TDWI RESEARCH

THIRD QUARTER 2015

TDWI BEST PRACTICES REPORT

Visual Analytics for Making Smarter Decisions Faster

Applying Self-Service Business Intelligence Technologies to Data-Driven Objectives

By David Stodder

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By David Stodder

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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 and Checklist Reports on data discovery, data visualization, customer analytics in the age of social media, BI/DW agility, mobile BI, and information management. He has chaired TDWI conferences on BI agility 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 he was the founding chief editor of *Intelligent Enterprise*, where he served as editorial director for nine years.

About TDWI

For 20 years, TDWI has provided individuals and teams with a comprehensive portfolio of business and technical education and research about all things data. The in-depth, best-practices-based knowledge TDWI offers can be quickly applied to develop world-class talent across your organization's business and IT functions to enhance analytical, data-driven decision making and performance. TDWI advances the art and science of realizing business value from data by providing an objective forum where industry experts, solution providers, and practitioners can explore and enhance data competencies, practices, and technologies. TDWI offers five major conferences as well as topical seminars, onsite education, membership, certification, live Webinars, resourceful publications, industry news, and in-depth research. See tdwi.org.

About the TDWI Best Practices Reports Series

This series is designed to educate technical and business professionals about new business intelligence (BI) and analytics 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 BI, analytics, and data management professionals.

To support the program, TDWI seeks vendors that collectively wish to evangelize a new approach to solving BI and analytics problems or an emerging technology discipline. By banding together, sponsors can validate a new market niche and educate organizations about alternative solutions to critical challenges. 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: Michael Boyda, Roxanne Cooke, Marie Gipson, Denelle Hanlon, and James Powell.

Sponsors

IBM, Information Builders, Oracle, Qlik, SAP, SAS, Tableau Software, and TIBCO Spotfire sponsored this report.

Research Methodology and Demographics

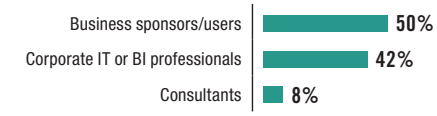
Report Scope. Organizations are seeking new business advantages from data. Many users would like to move beyond spreadsheets and limited business intelligence (BI) to embrace visual, self-directed BI and analytics. Users want to apply data visualization, graphical interfaces, and more to collaborate more effectively and be better able to explain data-driven conclusions so their organizations can make smarter decisions faster. Some organizations are looking to identify how they can react more quickly by automating decisions. This report examines organizations' experiences with self-directed visual analytics and progress toward business goals (such as decision management), and recommends best practices.

Survey Methodology. In March and early April 2015, 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; line-of-business (LOB) and departmental directors and managers; and other 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 490 responses. A total of 322 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. Marketing and sales personnel from technology vendors as well as students were excluded.

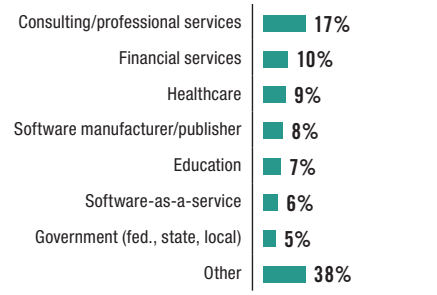
Survey Demographics. The largest percentage of respondents is business executives and sponsors/users (50%); included in that group are business analysts, data analysts, and data scientists (25%). Forty-two percent are data and IT professionals, with BI system designers or developers making up the largest part (16%) followed by VPs and directors of BI, analytics, and data warehouses (14%). Industry representation was varied, with consulting and professional services making up the largest segment (17%); financial services (10%) and healthcare (9%) were the next largest. Most respondents reside in the U.S. (47%) or Europe (22%), but other regions account for 31%.

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

Position

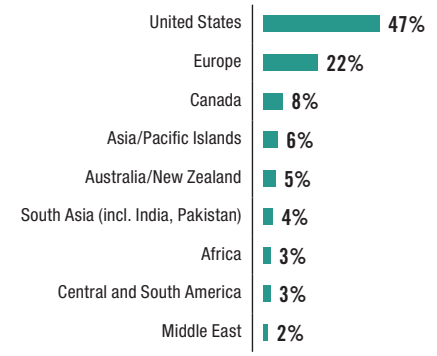


Industry

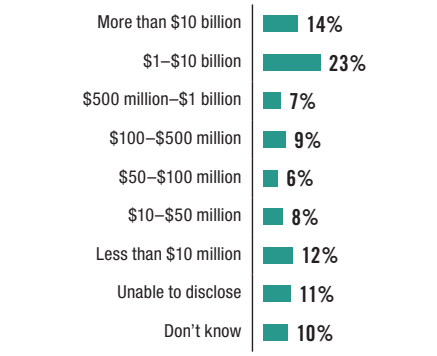


("Other" consists of multiple industries, each represented by 4% or less of respondents.)

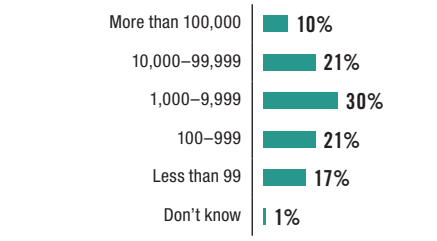
Geography



Company Size by Revenue



Number of Employees



Based on 490 survey respondents.

Executive Summary

Business users today want to move past the limits of spreadsheets and canned business intelligence (BI) reporting to gain a richer, more personalized experience with data. With data volumes exploding and a greater variety of data available to them, business users want to explore more data and discover new insights that they can apply readily to improve business strategies, processes, operations, and customer engagement. Along with easier data exploration, users are seeking to increase the depth and frequency of their data analysis. This is a significant change because users who are engaging in analytics processes interact with data differently from what has been the norm with traditional BI. Rather than just consume data, they ask questions, try different views and approaches, build predictive models, and more. Supporting users' forays into analytics is critical because it's becoming clear in nearly every industry that organizations need to be more analytical to compete effectively. To lead in their respective industries, organizations need to apply technologies and methods that enable them to spread to more users the ability to analyze data effectively without adding burdens and costs to IT.

Visual analytics can help users become more productive with data by using software to integrate data analysis capabilities with modern, graphical ways of expressing information.

Interest in performing analytics is intersecting with technology progress toward easier to use yet more sophisticated data visualization in tools and applications available on premises and in the cloud. The combination—visual analytics—is now a major trend. Visual analytics can help users become more productive with data by using software to integrate data analysis capabilities with modern, graphical ways of expressing information. Such technologies give users more power and control over analytic discovery, enabling them to progress further on their own, in a self-service fashion, rather than depend on IT developers' intervention. This can be important in large organizations (where there are often considerable IT application backlogs) as well as in small and midsize organizations (that lack extensive IT support for data analysis).

This TDWI Best Practices Report examines experiences with BI, visual analytics, and visual data discovery to uncover how organizations can move forward to make users more productive with data and use technologies to improve collaboration. Our research explores where users are succeeding with BI and analytics and where visual analytics can improve their decisions. Currently, users are not fully satisfied with their ability to use visual analytics functionality. Training and education are needed to help them understand how to use visualization effectively and exploit new methods of data analysis.

Our research finds that data governance is widely regarded as IT's responsibility; however, business users must share this responsibility.

In our report, TDWI Research advises that the best approach to expanding self-service visual analytics to more users will be balanced and well-managed, and include data governance. Our research finds that data governance is widely regarded as IT's responsibility; however, business users must share this responsibility if self-service is to avoid pitfalls such as inconsistent data security and quality as well as performance problems with data access and analysis. Good governance will be important as users begin to implement self-service data preparation and data blending technologies to access and integrate a wider variety of data.

Visual analytics can play an important role in other data-driven objectives such as identifying repeatable decisions that could be automated and enabling users to monitor, analyze, and continuously improve decision management processes. This report examines how visual analytics fits with this and other important goals and trends that are enabling organizations to realize higher value from their data.

Breaking Open the Potential of Data

A top priority in many organizations today is to enable their executives, managers, and employees to abandon uninformed guessing about what has happened and what to do next and move toward true data-driven decision making. Although many employees work with tools such as spreadsheets and IT-supplied business intelligence (BI) reporting applications, the tools plus surrounding people, processes, and data challenges have prevented many from attaining the flexibility and control they need to use data effectively to drive decisions. Today and increasingly in coming years, employees will demand easier means of engaging in broader and more frequent data analysis beyond what most of them can do with spreadsheets or with the periodic reports delivered through standard, one-size-fits-all BI applications developed by IT.

Users also need better ways to collaborate with their data than sharing spreadsheets or e-mailing reports to each other. To support collaborative decision making, users are seeking technology solutions that enable easier sharing of data insights so they can engage in data "storytelling": that is, explaining how data-driven conclusions were reached, what the trends show, and what decisions need to be made now. Most users are nontechnical business subject matter experts (SMEs) rather than data experts. To make their personal interaction with data and sharing of insights a routine part of their work they need software capabilities that require less special knowledge or the help of IT at every step.

To support collaborative decision making, users are seeking technology solutions that enable easier sharing of data insights so they can engage in data "storytelling."

Visual analytics, the primary focus of this TDWI Best Practices Report, is one of the hottest trends in BI today. The trend is fed by the demand for easier capabilities for nontechnical SMEs who analyze data more frequently and need better means of discovering and sharing data insights, all with less IT oversight. Visual analytics tools and applications offer graphical user interfaces that emphasize data exploration, search-based discovery, and analysis through drag-and-drop, point-and-click operations. Rather than in code or only in simple line and bar charts, these tools and applications present data in graphical form, such as dashboards. They provide users with libraries of possible formats and often the ability to use others developed externally by open source developers or data service providers.

Visual analytics builds on what has been accomplished with BI technology but adds innovations in visual data interaction and representation based on research into human perception and cognition. A key objective is to apply data visualization and new forms of computation to reduce the time it takes to interpret relevant data and perceive meaningful patterns, data relationships, structures, and outliers.

Accelerating toward User Self-Service

Visual analytics, which includes visual data discovery, is part of a larger trend in BI toward greater self-service data access and analysis from anywhere and at any time on any device. Many users are now accountable for numerous metrics about business performance, operational efficiency, and customer satisfaction. Users in marketing, product development, and other functions demanding constant innovation are growing more interested (if not more reliant) on data as a resource they can tap to uncover previously unknown trends, customer preferences, and competitive opportunities. It is not enough for these users to receive periodic reports that do not allow easy inquiry or multiple ways of viewing or interacting with the data more deeply. Users want tools and applications that let them personalize their data experience to fit their roles, responsibilities, and preferences, including on mobile devices while on the go.

Visual analytics, which includes visual data discovery, is part of a larger trend in BI toward greater self-service data access and analysis.

With self-service data discovery, users are involved in open-ended exploration and the end point or potential deliverable (such as a report or application) is unknown.

The self-service trend can conflict with IT in several ways. First, the trend may conflict with IT's project orientation, where requirements are carefully gathered and deliverables are well-defined for the IT developers. With self-service data discovery, users are involved in open-ended exploration and the end point or potential deliverable (such as a report or application) is unknown. Second, with users selecting their own tools, services, or applications—or at least playing a significant role in their selection—and having more control over data, confusion can mushroom about data definitions, data models, and metadata, all of which can complicate data integration, especially when compared to keeping all the data in a consolidated data warehouse.

The third area of conflict is data security and governance. IT has a traditional and vital role as guardian of data assets and how users access them. This role is even more critical as organizations amass customer behavior data and other sensitive information. Organizations need to secure this data from hackers and other threats, and they need to oversee how employees or external partners use and share it. Without centralized IT governance, each user may create a unique "version of the truth," making both collaboration and governance difficult (if not impossible). Many organizations are therefore pursuing a "managed" self-service or managed data discovery approach that takes a middle course between the extremes of total "Wild West" user freedom and locked-down IT restrictiveness that obstructs users' data needs.

Of course, visual analytics tools and applications are not all that users need for self-service data discovery and presentation. This TDWI Best Practices Report will discuss research findings about data preparation, cloud computing, and mobile BI and analytics. It will also examine how visual analytics fits with the common objective of integrating analytics and operations more tightly. At the leading edge in some industries, organizations are seeking to increase the speed with which analytics can be applied to business processes and operations, including through automation of decisions that respond to events. Visual analytics can enable operational managers and employees to see and interact with automated decision making ("decision management").

This report will discuss the results of an extensive research survey into visual analytics and related topics. It will provide best-practice recommendations to help organizations succeed with using visual analytics to improve users' ability to interact with and present data as part of collaborative decision making.

Current Satisfaction with Tools and Functionality

Penetration of BI tools into the entire user community has fallen far short of the "BI to the masses" dream that many vendors and user organizations share.

We begin our research study by setting a baseline understanding of what types of tools research participants are currently using and how often they are using them for major BI activities: data access, reporting, analysis, and presentation. BI tools are not universally implemented in organizations; in previous research, we found that the penetration of BI tools into the entire user community has fallen far short of the "BI to the masses" dream that many vendors and user organizations share about how widespread implementation could be. In our 2014 Best Practices Report, *Business-Driven BI and Analytics*, more than half (55%) of research participants said fewer than 30% of users in their organizations were working with BI and/or analytics tools, and 24% said less than 10% were working with them. One-quarter (25%) said that more than half of their organization's users were working with BI and/or analytics tools. These results were consistent with our research prior to the 2014 study.

We often hear anecdotally that "lots of users do BI" but with different tools from what the industry defines as BI tools. In particular, most often users are working with spreadsheet applications as the centerpiece of their data access, reporting, analysis, and presentation. Thus, for this report, we sought a comparative view of how often research participants use various software solutions for their standard BI activities. We found that although the majority of users do work with a BI tool or application (61% of research participants said they personally employ BI very often and 24% said somewhat often), just slightly fewer use a spreadsheet application (54% very often and 26% somewhat often). When the survey results are filtered to see just the responses of business sponsors or users, slightly more use spreadsheet applications than use BI tools or applications (58% very often and 26% somewhat often). Clearly, spreadsheets continue to be used commonly for BI activities.

