice’s expanding use of Tableau Software for visual, interactive, and actionable data analysis and reporting. It started when the company had built its own booking system and needed reporting. “I asked our teams to come up with their reporting requirements and we ended up with a massive list for detailed reports,” Thistleton recalled. “Our in-house software developers said, ‘Okay, we can do this, but it will take weeks and when we finish, you’ll want us to change things and you’ll have new reports that you hadn’t thought of.’”

The company's developers suggested that Thistleton look at third-party software, which seemed like a big leap for a small company. "I downloaded a couple of trials and didn't know where to start," he said. "You needed to be a data analyst to even understand how to work the programs."

Once introduced to Tableau Software by a friend, Thistleton was able on his own to start developing meaningful and highly visual reports from the booking system. "Then, I started to plug into other systems that were generating data, including systems that could tell us about customer behavior, such as what songs people like to sing, what they are drinking, and their satisfaction. We kind of taught ourselves how to get at least basic visualizations. It was also a huge leap forward to be able to access live data rather than having to download data into a spreadsheet and create pivot tables just to see old data. We are continuing to plug into sources we had never thought about to find out things we didn't know."

Thistleton said company personnel are using dashboard reports at all levels. Venue managers, for example, can develop dashboards to see the budget for the night and how much revenue has come in so far. "They can click on what drinks have sold and whether we need to create incentives to sell more of something to meet budget. Everyone from the top to the bottom of the business has some kind of relationship with the Tableau system. We have only been using it for about a year, but already, if you took it away from us, we wouldn't know what to do with ourselves."



Lucky Voice's on-shift dashboard enables employees to see the budget for the night and how much of selected items has been sold so far, as well as who is working that night and what they have sold.

Visualization Functionality and Chart Types

With the combination of maturing technologies and a clearer sense of the business purpose for deploying dashboards and visual analysis, organizations are able to expand functionality. Figure 10 offers a view of current and planned use for some of the most important functionality to be found in today's technologies. Readers of this report can use the chart to compare their implementation status with that of peer organizations.

Figure 10 shows that filtering, and using data to filter other data views, is the functionality with the highest current use percentage (57%). Filtering is a critical data interaction capability; it allows users to isolate data within time periods or other parameters and then zoom or drill down from there. Indeed, data drill-down into metrics shows the second highest percentage (54%) for current use. Some tools offer expanded drill-down capabilities, including hierarchical tree views that allow users to be aware of their path as they move down into finer levels of detail. Slide-and-dice analysis capabilities, which complement drill-down methods by allowing users to break up what they are analyzing into smaller parts, are currently used by 43% of respondents.

Current use of coloring and focus is significant. In Figure 10, we can see that about 4 in 10 survey respondents indicated that users in their organizations are implementing tools for color-coding data and creating linkages to charts (45%), and coloring, brushing, and highlighting in charts (40%). Color is vital to conveying information; humans are sensitive to the culturally conditioned meaning of colors, which means that users have to choose them carefully. They must also be aware that many humans are color blind and cannot differentiate easily between certain colors.

Functionality requirements vary somewhat by activity. Looking at the results for Figure 10 filtered for the three main data visualization activities described earlier in this report (see Figure 1), we can gain insights into functional priorities. For respondents who are currently implementing data visualization technologies for display or snapshot reporting, and/or scorecards, the highest currently used functions are filtering, data drill-down, and coloring of data and linkage to charts. For those who are currently implementing data visualization for operational alerting, not surprisingly, alerts rise to the third highest in current use; at 64%, the percentage for this segment is twice the overall current-use percentage shown for this functionality in Figure 10 (32%). Finally, for those using data visualization for visual discovery and analysis, filtering, drill-down, and coloring are the most used functionalities.

Some tools offer expanded drill-down capabilities, including hierarchical tree views that allow users to be aware of their path as they move down into finer levels of detail.

For those using data visualization for visual discovery and analysis, filtering, drill-down, and coloring are the most used functionalities.

Which of the following types of functionality are currently deployed or are planned to be deployed in your organization's dashboards or visual analysis applications?

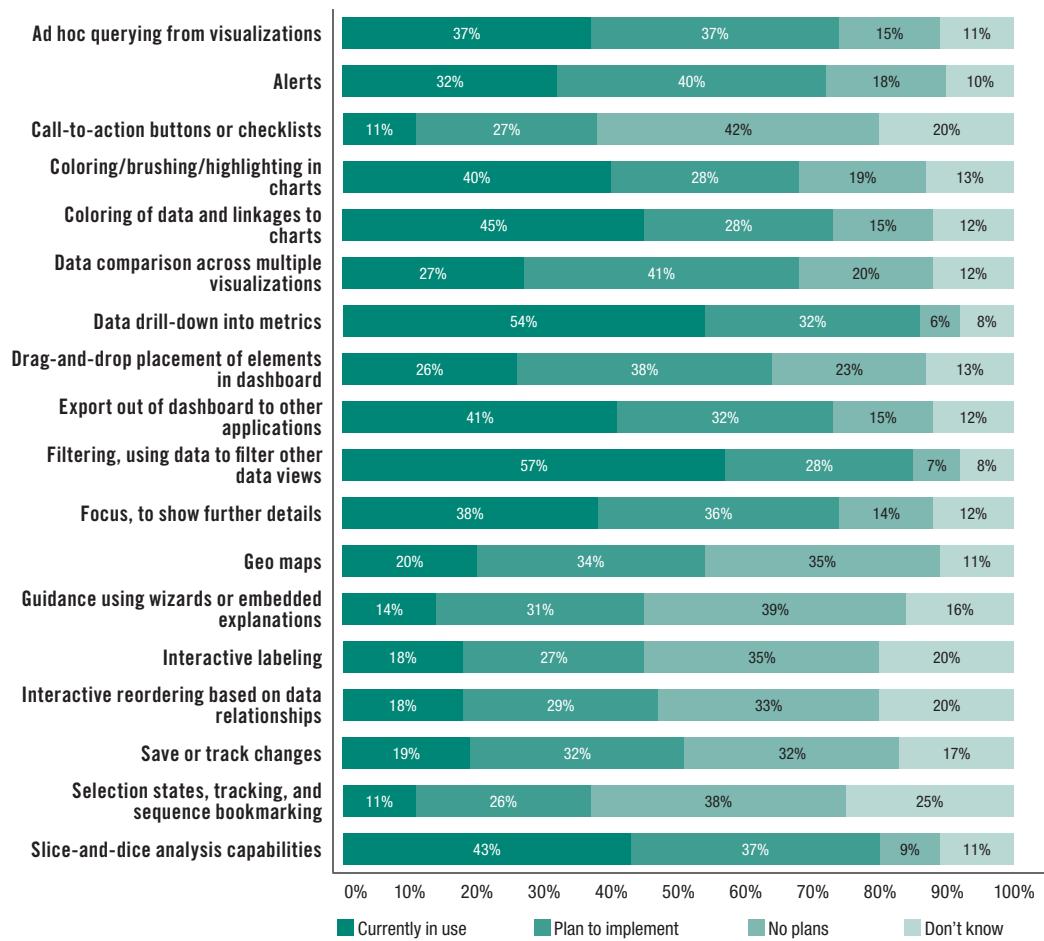


Figure 10. Based on answers from 356 respondents; respondents could select one answer per row.

Most Popular Visualization Types

Organizations should consider technology architecture that allows their users to expand the variety of visualization types they use, rather than restrict selection.

Along with functionality, users are gaining versatility through the growing libraries of visualization types that many tools offer. In addition to those provided by software vendors, visualization types are increasingly available from developers who are building them for specific industries, data sources, and more. As visual analytics become more prevalent, users will see things that others are doing and will want to follow suit; they may also be required to use certain visualization types associated with their industry or with access to a particular data source. Organizations should therefore consider technology architecture that allows their users to expand the variety of visualization types they use, rather than restrict selection.