Well below in usage percentages were the other software choices offered in the question. About one-quarter (24%) said they are using BI/analytics tools embedded in business application workflows rather than dedicated BI or analytics tools very often; 26% said they are using them somewhat often. About the same percentages held for those using desktop databases or business accounting tools, and smaller percentages are using homegrown tools or programs and mobile BI or dashboard applications. Interestingly, the percentages stayed about the same when we filtered the results for research participants in organizations with fewer than 1,000 employees (commonly regarded as small to midsize organizations); we had assumed that fewer would be using BI tools or applications.

Predefined query and reporting solutions offer greatest satisfaction. Probably the most common BI functionality is for predefined, "canned" query and reporting. These functions are carefully set up to perform reliably and deliver specified data, usually in a carefully specified format, although BI and visual analytics tools now give users greater flexibility in filtering and viewing results. TDWI Research finds that over three-quarters (79%) of research participants are satisfied with their ability to perform predefined query and reporting, with 30% very satisfied (see Figure 1). Participants are also fairly satisfied with ad hoc, on-the-fly query and reporting capabilities, which are critical to meeting data needs not addressed by predefined query and reporting; 69% are satisfied and 26% very satisfied.

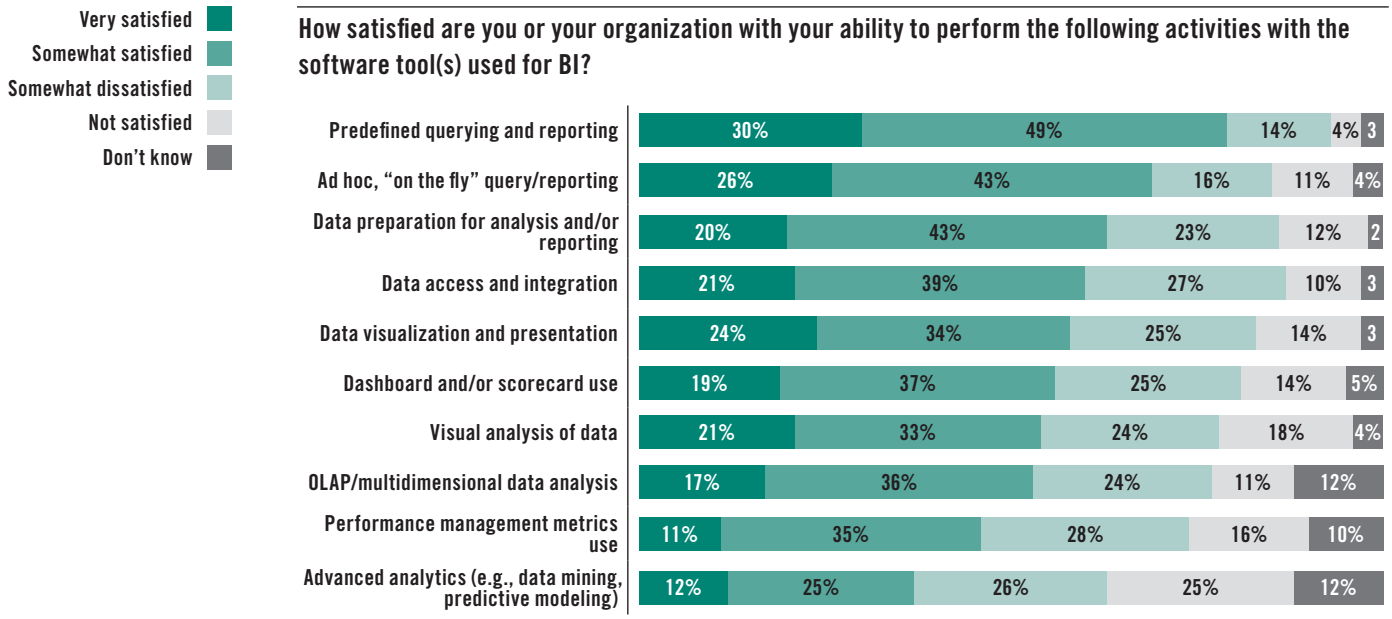


Figure 1. *Based on answers from 463 respondents.*

Somewhat fewer participants are satisfied with important functionality that visual analytics tools and applications address; 58% are satisfied with data visualization and presentation, with 24% very satisfied. About the same percentage is satisfied with their dashboard and/or scorecard use, and 19% are very satisfied. Slightly fewer respondents are positive about functionality for visual analysis of data. Primarily, this includes filtering, comparing, and data correlation functionality needed for engaging in analytical processes through visual representations. Research participants are least satisfied with their ability to perform advanced analytics such as data mining and predictive modeling with their software tools being used for BI; 26% are somewhat dissatisfied and 25% not satisfied. These results suggest that organizations are less mature with BI and analytics activities beyond reporting, and that heavy spreadsheet use may be holding back user satisfaction with data visualization and analytics.

Use of Cloud and SaaS Deployment Options

With cloud options, companies can focus on the business reasons for analytics rather than on configuring their data infrastructure.

Cloud computing and software as a service (SaaS) for BI, analytics, and data warehousing are maturing, giving organizations more options for servicing demand for BI and visual analytics. The options also give business functions choices for addressing growing demand for data without adding significantly to the IT function; this is particularly important for businesses that fear missing opportunities if they wait for on-premises systems to be built to handle their BI and analytics needs. With cloud options, companies can focus on the business reasons for analytics rather than on configuring their data infrastructure.

By far, the highest percentage of research participants say their BI and visual analytics tools and systems are currently deployed on premises (62%; see Figure 2). Just under one-quarter (23%) are deploying tools and systems on a private cloud running internally, usually inside the data center; 19% plan to do so. This mode ensures that IT personnel have control over resources and can manage data quality, security, and other matters in a traditional way. Only 10% currently employ an externally hosted platform as a service (PaaS).

How are BI and visual analytics tools and systems in your organization currently deployed and how is your organization planning to deploy them?

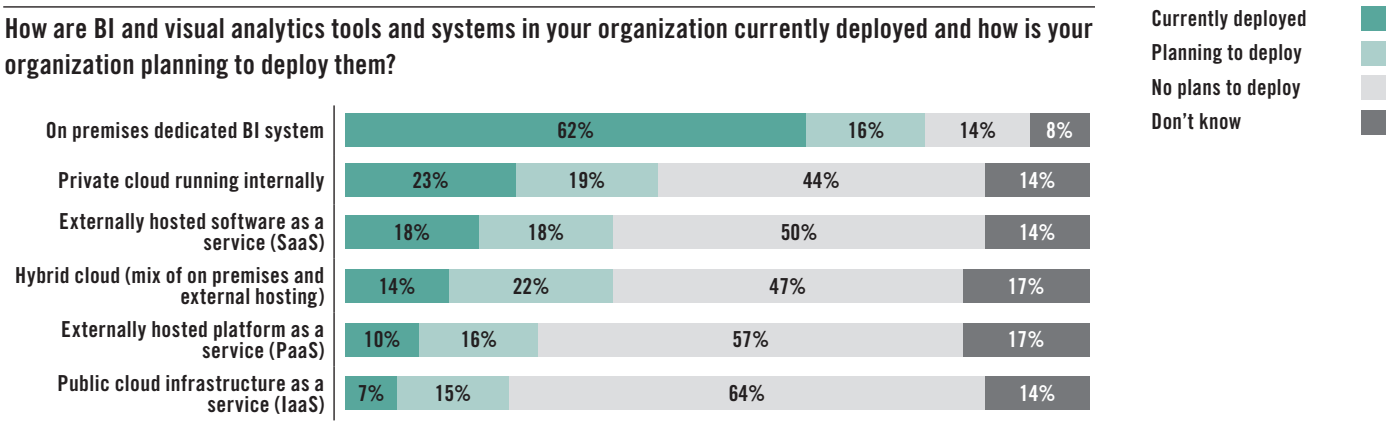


Figure 2. *Based on answers from 463 respondents who could select multiple answers.*

One option becoming popular in the marketplace is providing BI and analytics functionality via externally hosted SaaS. This approach is probably the simplest way of gaining BI and analytics functionality because it employs subscription licensing and does not require infrastructure because users typically access the services through a thin client on a Web browser. Our research finds SaaS is still in its early phase of adoption; just 18% of research participants' organizations are currently using this approach and only 18% plan to deploy it. When filtered exclusively for participants who are business users and sponsors, current deployment rises to 22% with 18% planning to deploy SaaS for BI and analytics. This suggests somewhat higher business-driven SaaS deployment.

Although the deployment of cloud and SaaS is not currently widespread among participants in our research, we find that they anticipate an increase in the next year. Nearly two-thirds (64%) said they expect that the number of users in their organizations working with BI or visual analytics tools and systems that are cloud-based or externally hosted will increase; 29% said they will stay the same.

Responsibility for Technology Selection and Maintenance

Our 2014 *Business-Driven BI and Analytics* Best Practices Report found that although IT is the lead sponsor for most BI and analytics projects, those on the business side are taking a more prominent role, including through allocating larger budgets for data-intensive projects. Business users want more data and more control over how they can access, analyze, present, and share it. In some organizations, business functions such as marketing, customer service, and e-commerce have substantial business, data analyst, and data science personnel reporting to their executives and managers. "Shadow IT" systems, both on premises and in the cloud, are cropping up in organizations as departments strike out on their own to supply data to their users, sometimes through use of SaaS or other externally hosted systems. It is within this larger trend that users are implementing easier-to-use, self-service visual analytics tools and applications.

"Shadow IT" systems, both on premises and in the cloud, are cropping up in organizations as departments strike out on their own to supply data to their users.

We wanted to learn whether IT alone, business management or users alone, or business and IT jointly are selecting the tools and applications organizations are using for BI activities (see Figure 3). We offered respondents two other choices as well—outside consultants and cloud/SaaS providers—but neither received many responses. Our research finds that for most front-end tools, business and IT work jointly to select technologies. For visual analytics or data discovery tools, for example, 54% of research participants said business and IT jointly select them for users, and 26% said business management or users select them. The percentages were similar for data visualization or dashboard tools. IT's role is larger with the more established BI/OLAP tools; 32% said IT selects them. However, 52% said they are selected jointly.

Who selects the following types of tools and applications that you and your organization use for BI activities?

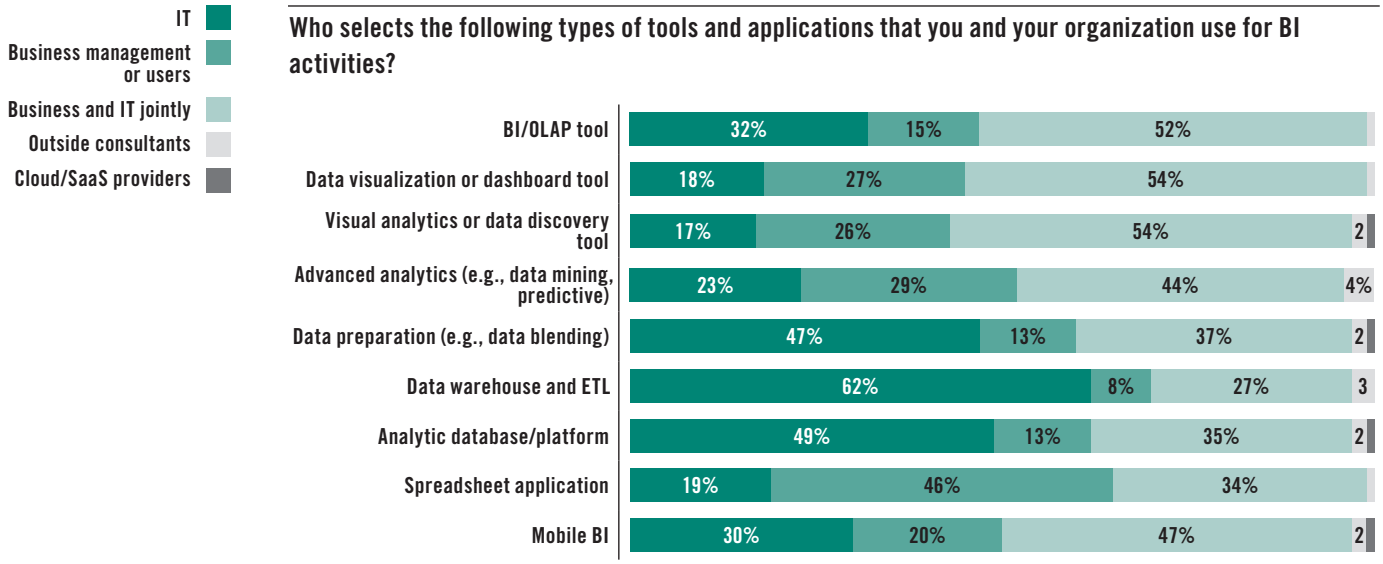


Figure 3. *Based on answers from 452 respondents who could select only one answer per row.*

Not surprisingly, IT is comparatively more dominant with systems that involve middleware and the back office. Almost two-thirds (62%) of research participants said IT selects data warehouse and ETL technologies in their organizations. Nearly half (49%) said IT selects analytic databases or platforms, although a healthy 35% said these systems are selected jointly by business and IT. IT's solo role appears to be smaller for advanced analytics (23%), not to mention spreadsheet applications (19%); in these areas, the business side's role is greater.

IT's role increases for tool implementation and maintenance. TDWI Research finds that once BI and analytics tools and applications are selected and it is time to implement and maintain them, IT's responsibility generally increases. IT involvement—and budget—can be critical if users want to scale up systems for more data, more users across more departments, and better performance. Almost two-thirds (63%) said IT alone is responsible for implementation and maintenance of BI/OLAP tools. More research participants said IT alone implements and maintains their organization's visual analytics or data discovery tools than do business and IT jointly (43% versus 33%; 20% said business management or users alone are responsible for this). Percentages were the same for data visualization and dashboard tools. More than half (55%) said IT is responsible for data preparation, with 29% saying business and IT are jointly responsible.