Bar charts, pie charts, and tables dominate. In Figure 11, we can see that the dominant visualization types are the standard ones: bar charts (91%), line charts (75%), pie charts (75%), and tables (70%), with spreadsheets coming in fifth (64%). These visualizations are commonly available for most dashboards, if not through spreadsheets and reporting tools. Their virtue is that since most users have experience in working with them to compare sets of values, track changes over time, or to see

how parts compare to the whole, these standard types can be shared with an expectation that other users will easily grasp their meaning.

Significant shares of users implement more advanced visualization types. Users who are performing more advanced visual analytics are implementing a range of somewhat more specialized types to understand data and communicate insights with others. These include histograms (44%), which are usually displayed as a type of bar graph that expresses the frequency distribution of data; scatterplots (43%), which help users to see correlations between variables; and heat maps (36%), which use color to show relative values and “what’s hot” compared to other values in a matrix. Tree maps, used by 17% of respondents, are a variation on heat maps.

**Which of the following visualization types are currently being implemented by users in your organization?
(Please select all that apply.)**

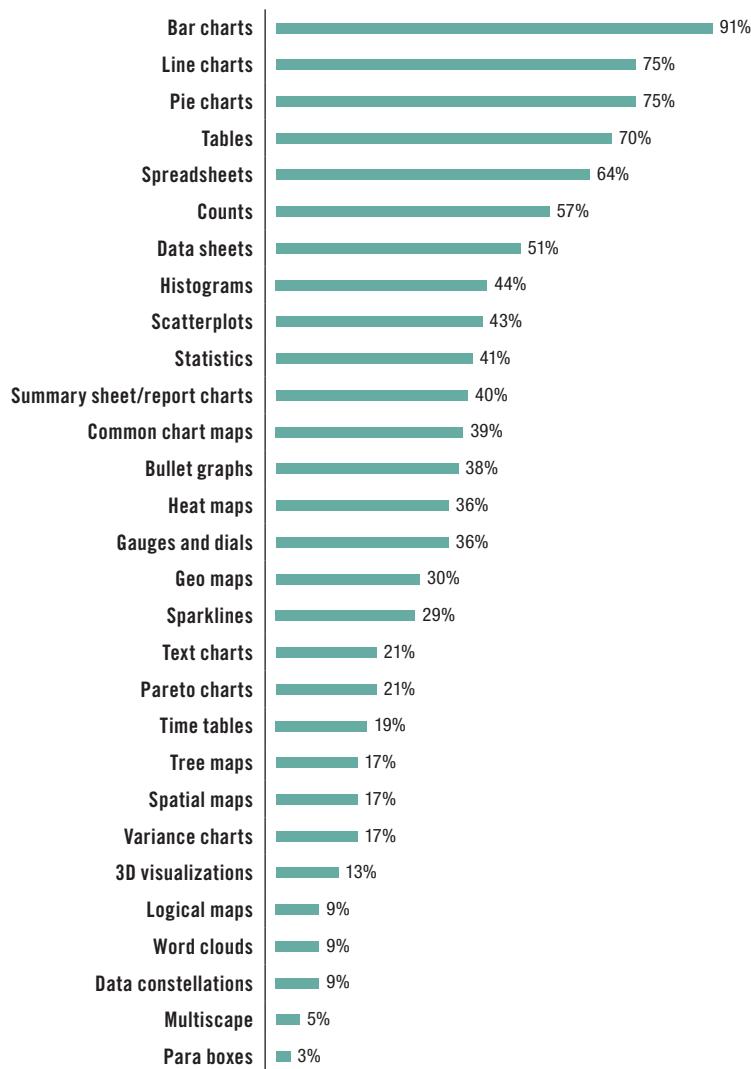


Figure 11. Based on answers from 352 respondents; respondents could select more than one answer.