[1] See the TDWI Best Practices Report *Mobile BI and Analytics* by David Stodder, available at tdwi.org/bpreports.

BI and Visual Analytics on Mobile: Slight Growth

The popularity of mobile devices is having an impact on the BI and analytics world, but not yet overwhelmingly so. The largest percentage of research participants (42%) said that one-quarter or fewer of their organization's users are performing some or all of their work on mobile platforms, either natively or via the Web. Just over 1 in 10 (12%) said that over half of users in their organizations are doing so. These results show just a slight increase in the number of users performing BI and analytics on mobile devices since our 2012 Best Practices Report research.[1]

Nonetheless, about half (51%) of research participants said they expect that users in their organizations will spend more time implementing or accessing BI and visual analytics applications on their mobile devices in the next year, with one-third (33%) indicating no change. Expectations have cooled somewhat since our 2012 report, however; then, 61% said they expected that users would spend more time implementing BI and analytics on mobile devices. Organizations have likely become more aware of the security and governance challenges that must be met before mobile BI and analytics can become more widespread.

About half of research participants expect users in their organizations to spend more time implementing or accessing BI and visual analytics applications on their mobile devices in the next year.

USER STORY MUELLER DELIVERS RELEVANT INFORMATION TO KEEP EMPLOYEES IN THE KNOW.

Mueller, Inc., a long-established manufacturer and reseller of pre-engineered metal buildings and metal roofing products, prides itself on being smart, lean, and coordinated. To communicate strategy and inform employees about what needs to be done to drive top- and bottom-line growth, Mueller implements the Balanced Scorecard strategic planning and management system with key performance indicators (KPIs). Balanced Scorecard plus a recent migration to a new ERP platform have helped Mueller enhance efficiency and coordination for its sales, manufacturing, and distribution processes. Increased customer satisfaction and improvements in product manufacturing and delivery have resulted.

Critical to the development and deployment of KPIs are self-service BI and analytics tools and dashboards, which have helped turn the metrics into actionable information by enabling employees to drill down into the data behind the metrics and see more than one perspective. "Self-service tools allow us to take different pieces of data from different sources that we're trying to analyze and put them together without being confined to defined elements and just one particular data model," said Mark Lack, manager of strategy analytics and business intelligence at Mueller. The company's ERP platform provides the lion's share of transactional and operational data, but non-ERP data drawn from call center volume, website activity, safety information, and system uptime are becoming more important parts of the mix to deliver comprehensive views.

Mueller is using IBM Business Analytics tools and platforms, which enable the company to automate time-consuming tasks of integrating and curating the data and distributing information visually so that everyone can see items such as sales revenue numbers, manufacturing performance, and, more important, how performance in different processes are related. "Everybody is on the same page, working together," said Lack. "An employee working on the line doesn't need to see the 3,000 transactions he was part of yesterday; that's not going to tell him any information. However, if he can see in some of the transactions where he might have had a higher level of scrap material than was expected, he and management know right then and there to investigate the problem and correct it. We can also use the system to communicate that we're doing a lot better than we thought we'd be doing, and so good job, everybody."

Driving Visual Analytics Expansion: Benefits and Growth

Delivering executive management insight is the most important business benefit sought from BI and visual analytics tools and applications, according to our research (see Figure 4). Visual analytics in particular can improve executives' ability (not to mention the abilities of line-of-business [LOB] and business function managers) to explore and customize views of data through visualizations appropriate to their analytical process. If the tool or application can support self-service analytics, executives and managers can explore data and form insights without waiting for IT development. Executives and LOB managers have historically been primarily consumers of information; our research has shown that they do not commonly develop and deploy their own visualizations. However, visual analytics tools can enable them to do so without having to first gather substantial development experience or deep knowledge about data structures.

If the tool or application can support self-service analytics, executives and managers can explore data and form insights without waiting for IT development.

In Figure 4, the second-most commonly cited business benefit by research participants is operational efficiency. LOB managers and other users responsible for operational performance need easy interaction with information to diagnose the root cause of a situation and determine what changes need to be made, often in near real time, so they can improve performance or address a customer concern, for example. Dashboards are important for consolidating information, including reports, scorecards, KPIs, graphs, and even collaborative applications such as texting and social media.

Smarter finance, budgeting, and forecasting forms the third most commonly cited business benefit, as shown in Figure 4. Chief financial officers (CFOs) and other finance managers need to perform sophisticated analytics to answer what-if questions, play with the data to see the impact of possible changes, and build (and share) scenarios. Self-service visual analytics tools can help them perform more types of analytics on their own than has been possible with BI/OLAP systems that often demand more data expertise than they have.

What are the most important business benefits that you and your organization seek to achieve through use of BI and visual analytics?

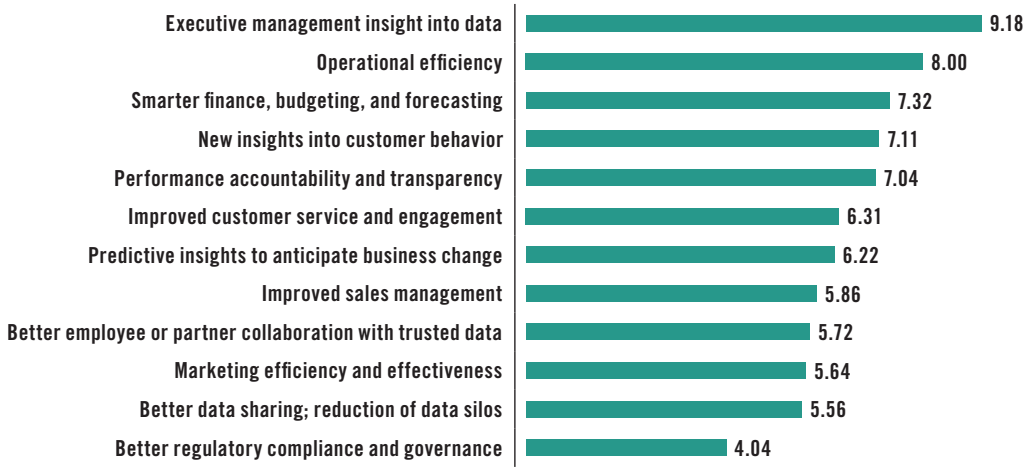


Figure 4. *Based on answers from 402 respondents who were asked to rank selections in order of importance. Weighted averages shown in order from highest to lowest.*

The fourth-ranked benefit is gaining new insights into customer behavior. Tapping the full potential of customer data inside and outside an organization in social media, for example, is critical to achieving higher efficiency and effectiveness in marketing, customer service, and customer engagement. Using visual analytics to increase customer insight is important to users across the spectrum, from executives to frontline sales, service, and contact center employees who work directly with customers. The ranking of the other potential business benefits is shown in Figure 4.

To gain the most value from introducing visual analytics, a best practice is to consider how users are currently consuming and interacting with data and sharing insights with others to meet the specialized needs of their business function. After studying their current behavior and usage patterns and identifying needs, business and IT personnel together should evaluate what users could do in a self-service fashion, without extensive IT support, to achieve their needs for data analysis, presentation, and sharing. Together they can select and test technologies that offer the visual analytics functionality relevant to users' roles, responsibilities, and interests.

A best practice is to consider how users are currently consuming and interacting with data and sharing insights with others to meet the specialized needs of their business function.

USER STORY HELZBERG DIAMONDS CLEANS UP DATA CHAOS AND IMPROVES OPERATIONS.

Operational excellence is critical for all organizations, but particularly for midsize companies competing in a marketplace that includes large competitors with comparatively more resources. Data chaos is a barrier to operational excellence. Operational managers need a constant flow of timely, quality data that is relevant and easy to consume so they can meet responsibilities and innovate to improve processes and satisfy customers.

Fine jewelry retailer Helzberg Diamonds, a subsidiary of Berkshire Hathaway, is reaping the benefits of a strategic move away from spreadsheets and older, disparate reports to an operational BI implementation supported by an enterprise business data model and a dedicated data warehousing infrastructure. "Initially, we had spreadsheets all over the place, which is a little like herding cats," said Greg Backhus, director of data warehousing and BI at Helzberg Diamonds. The company is implementing Information Builders' WebFOCUS. "We have eliminated a lot of spreadsheets, but at the same time, we have embraced [Microsoft] Excel as an output format; we now know that users' spreadsheets are sourcing consistent, current data refreshed via WebFOCUS and based off of the data framework we want them to be based off of."

Even more significant, however, is that Helzberg Diamonds is increasingly providing operational managers with intra-day updates from its point-of-sale systems and other operational sources. The company uses dashboards widely, with different levels of self-service applications that use interactive tabs to provide users with a combination of ad hoc querying and subscription-based access to a library of parameterized reports. "The company doesn't want us to just create scoreboards that everyone is just sitting around watching," Backhus said. "We want users to be able to dig into their numbers quickly and get on down the road to what they need to do."

Backhus said the company has been working intensely to implement a "bring your own device" mobile strategy, taking time to fully address security concerns. "I think we're about past that and are now ready to focus on exposing dashboards to mobile devices and rolling out applications within the WebFOCUS framework that can access operational data in real time."

BI and Visual Analytics Growth Paths

New technologies such as self-service visual analytics tools and applications take many different routes to their introduction into organizations. How new technologies enter an organization can determine who ultimately uses them, to which parts of the organization they spread, and whether they present IT with management challenges in terms of data quality, integration, security, and governance. With the potential business benefits sought by research participants' organizations in mind from our preceding discussion, this section offers a sense of whether and how the use of BI and visual analytics tools is expanding.

How new technologies enter an organization can determine who ultimately uses them, to which parts of the organization they spread, and whether they present IT with management challenges.

TDWI Research asked participants to rate the accuracy of the following statements that describe how BI and/or visual analytics use might be expanding inside their organizations:

- **"IT manages the expansion of our enterprise BI platform to more users as budget and platform capabilities allow."** This statement proved to be the most accurate in reflecting the approach taken by our research participants' organizations. About one-third (34%) said this statement describes the way BI and/or visual analytics expand in their organization accurately; 43% said it was somewhat accurate. Only 18% said it was not accurate (5% didn't know).
- **"IT manages deployment of tools requested by users on a case-by-case basis to meet business needs."** With this approach, IT responds to business needs by providing tools, but the organization may lack a comprehensive strategy. The breakout of research participants' responses was similar to the statement above; 29% called this statement very accurate and 48% said it was somewhat accurate in describing how BI and/or visual analytics expand.
- **"Business users select and deploy tools on their own, without IT involvement."** Under half (44%) of research participants indicated this statement, representing the most decentralized approach, accurately reflected the way their organization expands BI and/or analytics technologies, with 8% saying it is very accurate. However, 52% said it was not accurate (4% didn't know). Our research finds that the percentages are not much different in organizations with fewer than 1,000 employees.
- **"Technologies 'land and expand' at our company; users adopt a tool and then its use spreads to other departments."** Leading vendors of data discovery tools have had success by "landing" with the sales of their technology in a business function or with a select group of users rather than approaching IT first, and from there selling its expanded use into other business functions in the organization. Over half (56%) said this accurately represents how BI and/or visual analytics tools expand in their organizations, with 11% saying it is very accurate; 38% said it was not accurate (6% didn't know).
- **"Users first select cloud-based or externally hosted tools; the organization will determine later whether to move them on premises or not."** The majority of research participants (64%) said a cloud-first strategy is not how BI and/or visual analytics technology expand in their organizations; just 23% said this was an accurate statement (13% didn't know).
- **"Users select tools to explore data and build prototypes; IT or consulting developers then build production applications to support more users and data."** Our anecdotal research finds that this approach is popular as a way of giving users freedom to do data discovery and experiment with BI and/or visual analytics tools before IT builds the formal applications. Just over half (53%) of research participants said this statement accurately reflects their approach, with 10% saying it is very accurate (39% said it was not accurate and 8% didn't know).

- **"We have developers who work with open source technologies to build BI and visual analytics applications for business users."** Open source is becoming a greater presence, especially with the rising popularity of the Apache Hadoop ecosystem. However, some firms still forbid open source technologies or are reluctant to work with them due mainly to security and governance concerns, plus a "not-invented-here" bias against them. Fewer than half (44%) of research participants said this statement was accurate for their organization (12% said it was very accurate), but 46% said it was not accurate (10% didn't know).
- **"New tools and applications mostly come into our organization through mergers and acquisitions; IT must either support the tools or move users to our enterprise tools."** This statement expresses perhaps more of the reality of how technologies are introduced than a formulated strategy. Over a quarter (28%) of research participants said this statement accurately reflected how BI and/or visual analytics technology expand in their organizations. Just over 6 in 10 respondents (61%) said it did not (11% didn't know).

In sum, our research tells us that if an organization has an enterprise BI platform managed by IT, its most common mode of expansion in BI and/or analytics tool use is through growth in that platform under IT's guidance as budget and platform capabilities allow. We can see above that nearly as many research participants indicate that IT is responsive to business users and will deploy tools as requested on a case-by-case basis. However, our research shows the impact of the "land and expand" strategy, which is how much of the use of newer visual analytics and data discovery tools has spread, sometimes dramatically.

USER STORY WATTS WATER SPEEDS FLOW OF DATA TO USERS FOR VISUAL ANALYTICS INNOVATION.

Using data analysis to sustain business growth can be a challenge as a company's brands multiply and it engages customers across a widening variety of sales channels. North Andover, Mass.-based Watts Water Technologies, Inc., which started in 1874 as a small machine shop, is now a global provider of plumbing, heating, and water-quality solutions. In its primary wholesale channel, the company has over 10 brands and about 100,000 SKUs that are distributed in the market by 45 agents, according to Kris Munson, director of pricing at Watts Water Technologies. The company's enterprise resource planning (ERP) and other data systems service about 25 million transactions a year. "You start trying to line that up for reporting and analysis and that's a whole lot of data points to try and manage," Munson said.

Watts Water's users have been relying on classic BI tools with IT-developed reports as well as heavy use of Microsoft Excel spreadsheets for data analysis. As is typical in many firms, with this mode, users have had to wait for IT to find system time to run usually several different types of reports because each provides only a portion of the data. "Three hours later, if someone wants a different time range, you have to do the whole process over again," said Munson. As a result, confusion about data lineage can arise when users share reports and spreadsheets. "If someone hard codes something in the ERP for the report or decides to exclude all sales from particular sales channel, you might never know."

About three years ago, Munson was introduced to Tableau Software's data visualization technology through its embedded use in Zilliant's predictive selling application. He soon began to apply Tableau for other purposes, producing visualizations that drew the attention of Watts Water executives and kept them coming back to him for more.

Expansion in Tableau use caused IT concerns about data lineage and control. Munson, however, has allayed many IT fears by setting up a Tableau server to reduce data confusion; plus, IT still maintains control of data. Along with demonstrating to IT that he can track data lineage even more effectively, Munson has helped IT shield the data warehouse by using the server as "our pseudo master data management" system. "We didn't want to turn 15 product managers into 15 people who are not data people connecting to our data warehouse and pounding on it in ways it was not designed for," Munson said. He and his senior analysts can control what goes on the server and who can access which instances. "Once users have something useful for the entire audience, we look it over and make sure everything is done right. We then put it in the production folder where everyone can start using it."

At first timid about using a self-service visual analytics tool, many users are growing bolder. "We tell them to go in and play around; you're not going to break anything. The worst that can happen is that you make a visualization nobody likes, but it's easy to clear the worksheet and start over." Now, users are able to innovate about company strategies through better visualization and more comprehensive views of the data.

[2] From third quarter 2013, available at tdwi.org/bpreports.

User Experiences with Visual Analytics

Users are growing more satisfied with their ability to use tools to view, interact with, and share data insights effectively to support business decision making, according to TDWI Research. Two years ago in our survey for the TDWI Best Practices Report, *Data Visualization and Discovery for Better Business Decisions*,[2] research participants said 39% of users in their organizations were satisfied, with only 7% very satisfied. The results in this report show improvement; 52% said that they and their users are satisfied, with 14% very satisfied. Only 16% are not satisfied.

Exploring user experiences more deeply, we asked research participants how successful they and users in their organizations are with using tools to visually interact with data in a variety of important ways (see Figure 5). Overall, research participants report that users are most successful using tools to build dashboards or scorecards (70% successful, with 23% very successful) and filtering data dynamically (70% successful, with 30% very successful). Participants indicate about the same level of user success with editing existing views and charts (69% successful, with 23% very successful). These results show that users are growing more adept at working with dashboards and visual interfaces to tailor views of data and manipulate how data is represented in charts.

How successful are you and users in your organization with the ability to use tools to visually interact with data in the following ways?

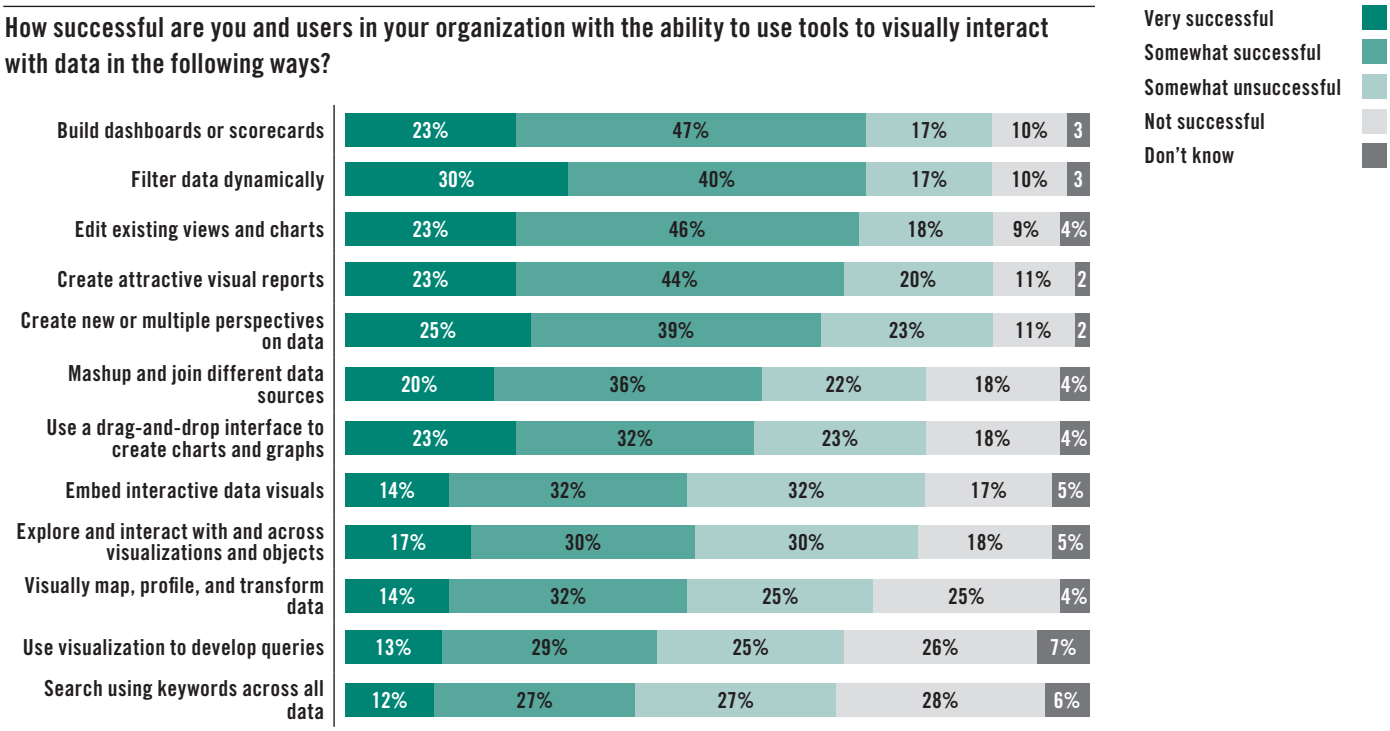


Figure 5. *Based on answers from 378 respondents who could select only one answer per row.*

Users need help in employing search capabilities in BI and visual analytics. Search-based data discovery is an important emerging technology. Such tools enable users to access and model data from multiple sources without requiring traditional BI metadata or relying on pre-built summaries, aggregates, and pre-calculations. Research participants report that users are thus far less successful in employing search using indexing and keywords across all data, which is often important for search-based data discovery in multi-structured data (39% successful and 55% unsuccessful).

In a later question, we asked further about what types of search-oriented data exploration capabilities are most important to have as part of BI and visual analytics tools. The largest share of research participants said that search to explore BI reports and tables was important (81% overall, with 41% indicating it was very important). Participants also found the ability to index new data or content to be important (65% overall, with 26% indicating it was very important) as well as to index business application data (64% important overall, with 25% indicating it was very important). Less important, interestingly, was having the search capability to explore unstructured data in Hadoop files (39% important overall, with 17% indicating it was very important); despite the buzz about Hadoop, many organizations have little if any, data in Hadoop files and therefore have no urgency for tool capabilities to search Hadoop files.

Not all tools provide an "immersive" user experience that makes it unnecessary to drop out of visualizations such as heat maps or other charts to go to a query interface to compose a query.

The "immersive" user experience remains elusive. Participants report that their users are not as successful with using visualization to develop queries (42% successful and 50% unsuccessful). Not all tools provide an "immersive" user experience that makes it unnecessary to drop out of visualizations such as heat maps or other charts to go to a query interface to compose a query. Constantly having to switch from visualizations to query interfaces can be a point of frustration for users. Finally, research participants report that users are not fully successful with performing data preparation steps with their tools, in particular to visually map, profile, and transform data (46% successful and 50% unsuccessful). More visual analytics tools and applications are beginning to include data preparation capabilities of their own or through partnerships with other technology providers.

USER STORY SELF-SERVICE VISUAL DATA DISCOVERY IMPROVES COLLABORATION AT SWISSCOM.

One of the primary drivers behind growing interest in visual BI and analytics is the promise of easier sharing of insights and collaboration on data. Users want more flexibility than traditional BI tools allow so they can create their own dashboards and publish them as they see fit for colleagues to access. Users can come together for more data-driven decisions. Swisscom's users sought to realize this opportunity when the company asked the SAP Business Process Solutions & Services consulting group working within the firm to launch a project featuring Lumira, SAP's self-service visual data discovery tool.

Most of the consulting group's customers at Swisscom have been using SAP Business Warehouse (BW) with spreadsheets or traditional BI query and reporting tools as front ends, said Matthias Mohler, BI consultant with the SAP consulting group at Swisscom. The users backing the consulting group's Lumira project are responsible for Swisscom's real estate management; they need to analyze a mixture of internal and external data from third-party business partners and suppliers contracted to perform facilities management, asset and equipment maintenance, and more. Users needed to establish KPIs and wanted an easier way to interact with data and keep everyone informed about KPI status. "They want to find out where we have high costs," said Mohler. "They also need to compare the monthly vacancy rate because this is a cost driver; they want to see how they can increase the share of buildings they can rent out."

Users, some of whom were former controllers, had been attempting to track the KPIs with spreadsheets but were frustrated with the lack of data interaction and challenges regarding collaboration and sharing, which are made easier with the visual data discovery tool approach. They also appreciate being able to do some data enrichment on their own, although most data preparation is still done by the consulting group's experienced data analysts and managers. Although Mohler acknowledged that the most difficult challenges with the project involve what's behind the visualizations—that is, the integration, data quality remediation, and preparation of the data—"users can now share and collaborate with data more than they could before."

Visual Interaction with Diverse Data Sources

As self-service visual analytics and data discovery expands across an organization, a greater variety of users will need to access a greater variety of data. Sources that are important for customer intelligence and tracking operational efficiency are often less structured than transactional or business data needed for cost management or other more traditional BI demands. Thus, organizations need to develop a strategy for enabling users to access and analyze a broader selection of data.

TDWI asked research participants how successful users in their organizations are in using their chosen tool's visual interaction capabilities to access and analyze a variety of important data sources (see Figure 6). Not surprisingly, participants said they and users in their organizations are most successful accessing and analyzing spreadsheet data (81% successful, with 44% very successful). Spreadsheets are often the first and most-available data source for users when they implement visual analytics and data discovery tools; many are seeking precisely better visualization and data interaction with spreadsheet data so they can perform more types of analysis with less custom coding.

How successful are you and users in your organization with the ability to use your tool's visual interaction capabilities to access and analyze the following data sources?

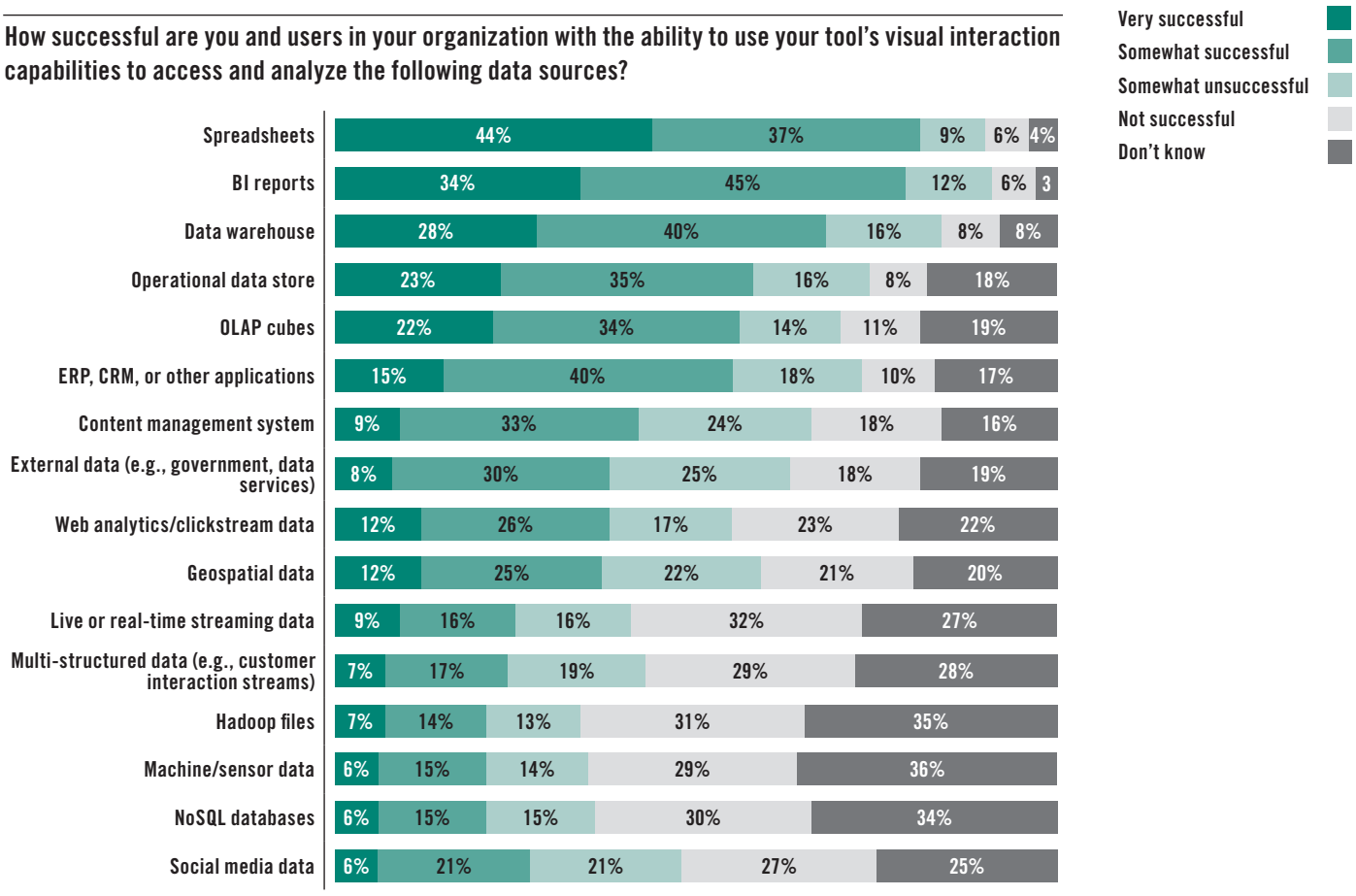


Figure 6. *Based on answers from 374 respondents.*

Research participants indicated that users are almost as successful in accessing and analyzing data in BI reports (79% successful, with 34% very successful). They also indicated that users have fairly good success with data held in the data warehouse (68% successful, with 28% very successful). Moving beyond these traditional sources, our research finds that users are having less success—keeping in mind that not all of these sources are important to all research participants' users (hence the higher "don't know" percentages for some of the less traditional sources). For example, 37% said their users are successful (with just 12% very successful) accessing and analyzing geospatial data, which is rising in importance as a data source for marketing, sales, customer service, and strategic planning.