Because technology progress is enabling ever broader and deeper data analysis, we expect no slowdown in innovation with data visualization.

As with the previous chart, Figure 11 gives readers of this report a sense of the breadth of visualization types available. It allows them to compare the extent of their implementations with what our research indicates other organizations are doing. The value of visualization types is in the eye of the beholder; although some are not implemented by a large percentage of respondents, this does not mean that they lack value. In fact, they could very likely deliver unique insight that more common visualization types will not show. For this reason and because technology progress is enabling ever broader and deeper data analysis, we expect no slowdown in innovation with data visualization.

Vendor Products

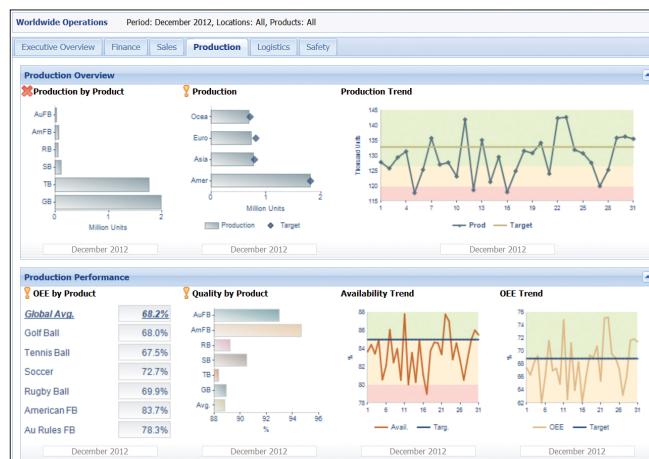
The firms that sponsored this report are among the leaders and innovators in providing technologies for data visualization, data discovery, and visual analytics. To get a sense of where the industry as a whole is headed, the next section takes a brief look at the portfolios of these vendors. (Note: the vendors and products mentioned here are representative, and the list is not intended to be comprehensive.)

More Content Online

Visit tdwi.org to view a slideshow of the visualizations featured in this report, plus additional samples. Go to: tdwi.org/bpr-visualization-slideshow

Adaptive Planning

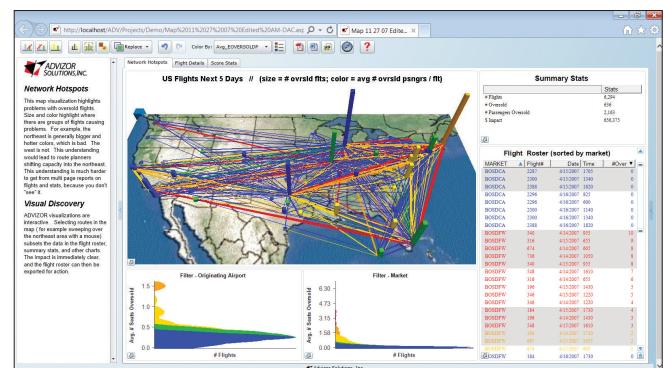
Adaptive Planning, known for software-as-a-service (SaaS) corporate performance management (CPM), acquired myDIALS, a cloud-based visual discovery and analytics solution, in September 2012. Called Adaptive Discovery, it is offered as either a standalone product or an integrated component of the Adaptive Planning suite; users do not need to subscribe to the Adaptive Planning CPM solution to use it. Combining visual discovery with planning, forecasting, and consolidation in the suite enables users not only to see what is happening now with key performance indicators; through visual analysis, they can also examine data behind the metrics to discover hidden relationships, root causes, and more. Users of Adaptive Discovery can see disparate and time-sensitive data from multiple sources, including data accessed through tight integration with NetSuite and connectors to Salesforce.com, Google Analytics, and Facebook and Twitter data sources. Aimed at addressing self-service requirements of line-of-business managers, Adaptive Discovery offers visual graphics through which users can drill down into data and, using a hierarchical drill tree, track their discovery path. Users can perform what-if analysis by changing drivers and viewing the projected impact. Adaptive Discovery runs on mobile devices.