Newer sources appear to be harder for users in research participants' organizations to access and analyze. Just 21% said they are seeing success in analyzing data in Hadoop files (7% very successful). Slightly more (24%) are successful in accessing and analyzing multi-structured data such as customer interaction streams (7% very successful).

Contribution of In-Memory Computing

One of the most important technology innovations for analytics is the adoption of in-memory computing, which exploits more random access memory (RAM) space for holding data and performing analytic operations. In-memory computing is frequently paired with compression technology to allow for even more data to be packed into RAM so users can perform compute-intensive analysis against large volumes of data. In-memory computing is not necessary or appropriate for all uses of visual analytics, but it can be important for many kinds of activities.

In-memory computing fits well with demands for "speed-of-thought" analysis and flexible, iterative styles of inquiry against more than just samples or summaries of data.

Analytics can suffer if there are delays and IT administration overhead associated with having to constantly read data from tables stored on disk. In-memory computing can bypass the disk I/O bottleneck and reduce the need to preprocess the data into OLAP cubes or other stores, which is how administrators typically try to reduce disk access. In-memory computing therefore fits well with demands for "speed-of-thought" analysis and flexible, iterative styles of inquiry against more than just samples or summaries of data. Organizations can use in-memory analytics engines to scale not only for faster analytic operations against potentially millions of rows of data but also to support larger numbers of users.

Most business users may be unaware of whether their tool or application is using in-memory computing because the technology is operating behind the visual interface. However, they could experience improved performance from in-memory processing because producing seemingly simple graphics such as box plots or histograms can require crunching through millions or even billions of rows of data. When users click on box-plot graphics to compare different sets of data to identify outliers, for example, the analytic engine has to calculate different levels of information on the fly. In-memory processing enables analytic engines to meet such speed-to-insight requirements.

TDWI Research asked research participants about whether various visual analytics activities are performed primarily in memory rather than on physical disk (see Figure 7). Although a significant number of those who identified themselves as business executives, sponsors, and users did not know, the responses of business and IT participants overall give us a sense of where tools that exploit in-memory processing are being used or are planned to be used.

Which of the following activities are users in your organization currently performing with BI and visual analytics tools primarily in memory rather than on physical disk?

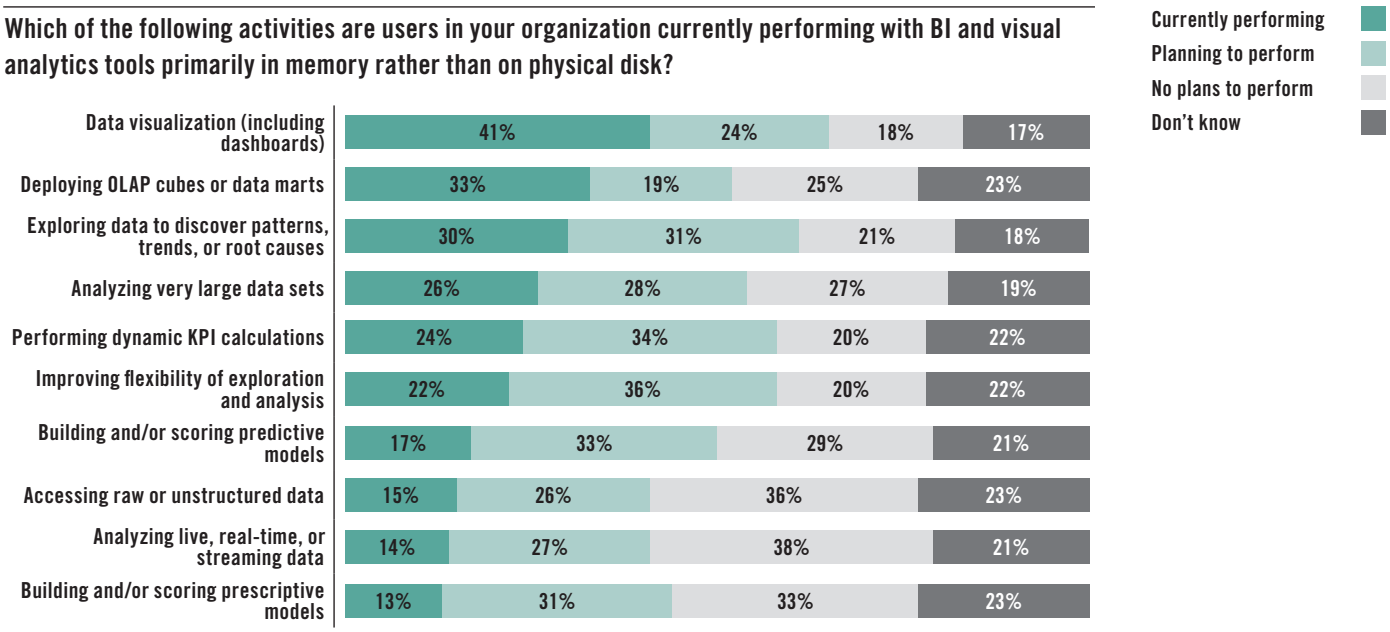


Figure 7. *Based on answers from 322 respondents.*

The highest percentage of participants (41%) indicated they are using in-memory technologies for data visualization, including dashboards; 24% are planning to do so. One-third (33%) are deploying OLAP cubes or data marts in memory, and 19% plan to do so. Nearly as many (30%) are currently using in-memory computing to explore data to discover patterns, trends, or root causes, all of which are common use cases for visual analytics and data discovery; 31% are planning to do so. The fewest research participants are currently employing in-memory computing for more advanced analytics, such as building and/or scoring prescriptive models (13%) but a significant percentage plan to do so (31%).

USER STORY UHC APPLIES VISUAL ANALYTICS AND IN-MEMORY COMPUTING FOR GREATER AGILITY AND SPEED

Ravi Shanbhag, director of data science at UnitedHealth Group, has sage advice for those seeking to harness the potential of visual analytics tools. "You can't expect a tool to solve every problem; you've got to know what you want to do and the appropriate use case. That's a good thing, because you will be giving the project a lot of thought and asking yourself good questions up front before diving in."

Shanbhag serves as chief architect of the advanced analytics platform at UnitedHealthcare (UHC) Finance, providing technical and strategic leadership for applying analytics to solve a variety of challenges involving Medicare, Medicaid, and commercial businesses. A health benefits provider serving more than 45 million people, UHC is an operating division of UnitedHealth Group, the global provider of health management, care delivery, and healthcare technology services. Needless to say, UHC and its parent company are awash in massive volumes of both structured and unstructured data that hold tremendous potential for analytic exploration and research.

UnitedHealth has been implementing SAS tools and applications for some time for statistical analysis, data manipulation, and predictive modeling. It has in recent years expanded its data environment to include Hadoop and NoSQL data stores, broadening the types of data accessible for a greater spectrum of analytic processes aimed at identifying fraud and risk exposure, managing costs, learning customer sentiment and improving their experiences, and more. UHC developed a data framework to integrate data from SAS and other stores and perform query processing, statistical analysis, and modeling on the most appropriate platforms.

UHC has deployed SAS Visual Analytics, lifting data from all these sources directly into the underlying in-memory SAS LASR Analytic Server so business users, not just data scientists, can perform their "data jujitsu" manipulation faster, Shanbhag said. "Unlike with static BI reporting, most analytics involves working with lots of data with many attributes and dimensions. We need to avoid I/O and use the power of in memory to iterate really fast through this data. Speed equates to time, and time is money." Shanbhag said UHC has succeeded by ensuring that the memory space is not just a data dump. "You can't just shove any data in there and expect magic. You have to cleanse your data and do enough data preparation so you can build analytic value from it."

Data Preparation: Moving toward Self-Service

Users need technologies that are more geared to ad hoc, on-the-fly data integration, transformation, quality improvement, and other preparation for analytics activities.

As mentioned earlier, one of the hot trends in the industry is the technology evolution toward self-service data preparation, including data blending, data wrangling, and data munging. These terms variously describe steps for easier and faster data preparation and integration of a wider range of data sources, usually through automated processes driven by advanced analytics such as machine learning to sharpen the software's knowledge of data sources, data relationships, and user preferences.

This trend is important because organizations increasingly need to support a wider spectrum of user requirements for accessing and analyzing a wider spectrum of data. Users need technologies that are more geared to ad hoc, on-the-fly data integration, transformation, quality improvement, and other preparation for analytics activities (such as blending internal and external data to gain insights into competitive pricing). Both inexperienced and expert analysts today increasingly want to blend views of disparate data types including geospatial, text, and demographic data with their more traditionally structured transactional data. In addition, some organizations need to access and analyze data in the growing "data lake" stored in Hadoop clusters. Organizations need tools that are geared to the schema-on-read data analysis of Hadoop files, where schema, transformation, and other steps are applied to data when it is accessed and analyzed rather than as it enters the systems, as is typical with traditional BI and data warehousing systems.

Nearly half (48%) of research participants said it is very important that they and users in their organizations be able to ingest and prepare data for visual analysis in a self-service fashion without IT involvement, and 36% said it was somewhat important (13% said it was not important and 3% said they didn't know).

We asked research participants which of a series of data preparation steps are currently undertaken by IT or in a self-service fashion by users in their organizations (see Figure 8). The survey results indicate that users have the greatest self-service role in moving or replicating data onto a desktop (52%, with 30% saying it is undertaken by IT). This is probably the most basic step in self-service data preparation: simply grabbing data and moving or replicating it into a spreadsheet or tool for reporting and analysis.

To prepare data for visual analytics, which of the following steps are currently undertaken by IT or in a self-service fashion by users?

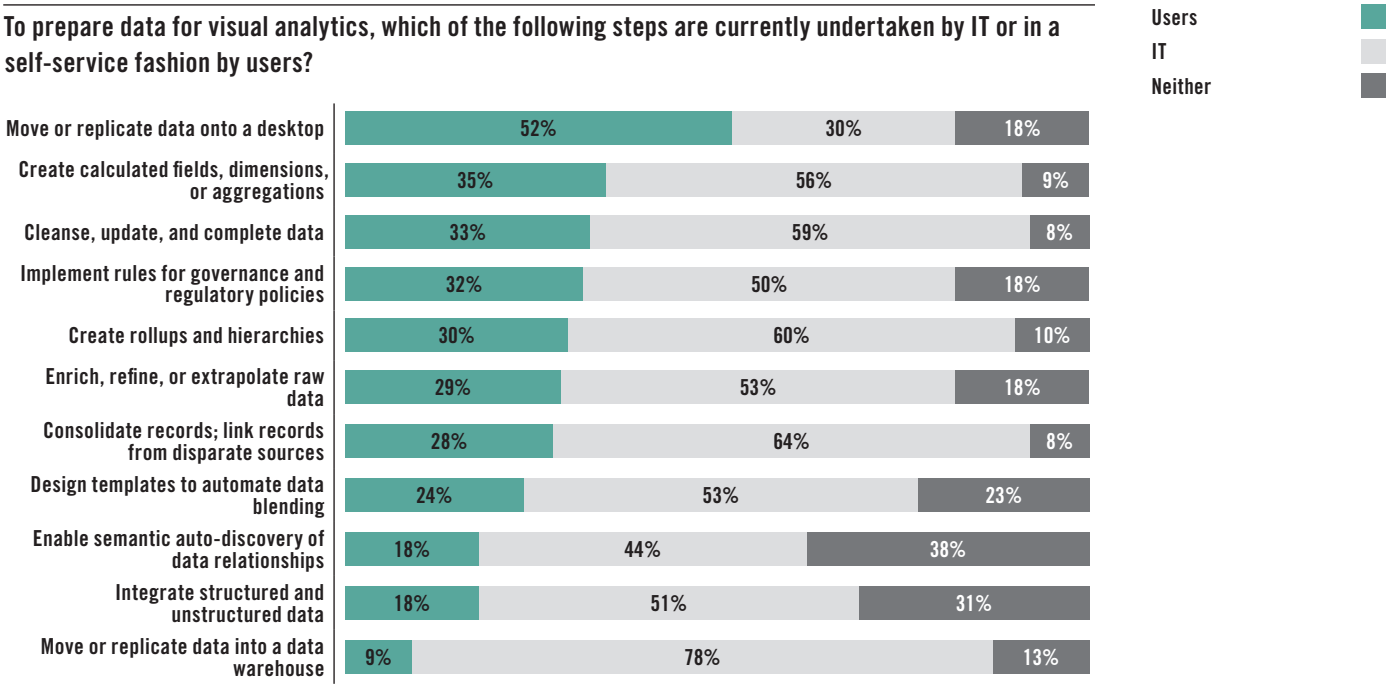


Figure 8. *Based on answers from 348 respondents. Shown in order of highest to lowest level of user self-service.*

Over one-third (35%) of research participants said users are creating calculated fields, dimensions, or aggregations themselves, and 56% said IT undertakes these steps. These are core steps for BI/OLAP analysis, which in many organizations is traditionally performed by IT or users and IT together. However, many visual analytics tools are enabling these activities as well but with an emphasis on making them self-service. One-third (33%) of research participants also said users can take steps to cleanse, update, and complete data in a self-service fashion; these are some of the steps targeted by providers of self-service data preparation tools (59% said IT undertakes these steps).

Research participants indicated that most users cannot integrate structured and unstructured data in a self-service fashion. About one-quarter (24%) can design templates to automate data blending, and somewhat more (29%) can enrich, refine, or extrapolate raw data on their own. These steps are important for users to derive value from raw data sources that are stored in Hadoop files. We can infer by the sizeable percentages of research participants choosing "neither" for some of the steps that many organizations have not yet undertaken them, perhaps because they are not relevant.

Research participants indicated that most users cannot integrate structured and unstructured data in a self-service fashion.

Hadoop and NoSQL Data Sources: Moderate Interest

Despite the industry hype about Hadoop, our research finds that overall, although there is interest in accessing Hadoop data sources and/or NoSQL databases (such as key value store or graph databases) for BI and visual analytics, it is not overwhelming. Half (50%) of research participants said their organizations' users are interested, with 15% indicating that they are much more interested than they were a year ago. About one-quarter (26%) said their users are not interested.

To gain a deeper understanding of the current situation with Hadoop and NoSQL data sources, we asked research participants what they regarded as the most significant barriers to users' ability to access and analyze data from these sources with their BI and visual analytics tools (see Figure 9). Beyond the fact that many lack Hadoop or NoSQL data sources (54%), the top reason indicated by research participants is that training and expertise are lacking (46%). This is a common problem when new technologies are introduced and tooling is not available to let business and IT professionals work at a higher level. Being able to identify the business case is also critical to driving sponsorship; 38% said difficulty in this area is a barrier. Interestingly, only 8% of research participants said opposition from their IT leadership team is a barrier.

In your organization, which of the following factors are barriers to users' ability to access and analyze Hadoop or NoSQL data sources with their BI and visual analytics tools?

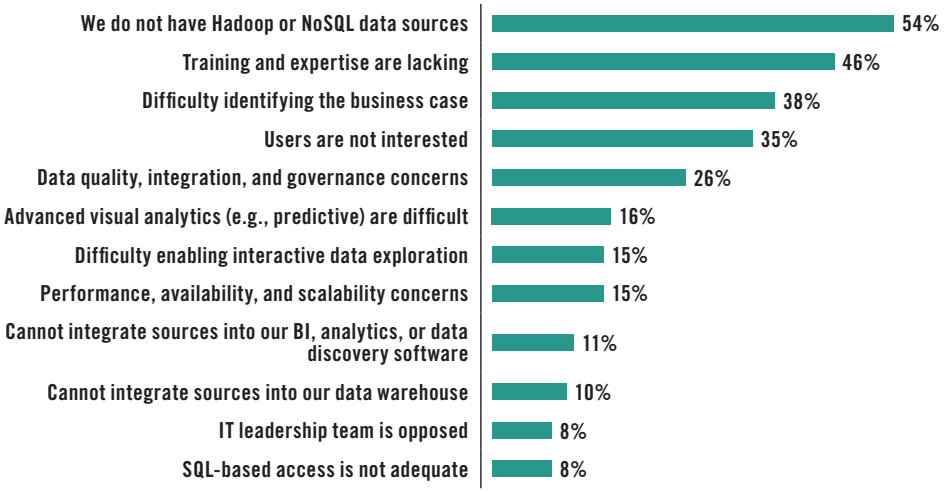


Figure 9. *Based on answers from 338 respondents who could select more than one answer.*

Data Interaction and Collaboration

Business users are drawn to visual analytics and data discovery tools and applications because these tools offer broader opportunities to interact with data and perform and present analytics results to colleagues in ways that might have previously required advanced programming knowledge. Business users responsible for identifying competitive advantages, creating strategies for improving operational efficiency, detecting fraud, and spotting untapped market segments need easier and more advanced ways to analyze data. Software tools can provide nontechnical users with a means of engaging in predictive, prescriptive, descriptive, or diagnostic analyses through easy-to-use, graphical interfaces. Working with visual items rather than code, users can drag and drop items, measures, or variables they want to apply.

Research participants indicated the greatest success with traditional BI/OLAP drilling down and data slicing and dicing.

Our study examined the success with which research participants and users in their organizations use visual analytics to perform a range of activities via their chosen tools (see Figure 10). Research participants indicated the greatest success with traditional BI/OLAP drilling down and data slicing and dicing (71% successful, with 35% very successful). A strong percentage also noted success in identifying data patterns and trends (64%, with 22% very successful) and ad hoc visual data discovery (61% successful, with 23% very successful)—both of which are defining activities in self-service data exploration.

A little over half (53%) of participants said they and users in their organizations have success in showing data relationships (16% very successful); 47% noted success in using heat maps to show insights (20% very successful). These results indicate moderate success in employing data visualization functionality to improve analysis and potentially improve collaboration on data. There appears to be less success—and perhaps less experience—with creating 3D visualizations (27% successful, with just 8% very successful).

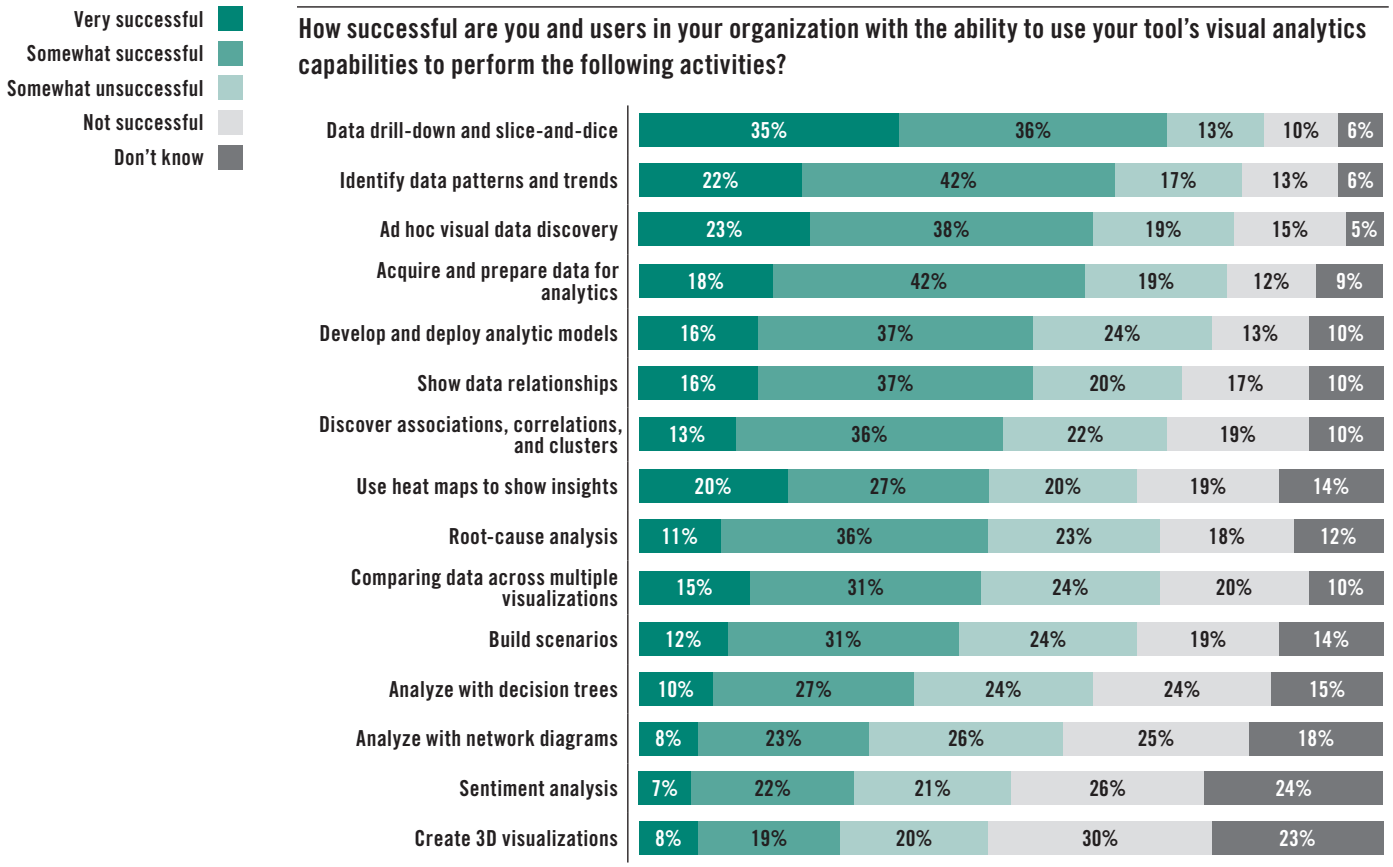


Figure 10. *Based on answers from 368 respondents.*

Satisfaction with Dashboards

Widespread adoption of BI dashboards has pushed the evolution of the user experience in a visual direction. However, entry-level BI dashboards are often static, offering only a few metrics, simple graphics, and basic integration with e-mail applications. More mature dashboards consolidate data access to multiple sources for both traditional BI and advanced analytics. These dashboards can serve as the centerpiece of enterprise performance management initiatives that integrate visual representation of metrics and scorecards with deeper analysis. Users can drill down into data and perform visual analytics without having to drop out into separate applications.

Our research examined levels of user satisfaction with various capabilities in their dashboards or similar graphical workspaces such as portals. Research participants said users are most satisfied with their ability to add or update data from multiple sources (62% satisfied, with 20% very satisfied). Just under half (48%) said users in their organizations were satisfied with the ease of choosing and integrating visualizations, and 45% said users were satisfied with self-service capabilities for creation and modification of visualizations (15% said very satisfied).

Research participants are more satisfied with self-service customization of look, feel, and scope than they were in 2013 when we asked this question as part of the TDWI Best Practices Report on data visualization. Then, just 28% noted users' satisfaction with this capability; this rose to 42% for this report. Also, more research participants are satisfied with their organizations' ability to communicate the dashboard's business purpose than they were in 2013 (61% compared to 56%). Failure to communicate dashboards' business purpose can doom them to irrelevance because users will not understand how the metrics and other information express the organization's strategic goals and objectives.

Research participants are more satisfied with self-service customization of look, feel, and scope than they were in our 2013 study.

Data Storytelling to Improve Collaboration

Dashboards plus other more advanced types of data visualization and visual analytics are important to enhancing communication about data insights, particularly to explain how data-driven conclusions were reached and suggesting actions or decisions to make. An industry term for this activity is "data storytelling"; the goal is to get beyond simply presenting numbers and facts in reports to narrate the data exploration and analysis so that findings are better understood and their significance or relevance can be readily grasped. BI reports can enable users to share the data; visualization and visual analytics tools and applications help users share insights about why the numbers are what they are and collaborate on further analysis and decisions about what actions to take.

More than half of research participants indicate success in using BI and analytics to explain how data-driven conclusions were reached.

Many BI tools offer capabilities for users to annotate reports and share comments, standardize visualizations in dashboards for multiple users, and more. Our survey finds that more than half (58%) of research participants and the users in their organizations are successful in using BI and analytics tools and applications to explain how data-driven conclusions were reached and can accelerate decisions, with 13% saying they are very successful; 35% noted lack of success and 7% didn't know. We asked participants to indicate what steps they are taking to improve collaboration on data with other users—one of the primary objectives of data storytelling (see Figure 11). The most prevalent course of action among research participants is deploying platforms to facilitate publishing and sharing of analytics (52%). Through interview research, we find that organizations have been using a variety of Web application platforms, analytics platforms, and more to publish analytics so others can access them. Just under half can personalize distribution, scheduling, and alerts of BI/analytics (48%).

Just under one-third (31%) of research participants said users can document data lineage so others can see the path to analytic conclusions, which is an important part of data storytelling. The same percentage (31%) said users are applying integrated data storytelling to facilitate conversations around data. Interestingly, the smallest percentage (21%) of research participants said users are contributing insights to social media discussion threads, which could be the easiest available option but one possibly fraught with governance concerns. One research participant commented that their organization is "starting to socialize around a logical model framework in all data dictionaries as part of the engineering life cycle."

Which of the following steps are users in your organization taking to improve collaboration on data with other users, including, if appropriate, business partners and/or customers?

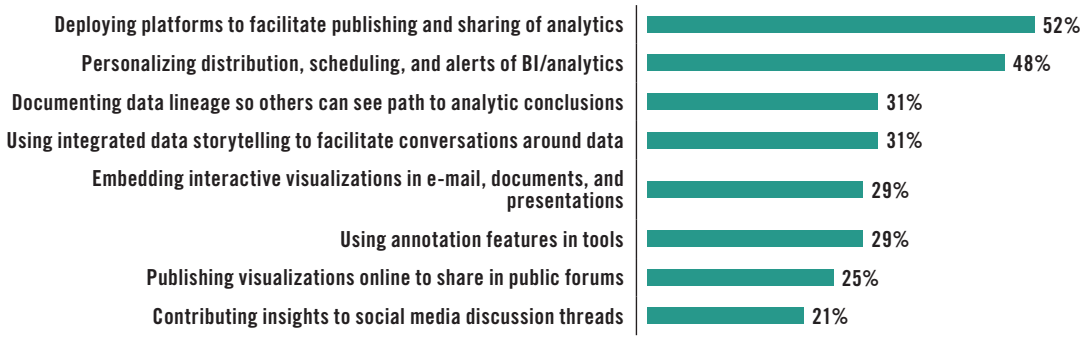


Figure 11. *Based on answers from 359 respondents who could select more than one answer.*

USER STORY NHS APPLIES ANALYTICS TO IMPROVE PROCESSES, FIND SAVINGS, AND UNCOVER FRAUD AND ERROR.

Nina Monckton is head of information services at the NHS Business Services Authority, a Special Health Authority of the Department of Health. The Authority provides a variety of business support services including payment processing, validation and assessment processes, procurement, contract management, and information services to a range of NHS organizations and other public sector bodies across the UK.