Adaptive Planning: Customized dashboard. Adaptive Discovery displays data, metrics, and KPIs on visual charts, organized on intuitive, interactive dashboards. Dashboards can be tailored to each user's role and scope of authority to show data most meaningful to different types of users, such as finance, sales, other business managers, and executives.

ADVIZOR Solutions

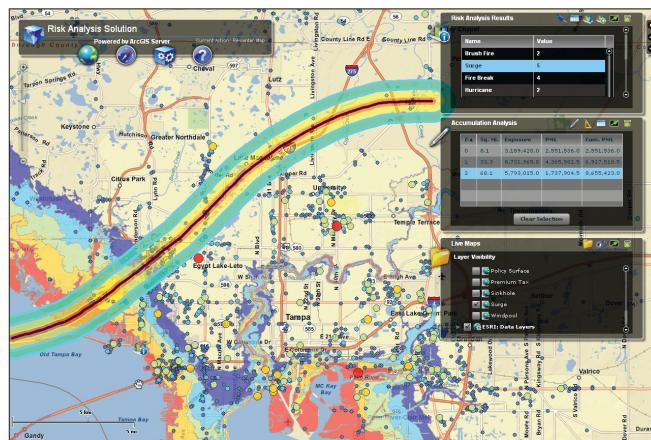
ADVIZOR Solutions, founded in 2003 as an offshoot of Bell Labs, offers data visualization, predictive analytics, and in-memory data management software. It provides business users with easy-to-use but deep analytics against integrated data sources. ADVIZOR's software runs on desktops, mobile tablets, through browsers, or in a SaaS model. Dashboards are powered by the company's patented Visual Discovery technology. Users can choose from among at least 15 chart types; charts are linked and interactive, allowing users to work iteratively rather than be stopped at a shallow level of analysis. ADVIZOR's in-memory data management enables organizations to make all data available for analysis and avoid the delays, complexity, and limitations of preconfiguring data. The Expression Builder can then perform different types of calculations, parse tables, and do table roll-ups in memory. ADVIZOR's integrated predictive analytics enables users to visually select a target and then build models to examine causal factors. This guides users to what matters most and complements visual discovery. Models can be saved and then used to score current or future data sets to create ranked and/or prioritized lists or forecasted amounts.



ADVIZOR Solutions: Network hotspots. This map visualization highlights problems with oversold flights. Size and color indicate groups of flights creating issues. It is immediately apparent that the northeast has a problem—an understanding that is harder to get and communicate from typical reports and lists.

Esri

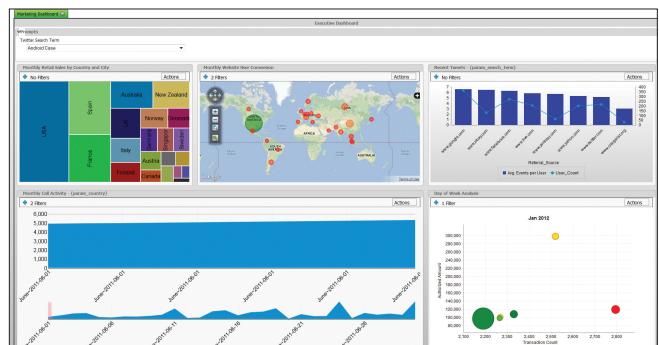
Founded as Environmental Systems Research Institute in 1969 by Jack and Laura Dangermond, Esri began producing software for mapping and GIS in 1982. The Redlands, California-based company's customer base stretches across business, governmental, and NGO organizations. Esri's ArcGIS platform for mapping and geographical analysis includes a range of tools and solutions for decision makers who need to bring together data sources with geographic information and mapping tools. Esri Location Analytics augments business systems with mapping visualizations and special analytics that complement existing functionality without disrupting existing business workflows. Location analytics also provides access to external spatial data, including demographics, lifestyle, business, and weather. Esri's easy-to-adopt solutions make them impactful immediately to a business and can provide organizations with a platform for growth to fully exploit geospatial visualization and analysis. Esri also offers developer tools, free mapping software, specialized geospatial applications, and industry-specific ArcGIS solutions.