Monckton is passionate about analytics. Better use of data and analytics is a key aspect of the Authority's ambitious goal to improve all NHS business processes and drive better value from the services for which it has administrative responsibility on behalf of NHS and others. The Authority is employing Oracle Exalytics and Endeca products to gain insight from the vast volumes of data that the Authority collects as part of its business service streams.

Monckton said one of the key objectives has been to find and reduce fraud and error. "We have used Exalytics within the European Health Insurance application to improve the front-end validation process and blacklist addresses from which there were suspicious activities," Monckton said. "With analytics, it is much easier to detect anomalies in behaviors. We have used anomaly detection to discover … evidence of inappropriate behavior in dentists' and pharmacists' claims, for example, enabling NHS commissioners to follow up and challenge their activities."

Analytics has been critical to enabling the Authority's NHS colleagues to gain better value and improve patient safety. "Quite often the work we do will then involve further work to recover funds or improve the flow of information to help individuals understand when their activity is out of kilter with peers." The Authority implements Oracle Endeca to enable users to visualize survey results and apply visualizations such as heat maps to examine trends such as the "take up in electronic prescribing." Monckton said. Analytics have also helped the Authority anticipate the impact of planned changes to operations.

Monckton advises that organizations embarking on analytics projects "start thinking about what changes you want to make that data analytics can help you achieve even before you pen your business case. Do not underestimate the impact that analytics will have on your business, including countless ways you could improve data quality and business rules. We are quickly becoming even more expert in our own business."

Data Governance and Business/IT Collaboration

If data governance is unnecessarily tight, users will not realize the potential business value of data and will most likely go outside the governance system.

As more users engage in self-service visual analytics and data discovery, organizations need to establish data governance to oversee what data is being accessed, how it is being accessed, whether data quality is appropriate for users' analytic processes, and more. Perhaps most important, governance covers adherence to data security, privacy, and other regulatory rules. Organizations need to balance with data governance. If there is too little governance over what data users are accessing and using to make decisions, errors in judgment can result or regulations can be violated. If data governance is unnecessarily tight and full of red tape, users will not realize the potential business value of data and most likely go outside the governance system to set up their own "shadow IT" systems.

TDWI asked research participants to indicate how accurately each of the following statements describes their organizations' approach to data governance for users' self-directed implementation of BI and visual analytics tools:

- **"Users have role-specific access to data inside our organization."** By far the most research participants indicated agreement with this statement (82%, with 42% saying it was very accurate). Role-based access is an effective method for ensuring that users can only access and interact with data that they are supposed to access according their role and responsibilities.
- **"IT is responsible for data governance for all users."** About three in five participants (61%) called this statement accurate; 18% said it was somewhat inaccurate and 17% said it was not at all accurate.
- **"Our data governance covers not just data but what users do with it."** Nearly three in five participants (59%) said this statement was also accurate, including 25% who indicated it was very accurate. These organizations are taking a broader strategy toward governance than just securing the data within their systems.
- **"Data management and data ownership policies are documented."** Only 11% of research participants said this statement was very accurate, with 44% indicating it was somewhat accurate. Documenting data management and ownership policies is not always easy, but it can avoid confusion and help organizations assign responsibility for governance.
- **"Governance is overseen by our center of excellence (CoE) or competency center."** Just under half (48%) said this statement was at least somewhat accurate, with 16% calling it very accurate. A CoE or competency center can be critical to supporting "managed" or "guided" self-service visual analytics and data discovery because it can ensure that business and IT leadership provide joint, visible, and sustained leadership.
- **"Data governance efforts limit flexibility for business users."** About two in five (42%) research participants acknowledged the accuracy of this statement of the potential downside of too tight a data governance policy; 46%, however, said it did not describe their organizations (12% said they didn't know).
- **"Our governance focuses only on data security."** Almost two in five (39%) said this statement accurately describes their organization. Data security is an essential part of governance, but most experts believe the scope of governance should be broader to include other people, policy, and project strategy concerns.
- **"We do not have any data governance."** About-one third (34%) of research participants said this statement was an accurate description of their organization; 60% said it was not accurate and 6% didn't know. TDWI believes data governance is essential. Firms that do not currently

address data governance in a dedicated manner should make it a priority, especially as self-service tools for data access and analysis spread beyond IT's direct oversight.

USER STORY INTEGRATED U.S. ENERGY COMPANY IMPROVES DECISION SPEED AND QUALITY.

"The oil industry has always been a data analysis industry," said Mark Ruths, consultant geophysicist and technology coordinator for Reservoir and Production Engineering with a major U.S. integrated energy company; his group supports the company's varied businesses. Ruths, who has been with the company for 37 years, has been focused since 2002 on identifying new technologies and bringing them into the company.

He was then a supervisor of geographical information systems (GIS)—a crucial technology for energy companies for identifying energy exploration opportunities and managing oil wells and other facilities. With GIS, he could click on maps to see the attribute data behind a certain area or object of interest, but analysis of the data in Microsoft Excel spreadsheets was slow and painstaking. Seeing a demo of (now TIBCO) Spotfire, he became excited about the possibilities of integrating GIS with a visual analytics and data discovery application. By cutting and pasting the voluminous attribute data into Spotfire, "almost anybody could become the equivalent of an Excel guru right away," said Ruths. "I thought, 'This is what GIS has needed all along. You can truly see all the dimensionalities of the data.'"

Use of the application has since become widespread at the company, enabling geologists to analyze single wells or broader collections of wells to determine, for example, the right amount of water to inject into injection wells. "You might analyze oil production over time from a field," said Ruths. "One map chart could show all of the wells and another the total of oil production per day. You could filter to see one or a specific group of wells or the production from just a portion of the field; each time you filter, the charts change immediately. You decide to determine what kinds of workovers have been done to improve well production, circling the ones you want to look at and make that serve as a filter. You have at your fingertips the ability to ask many questions of the data and winnow down quickly to find what you're looking for."

Ruths said the application has made collaboration on decisions easier. "It used to take longer to make decisions and people weren't as confident in them if they couldn't answer all the questions they had," he said. "Now, people can get answers to their questions instantly by filtering the data appropriately so they are more confident about their decisions and are able to make them faster."

Visual Analytics and Decision Management

Today, organizations are looking for opportunities to optimize business processes through smarter and faster decisions. In financial services, banking, insurance, e-commerce, and other industries, organizations want to identify decisions that are repeatable and could be automated. Firms in these and other industries need to accelerate credit approval, monitor fraud and misuse in real time, and improve the consistency of responses to thousands of customers. They also need management capabilities with easy-to-use interfaces designed for nontechnical personnel so they can orchestrate and govern fast decisions across multiple systems and channels.

A trending solution is "decision management," which is about using analytics to improve and optimize processes. It consists of a set of processes and technologies that can be implemented particularly for real-time, high-volume decision making where many, though not all, decisions can and must be automated. Decision management requires a combination of technologies including predictive analytics, artificial intelligence, business rules management, complex event processing, and business process management.

Visual analytics can help business managers identify areas where optimization is possible and where decisions could be automated.

Visual analytics can play a key role in decision management. First, tools and applications can help business managers identify areas where optimization is possible and where decisions could be automated. Second, visual analytics can improve the human interface to decision management systems, giving managers tools for monitoring and continuous improvement. Some visual business analytics tools and applications can help managers with scenario analysis and simulations to see the potential impact of decision management.

Decision management intersects with the idea of embedded analytics: that is, incorporating BI reporting and analytics functionality inside other applications and business processes such as those for customer relationship management, contact center and customer service, ERP, supply chain management, and portals. Embedded visual analytics can improve the user experience of these applications and make them more data-oriented to go along with the normal processes and procedures.

Visualizing Operational Performance

TDWI Research asked participants about the importance of a variety of steps for integrating analytics with business applications, processes, and workflow to improve operational performance (see Figure 12). Three quarters (75%) of research participants said integrating visual analytics with business process management was important, with 39% indicating it was very important. This result underscores the importance of operational efficiency as a business driver behind implementation of visual analytics and its potential as a contributing technology for decision management.

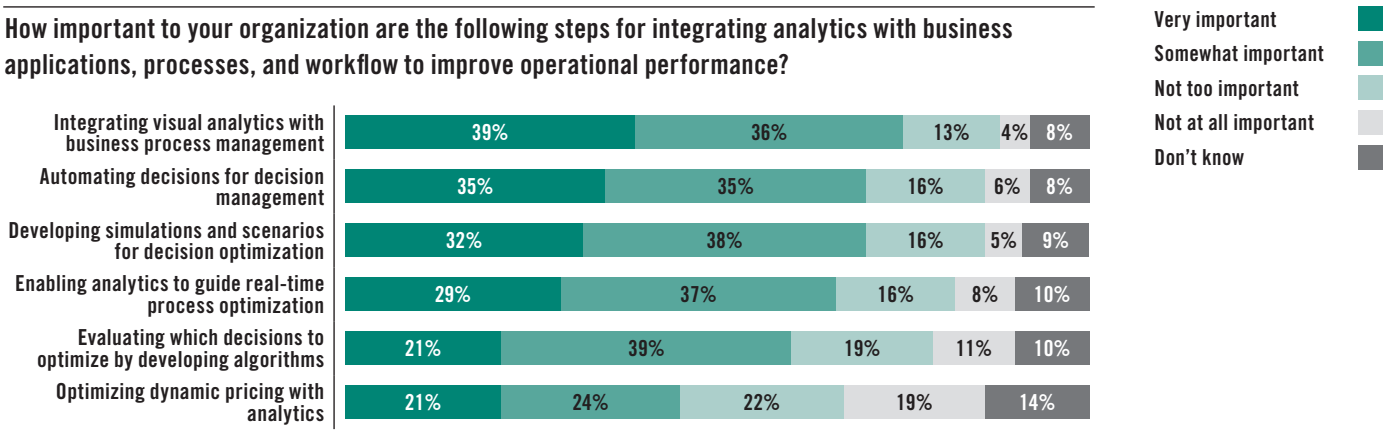


Figure 12. *Based on answers from 324 respondents.*

Nearly as many (70%) said automating decisions for decision management was important, with the same percentage (70%) indicating the importance of developing simulations and scenarios for decision optimization. Clearly there is interest in bringing visual analytics to bear on decision management and process improvement. We expect organizations to continue to explore ways of tightening this integration to meet objectives where smarter and faster decisions create a competitive advantage.

USER STORY DARKMATTER²bd APPLIES USER-FRIENDLY ANALYTICS TO GAIN VALUE FROM HEALTHCARE DATA.

These are exciting and rapidly changing times for firms in the healthcare and life sciences industries. With pressure to meet business challenges, regulatory pressures, and changing patient treatment expectations, it has never been more critical for firms to derive value from data and make insights actionable. Massive volumes of data from claims, clinical trials, and other sources hold enormous potential, but many firms lack the experience and data infrastructure to realize it soon enough. Cloud options and technology advancements toward easy-to-use, visual BI and analytics are therefore extremely relevant to healthcare and life sciences firms that need to harness the power of data without the traditionally long and difficult development cycle.

"We believe that data is the dark matter of healthcare," said Vince DeChellis, co-founder and principal of DarkMatter²bd, a leading (and appropriately named) provider of healthcare market data, visualization tools, custom analytics, and services. With a database containing medical claims data for over 60% of the U.S. patient population, the company is focused on turning the "amorphous nature" of healthcare data, as DeChellis terms it, into a source that enables pharmaceutical companies, medical device suppliers, contract research organizations (CROs), and others to discover business opportunities and optimize processes.

DarkMatter²bd implements QlikView for front-end dashboards and visual analytics, DeChellis said. "Let's say a CRO seeking to provide clinical trials services wants to identify patients suffering from lupus. Within our platform, we can identify physicians who have diagnosed or are treating patients with lupus, including their comorbid states, to see which physicians have candidates for clinical trials." DeChellis described how business users can employ QlikView to interrogate the database and use the interface to apply the inclusion and exclusion criteria based on clinical trial protocols and other factors to segment and "hyper-target" prospects.

Reducing the patient recruitment time is a key benefit of DarkMatter²bd's analytics. "Specialists are usually very reluctant to give up a patient for a clinical trial; they are not incentivized to do that." With DarkMatter²bd's services, client firms can overcome such obstacles and identify patient populations rapidly for possible clinical trials. "This can result in faster approvals, which can mean billions of dollars for pharmaceutical companies in savings, longer product market life, and improvements for patients who can get new treatments faster."

Vendor Products

The firms that sponsored this report are among the leaders and innovators in providing technologies for BI, data discovery, and analytics tools and platforms. 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.)

IBM

Founded in 1911 and headquartered in Armonk, New York, IBM, as part of its Analytics Platforms and Analytics Solutions offerings has products across the spectrum of BI, data management, enterprise performance management, and analytics. IBM Cognos provides an integrated platform for all BI activities including query and reporting, dashboard authoring, and data discovery. IBM's dashboard and visualization tools enable users to personalize dashboards and share results as well as employ more sophisticated displays to understand data relationships, trends, and predictive insights. In March 2015, IBM introduced Cognos Business Intelligence on Cloud (as-a-service) running on SoftLayer, an IBM company. In late 2014, IBM introduced IBM Watson Analytics, a cloud-based self-service analytics platform for business users that applies natural-language-based cognitive capabilities to speed data refinement, visualization selection, and more. The service, designed to run on desktops or mobile devices, aims at providing a unified analytics experience. Its natural language dialog capability enables users to drill down and interact with data in their own language; it can quickly interpret and respond to their queries. Watson Analytics can then provide recommendations for analysis and those insights can be shared with Cognos users.

Information Builders

Information Builders, Inc. (formerly known as IBI), founded in 1975 and headquartered in New York City, has an extensive portfolio of products stretching from BI and analytics to data integration, data quality, and data management as well as business process-specific solutions. The WebFOCUS BI and Analytics Platform customer base includes many firms that have deployed the solution's desktop, mobile, and cloud/SaaS-based BI, performance management, and analytics tools operationally to large numbers of users. In late 2014, Information Builders introduced WebFOCUS InfoDiscovery, a Web-based, "governed" self-service data discovery tool aimed at the needs of business users and analysts. InfoDiscovery enables users to access a wide variety of data, including from spreadsheets, data warehouses, and external sources. It provides shared metadata, version control, auditing, and centralized administration so organizations can apply governance rules and manage performance effectively. Information Builders' InfoApps take self-service a step further by packaging data preparation and interaction technologies into an "app" that requires little to no training for analytics, and can enable users to embed shareable visual objects into applications, dashboards, and portals.

Oracle

Oracle, founded in 1977 and headquartered in Redwood Shores, California, offers integrated technology products and pre-built applications for BI, enterprise performance management, big data, information discovery, advanced analytics, and more. Oracle has adopted a cloud-first strategy and it is core to everything the company offers, including its BI, data discovery, and visual analytics offerings. Oracle Business Intelligence Foundation Suite, part of its Business Analytics solutions, is Oracle's comprehensive enterprise BI platform covering the range of BI and analytics activities, including for users on mobile platforms. The Oracle BI Cloud Service is designed to make it easier and faster for users to load, prepare, visualize, analyze, and share data insights. Introduced in 2015 as part of the service is Visual Analyzer, a new feature that offers browser-based tools that support the self-service visual analysis lifecycle, from data staging to data exploration to consumption. It also provides for governing data access and defining roles. Oracle has released cloud-based Big Data Discovery for Hadoop and offers Oracle Endeca Information Discovery for governed, self-service search and interaction with structured and unstructured data.

Qlik

Qlik, first established in Lund, Sweden in 1993, has its U.S. headquarters in Radnor, Pennsylvania. Qlik has long been focused on developing products that enable a broader range of business users to engage in intuitive, visual data discovery and analytics. A key goal has been to drive greater business agility by enabling users to discover relationships in information that would otherwise be hidden in standard BI/SQL query result sets. Qlik's associative data indexing engine dynamically calculates and reveals data associations across multiple sources as users interact with analytics through selections or searches. Both the QlikView data discovery platform and the newer Qlik Sense visual analytics platform, introduced in 2014, employ this underlying in-memory engine. Qlik Sense is a visual analytics and discovery platform that supports a full spectrum of BI use cases including self-service visualization, BI apps and dashboards, embedded analytics, collaboration, and reporting. The Enterprise edition supports "governed" data discovery by enabling IT to provide centralized control to ensure access to secure data libraries from desktops or mobile devices, scale application performance, and more.

SAP

Founded in 1972 and headquartered in Walldorf, Baden-Wurttemberg, Germany (U.S. headquarters in Newtown Square, Pennsylvania), SAP is a major provider of BI and analytics applications, with SAP BusinessObjects a common enterprise BI standard. SAP is currently forging a convergence of its multiple BI use cases for reporting, discovery and analysis, dashboards and applications, and office integration. SAP Lumira, formerly called SAP Visual Intelligence, is the primary product for self-service data discovery, analysis, and visualization. SAP Lumira, Edge edition, introduced in 2015, is a server solution that aims at providing quicker installations and rollouts. Edge edition offers server versions for small and midsize businesses and LOB teams as well as to large enterprise customers with the SAP BusinessObjects BI Platform. Features in SAP Lumira, Edge edition, include Linked Analysis, which enables users to automatically update all charts on a dashboard as they are drilling down or moving up a hierarchy. Organizations can achieve trusted data discovery by integrating agile capabilities of SAP Lumira with the capabilities of the SAP BusinessObjects Platform. Lumira users, who may be business analysts or decision makers consuming data, can be given self-service agility while IT manages, controls, and administers the data.

SAS

SAS, founded in 1976 and headquartered in Cary, North Carolina, offers technology products and services for BI, analytics, and data management as well as solutions for specific requirements such as risk management and customer intelligence. The company introduced SAS Visual Analytics in 2012, and it is now the core product of its BI and analytics technology suite. SAS Visual Analytics offers users intuitive, visual, and self-service ways of exploring and interacting with data and performing analytical activities such as building predictive models with the integrated SAS Visual Statistics product. Users can perform activities such as building interactive reports and dashboards, conducting data discovery, sharing insights via mobile or Microsoft Office Add-in, and utilizing self-service analytics (e.g., forecasting, decision trees, and text analytics) in a governed, managed, and reusable manner. SAS Visual Analytics is powered by the underlying in-memory engine, SAS LASR Analytic Server, for multiple users to access distributed data, run analytics operations, and generate rapid insights.

Tableau Software

Tableau, founded in 2003 and headquartered in Seattle, enables a broad range of users to realize value from data without the complexity and delay often associated with using a traditional BI technology stack. Tableau introduced version 9.0 in the first half of 2015, offering a significant update to its Desktop, Server, Online (cloud), and mobile products. Among the key objectives of the new version is to make it easier for users to connect natively to a wider selection of data sources and to clean and otherwise prepare data on their own as part of the flow of their analysis. In particular, the 9.0 release can apply metadata and algorithms to automatically clean "dirty" spreadsheet and other types of files, relieving users of mundane reformatting tasks. The enhancements enable users to perform "instant" analytics and apply level-of-detail (LOD) expressions such as cohort analysis and aggregates of aggregates. Version 9.0 also applies query, data engine, and server enhancements to improve performance.

TIBCO Spotfire

Founded in 1997 and headquartered in Palo Alto, California, TIBCO Software has an extensive software and services portfolio covering BI, analytics, and data infrastructure. In 2014, TIBCO acquired Jaspersoft, which added breadth to its BI platform. TIBCO Spotfire, running on premises or in the cloud, is a visual analytics and data discovery application that enables business users to interact in a self-service fashion with multiple data sources in one workspace, augment the data, and perform a range of analytics to identify trends, patterns, and other significant facts. TIBCO Spotfire supports a broad range of use cases from building dashboards to deep analytics. Features such as its latest Recommendations Engine enable users to quickly build dashboards by helping users select the most impactful way to visualize data. Other features such as its TERR engine enable the most sophisticated data scientist to perform predictive, location, and real-time analytics.

Recommendations

Self-service users must accept additional responsibility for governance, data quality, and data lineage, and adhere to accepted data definitions and metadata.

Make self-service visual analytics and data discovery a priority—but ensure users understand new responsibilities. Users have much to gain from greater control over their experience with data and over the selection of data sources they use for visual analytics and data discovery. However, they must also accept additional responsibility for governance, data quality, and data lineage, and adhere to accepted data definitions and metadata. Centers of excellence and governance committees are valuable institutions for clarifying and assigning responsibility.

Don't let IT become the roadblock; develop a strategy to address IT concerns about self-service. TDWI Research finds that in organizations with enterprise BI platforms, IT manages user and data expansion. Although this might be sensible for the growth and value of the enterprise BI platform, our interviews reveal frustration among users who need more visual analytics capabilities and don't want to wait. To avoid undesired growth in "shadow IT" systems, organizations should foster dialogue between IT and business users about how to enhance freedom for adoption of self-service BI and visual analytics tools.

Aim for "managed" or "governed" self-service with business-focused analytical applications. Organizations need to find the right balance between user freedom and flexibility and proper observation of data security, privacy, and regulatory policies. IT functions also need good communication with users to ensure performance, availability, and data quality. Organizations should establish governance or center of excellence committees to support the notion of managed or governed self-service visual analytics.

Provide training and education opportunities for users who seek to do more advanced analytics. Our research finds that users are most successful in using BI and visual analytics tools to build dashboards and scorecards. Although these capabilities are critical, many users could benefit from incorporating more advanced analytics into their work. Organizations should encourage and educate users to take advantage of more predictive and other forms of analytics capabilities in their tools and applications, if they are available.

Put delivering upper management insight high on your priority list. Our research finds that satisfying executives is the business benefit most sought by research participants through implementation of BI and visual analytics. Indeed, easier-to-use visual analytics tools offer an excellent opportunity to give corporate, financial, and operational executives more than traditional BI reports to consume. Executives who want to lead data-driven organizations need more capabilities for data interaction. Demonstrate to executives how their needs could be met; make sure they are sufficiently trained to get the most out of the tools and applications.

Take advantage of in-memory computing to improve performance and data availability. In-memory computing has become an important infrastructure feature supporting many visual analytics tools and applications. Although not always the right solution if users need near-real-time data, in-memory computing can improve performance and bring more data to users for their analysis. Evaluate needs for in-memory computing and take advantage of it for highly interactive and iterative visual analytics.

Make self-service data preparation part of the visual analytics experience if the technology can support it. Users will be even more satisfied with self-service capabilities if they can select, blend, and otherwise prepare data for visual analytics themselves. New technologies are increasing the options for self-service data preparation, which could offer the added benefit of taking pressure off IT, which is largely responsible for data preparation in most organizations.

Use visual analytics to support data storytelling for smarter and faster decision making. Data visualization can give users greater capabilities for putting together the "story" of how data-driven conclusions were reached and why they are relevant to a particular objective or decision to be made. Educate and train users to move beyond simply presenting reports or isolated visualizations to tell a fuller story of the data exploration and analysis.

Evaluate cloud and SaaS options to gain visual analytics advantages without infrastructure commitment. TDWI finds that neither cloud nor SaaS are in widespread use yet, but research participants anticipate rising use over the next 12 months. Many vendors now offer these options as alternatives to on-premises deployment. Organizations should evaluate them as an opportunity for users to try out tools and build prototypes; organizations could use cloud and SaaS options to provide capabilities to more users without additional infrastructure investment.

Integrate visual analytics, including as embedded functionality, into strategies for decision management. Organizations that need to manage a high volume of real- or near-real-time decisions can benefit from decision management, an integrated technology and process approach to intelligent automation of decisions. Visual analytics can play a beneficial role in helping managers identify opportunities and oversee implementation.

IBM

www.ibm.com/bigdata

IBM is unique in having developed an enterprise-class big data and analytics platform—Watson Foundations—that allows you to address the full spectrum of big data business challenges. Analytics and information management are key to that platform helping organizations discover fresh insights, operate in a timely fashion, and establish trust to act with confidence. IBM InfoSphere BigInsights brings the power of Apache Hadoop to the enterprise with application accelerators, analytics, visualization, development tools, performance, and security features. IBM InfoSphere Streams efficiently delivers real-time analytic processing on constantly changing data in motion and enables descriptive and predictive analytics to support real-time decisions.

Information Builders

informationbuilders.com

Information Builders helps organizations transform data into business value. Our software solutions for business intelligence and analytics, integration, and data integrity empower people to make smarter decisions, strengthen customer relationships, and drive growth. Our dedication to customer success is unmatched in the industry. That's why thousands of leading organizations rely on Information Builders to be their trusted partner. Founded in 1975, Information Builders is headquartered in New York, NY, with offices around the world, and remains one of the largest independent, privately held companies in the industry. Visit us at informationbuilders.com and follow us on Twitter at @infobldrs.

Oracle

oracle.com

Modern cloud computing helps companies seize new business opportunities and innovate faster. Oracle delivers the most comprehensive portfolio of cloud solutions for business, IT, and development needs, including software as a service, platform as a service, infrastructure as a service, and data as a service. Built on proven, industry-leading Oracle Business Intelligence and database technologies and the Oracle Cloud infrastructure, Oracle Cloud Platform for Business Analytics delivers flexible analysis of any data from any source, including cloud, on-premises, traditional, and big data. Mobile access and analysis is provided out of the box, so customers can access and analyze insights on the go.

Qlik

qlik.com

Qlik (NASDAQ: QLIK) is a leader in data discovery delivering intuitive solutions for self-service data visualization and guided analytics. Approximately 35,000 customers rely on Qlik solutions to gain meaning from information from varied sources, exploring the hidden relationships within data that lead to insights that ignite good ideas.

Qlik provides a platform-based approach to visual analytics that brings insights and clarity to where it's needed the most: the point of decision. This empowers the entire organization to make decisions with confidence and transforms business analysts and knowledge workers across the organization into indispensable champions.

SAP

sap.com

As market leader in enterprise application software, SAP (NYSE: SAP) helps companies of all sizes and industries innovate through simplification. From back office to boardroom, warehouse to storefront, on premises to cloud, desktop to mobile device—SAP empowers people and organizations to work together more efficiently and use business insight more effectively to stay ahead of the competition. SAP applications and services enable customers to operate profitably, adapt continuously, and grow sustainably.

SAS

sas.com

SAS is the leader in advanced analytics software and services, and the largest independent vendor in the business intelligence market. Through innovative solutions, SAS helps customers at more than 75,000 sites worldwide benefit from advanced analytics—whether for revealing relationships between pricing and demographics, understanding how social media influences your customers, or predicting risk and fraud. With an unwavering focus on analytics since 1976, SAS offers the breadth and depth of advanced algorithms and techniques such as machine learning, text analytics, and a broad set of predictive techniques.

Tableau Software

tableausoftware.com/trial

Meet the new face of business intelligence: Tableau Software. Other solutions require expensive custom development, pre-defined data models, and lengthy training. Not so with Tableau. Tableau shifts BI into the do-it-now era with the easiest, fastest, and most agile solution in the market. Used by more than 26,000 companies and organizations worldwide, and ranked by Gartner as the fastest growing BI company in the world, Tableau makes business users happy and saves IT time and money. See how Tableau can help you by downloading the free trial.

TIBCO Spotfire

tibco.com

TIBCO Spotfire is the analytics and smart data discovery solution from integration and business intelligence giant, TIBCO Software. From interactive dashboards and data discovery to predictive and real-time analytics, Spotfire's intuitive analytics platform provides an astonishingly fast and flexible environment for visualizing and analyzing your data. As your data analytics needs and requirements increase, our enterprise-class capabilities can seamlessly grow with you, helping you to be first to insight—and first to action.

TDWI RESEARCH

TDWI Research provides research and advice for data professionals worldwide. TDWI Research focuses exclusively on business intelligence, data warehousing, and analytics 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, data warehousing, and analytics 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.

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