Esri: Risk analysis dashboard. The dots represent insurance policies and their value. The map is overlaid with the path of a hurricane as it comes ashore, color coded to represent wind velocity. The shoreline is also color coded to represent the storm surge.

Pentaho

Pentaho, founded in 2004, has an open source heritage and provides commercial professional and enterprise editions of its Pentaho Business Analytics technologies through a subscription model as well as open source versions. Along with reporting, interactive data discovery, and predictive analytics capabilities, Pentaho also provides data access and integration. Pentaho's most recent release includes Pentaho Mobile, the full Business Analytics platform on Apple iPads, and Instaview. Built to meet demand for ad hoc discovery, visualization, and exploration of large and diverse big data sources, Instaview brings analytics, data access, and preparation together in a simple, easy-to-use package. Instaview enables users to specify a desired data set from the larger pool, and the tool will automatically aggregate the data and load it into an in-memory columnar database. Because the system is pluggable, users can work with either Instaview's supplied visualizations or plug their own visualizations into the system. Organizations with standardized chart libraries and engines or that need to use industry-standard charts can implement them as part of Instaview.



Pentaho: Interactive dashboard. Using advanced visualizations such as tree maps, geomaps, and bubble charts, critical information is provided in a single dashboard to help users understand and improve organizational performance.

SAS

SAS introduced SAS Visual Analytics in 2012. Available on desktops, mobile devices, and through the cloud, SAS Visual Analytics aims to bring an easy-to-use data visualization interface together with powerful server capabilities and a flexible architecture designed to run advanced analytic operations against any size of data, up to multiple terabytes. The user interface enables drag-and-drop selection of variables for analysis and the use of filters and other devices to zero in on the right data sets. SAS Visual Analytics guides nontechnical users by offering explanations of the analytics being used as well as automated suggestions of the most appropriate visualizations. The power of the application comes from the underlying SAS LASR Analytic Server; an in-memory engine, it leverages a co-located data storage, such as Hadoop Distributed File System (HDFS) or appliances from Teradata, EMC Greenplum, and other providers for scaling up to big data dimensions. LASR Analytic Server can execute computations on large data volumes rapidly. The Server supports rapid generation of and interaction with data visualizations, and allows users to define dimensions on the fly rather than wait out cube development.



SAS: Profit performance. In this single visualization, users can view the business's profit performance by year, see the prediction for future profit performance, and then examine different scenarios by adjusting variables that influence the profit.

Tableau Software

Tableau aims to excite the “data enthusiasts” in organizations who may have considerable understanding of the data sets relevant to them but lack self-service tools for data discovery analysis and for building interactive visualizations for interpretation and collaboration. User interfaces for Tableau Desktop and Server products offer drag-and-drop functionality and visual query and analysis. By taking data out of its numeric context, Tableau visualizations allow users to be inventive. The new visualization engine in Tableau 8 supports a broader array of visualization types, including tree maps, bubble clouds, and forecasting extrapolations. The forecasting capability expands how users can project data values based on historical data and see forecasts as visualizations. For mobile users, Tableau 8 allows users to create visualizations in Web browsers as well as natively on mobile devices. JavaScript and data extract APIs, in addition to native connectivity to Google Analytics and Salesforce.com, increase developers’ options for integrating multiple data sources and bringing interactive, custom Tableau content into other applications or Web pages.

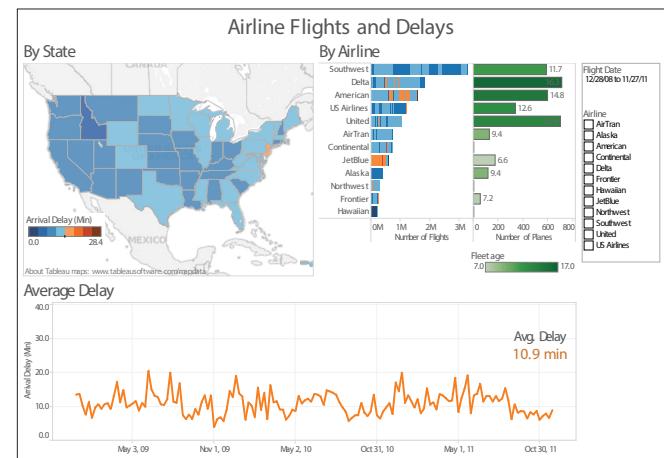


Tableau Software: Airline flights and delays. This interactive dashboard tracks and displays flight delays across several dimensions.

Recommendations

Improve data visualization and visual analysis for nontechnical users. “Nontechnical” users are by definition not expert in the tools and practices of accessing data and creating visualizations, but they often know their data well. Their struggle is in trying to interact with data. With visualization, organizations can give nontechnical users easier and more powerful means of data interaction.

Match visualization capabilities to users’ types of activities. Some users, including executives, need visualization primarily for display or snapshot reporting and scorecards. Others need operational alerting. Still others need visual data discovery and analysis, which can demand different visualization capabilities. Ensure that the technology deployment fits each purpose.

Increase data interactivity with broader visualization functionality. Just as many users need to go beyond static and tabular data, they need the flexibility to explore visualization options other than standard bar and line charts. Evaluate tools that offer more visualization options, including the ability to plug in visualizations that may not be part of the BI tool’s library.

Use dashboards to establish a single view of information. TDWI Research finds that users would like to see dashboards provide a complete and consolidated interface to view all the information they need. However, at large organizations in particular, users must deal with many application interfaces. Aim at consolidating interfaces into a single or small number of dashboards.

Make self-service data visualization and discovery capabilities a priority. The biggest trend in BI and analytics today is self-service. Users want tools and platforms that allow them to interact with data on their own without hands-on IT development and supervision. Self-directed visual reporting and data discovery can free users throughout organizations to be more creative in their analysis and selection of visualizations to express insights.

Address time series analysis requirements with improved visualization. TDWI Research shows that evaluating how business performance and other conditions change over time is a common need for nearly all users. Yet, some users have only primitive means of analysis for this requirement. Provide users with greater interactivity and breadth of visualization options for time series analysis.

Evaluate geospatial analysis and GIS sources for visual analysis needs. Location is fast becoming a vital new dimension for data analysis. Location’s relevance is growing for users in fields that may not have considered geospatial analysis previously. Organizations should consider whether mapping and geospatial analysis functionality could give users new insights for strategic and operational decisions.

Develop a strategy for integrating desktop and mobile dashboards. TDWI Research finds that in most organizations, existing dashboards and visualizations are not accessible from mobile devices. Yet, with mobile device use growing, more users will demand BI and analytics capabilities on devices. To avoid chaotic dashboard proliferation, organizations should develop a comprehensive strategy.

Evaluate in-memory computing to support visual analysis. In-memory computing is an alternative to the performance constraints and design complexity that exist in standard disk-based environments. It is not always the right solution if users need access to near-real-time, live data. However, for highly interactive and iterative visual analytics, in-memory computing should be considered.

Make improved operational efficiency a goal of data visualization and analysis. TDWI Research finds that improved operational efficiency is the top business benefit organizations seek from deploying data visualization and analysis technologies. Organizations should therefore ensure that the right functionality and visualization options are available for users’ dashboard reporting and analytics as they address operational challenges.

Adaptive Planning

Adaptive Planning www.adaptiveplanning.com

Adaptive Planning provides the leading cloud business analytics solution, empowering finance and management teams to automate budgeting, forecasting, reporting, consolidations, and data visualization. We fundamentally transform business management by enabling business leaders to easily create financial and operating plans, monitor performance in real time, and report on and analyze results. An alternative to manual spreadsheets and legacy enterprise software, Adaptive Planning is affordable, easy to use, and rapidly deployable, going live in just weeks. We allow managers to cut cycle times by 90%+, reduce errors and risk, visualize KPIs and metrics, improve analysis, enhance collaboration, and ultimately drive better business decisions.



ADVIZOR Solutions www.advizorsolutions.com

ADVIZOR® Visual Discovery software enables people to make better, faster, fact-based decisions from their data, without relying on others to create custom reports or perform complicated queries or analysis.

ADVIZOR's powerful, easy-to-use, interactive dashboards are built on three key technologies:

- In-memory data management for “speed-of-thought” interactions across large data sets
- Data visualizations that quickly reveal trends, patterns, and anomalies
- Predictive analytics for powerful model building without an advanced degree

From the desktop to the enterprise, business managers and analysts can easily load data, do analysis, and share results within minutes, all at the click of a mouse!



Esri esri.com

Since 1969, Esri's geographic information system (GIS) and location analytics software has empowered organizations to think and plan geographically. GIS is used in more than 350,000 organizations worldwide and helps cities, governments, universities, and *Fortune* 500 companies run more efficiently and communicate more effectively. Whether serving constituents, finding new markets, or reducing risk, these organizations use GIS to collect, analyze, and visualize data, helping them discover relationships, patterns, and trends. They can then solve problems and make better decisions because they are seeing their data in a way that is easily understood and shared.



Pentaho www.pentaho.com/get-started

Pentaho is delivering the future of business analytics. Pentaho's open source heritage drives continued innovation in a modern, integrated, embeddable platform that tightly couples data integration and business analytics to meet diverse and big data requirements. Pentaho is the only vendor that provides a full big data analytics solution that supports the entire big data analytics process, from data integration through interactive data visualization, exploration, and predictive analytics. Pentaho natively supports Apache Hadoop, Cloudera, and MongoDB, as well as high-performance analytic databases like Greenplum and Vertica, among other big data sources.



SAS www.sas.com

The leader in business analytics software and services, SAS helps organizations anticipate opportunities and improve decisions. We do this through advanced analytics that turns data about customers, performance, and financials into meaningful information.

Our latest offering, SAS® Visual Analytics, combines data visualization, mobile BI, and analytics to enable everyone—regardless of analytic background—to understand and act on complex data. With SAS Visual Analytics, users can design attractive, interactive reports, and distribute them to anyone, anywhere via the Web or mobile devices.

Since 1976, SAS has been giving customers around the world THE POWER TO KNOW®.



Tableau Software www.tableausoftware.com/trial

Tableau Software helps people see and understand data. Tableau helps anyone quickly analyze, visualize, and share information. More than 10,000 organizations get rapid results with Tableau in the office and on the go. And tens of thousands of people use Tableau Public to share data in their blogs and websites. See how Tableau can help you by downloading the free trial.

TDWI RESEARCH

TDWI Research provides research and advice for business intelligence and data warehousing professionals worldwide. TDWI Research focuses exclusively on BI/DW issues and teams up with industry thought leaders and practitioners to deliver both broad and deep understanding of the business and technical challenges surrounding the deployment and use of business intelligence and data warehousing solutions. TDWI Research offers in-depth research reports, commentary, inquiry services, and topical conferences as well as strategic planning services to user and vendor organizations.



1201 Monster Road SW T 425.277.9126
Suite 250 F 425.687.2842
Renton, WA 98057-2996 E info@tdwi.org

tdwi.org