

TEC BUYER'S GUIDE 2015

Business Intelligence: Data Discovery and Visualization

TEC Technology
Evaluation Centers

TABLE OF CONTENTS

4	ABOUT THIS GUIDE
5	DATA DISCOVERY AND VISUALIZATION—UNCOVERING THE HIDDEN STORY BEHIND YOUR DATA <i>by Jorge García, Senior Business Intelligence Analyst, Technology Evaluation Centers</i>
6	State of the Market—Data Discovery and Data Visualization
18	Data Discovery and Visualization in the Business Place
26	DATA DISCOVERY AND VISUALIZATION SOLUTIONS
27	Product Comparison: Data Discovery and Visualization Solutions
31	Self-assessment: Your Data Management and Discovery Readiness
34	TEC RESOURCES
35	FIVE ESSENTIALS TO SELECTING THE BEST SOFTWARE SOLUTION FOR YOUR COMPANY <i>by TEC Staff</i>
39	CASEBOOK
40	Dundas Thought Leadership <i>Easy Data Discovery with Smart Data Transitions</i>
45	GoodData Customer Success Story <i>Demandbase: Revolutionizing the Marketing and Sales Game</i>
49	IBM Thought Leadership <i>Using Visualization to Understand Big Data</i>
63	Qlik Customer Success Story <i>Qlik Helps the NIHR NHS Research Body Improve the “Health and Wealth of the Nation”</i>
68	SAP Customer Success Story <i>State of Indiana Chooses SAP HANA Platform to Help Fight Infant Mortality</i>
71	VENDOR DIRECTORY
73	ABOUT THE AUTHOR

About This Guide

Organizations today are grappling with making sense of the incredible amount of data that they have at their disposal in order to make better business decisions. Companies across a wide range of vertical sectors have been using software solutions for years to uncover important patterns and trends hidden in their data and to visualize their data in new informative ways, allowing for informed and relevant decision making.

This buyer's guide presents the trends and opportunities for insight and informed decision making in the areas of business intelligence (BI), particularly data discovery and visualization. It provides a comprehensive overview of the wide spectrum of software solutions currently available on the market that can address the multitude of challenges associated with data discovery and visualization that different types of organizations face today. The guide is intended for business owners, managers, decision makers, and anyone interested in learning about the deployment of data discovery and data visualization solutions within their organizations. It offers guidance for the successful selection and deployment of a data discovery and visualization solution for any company.

The guide also presents and reviews the individual components of data discovery and data visualization solutions and their support of business processes. It offers comprehensive comparison charts of the features and functions of the different data discovery and data visualization software solutions currently available on the market. It also includes a variety of real-life case studies depicting how different companies have used specific data discovery and data visualization solutions to gain important insights and improve their business operations.

DATA DISCOVERY AND VISUALIZATION— UNCOVERING THE HIDDEN STORY BEHIND YOUR DATA

The analysis of data originating from disparate sources for the purpose of discovering patterns and behaviors is not a new practice. In fact, many academic institutions and businesses worldwide had been analyzing data in the hopes of achieving business insights for decades. But it is within the last decade that solutions permitting the discovery and visualization of data have grown dramatically—both in numbers and capabilities. As an integral component of the sciences and technology disciplines, data discovery and visualization has been used for at least a decade by many corporations looking at data as the raw material for business analysis and decision making.

The use of reliable data discovery solutions, along with effective ways to process, visualize, present, and consume the data, can have a great impact on the way organizations run and analyze their business. These solutions (regardless of their type, shape, or form) can help companies make informed and reliable decisions at all levels of the organization—increasing operational efficiency and business performance, and enhancing opportunities for success.

Nearly every organization in every vertical industry today exploits some form of data discovery activity and/or data visualization method for gaining data insights. Data discovery and visualization has become a vital part of any data management and/or business intelligence (BI) initiative, regardless of whether it comes from a traditional powerhouse BI solution provider or a modern newcomer. And those organizations aspiring to expand their business operations in the most efficient way possible know how important it is to have a modern BI and analytics initiative that relies on informative data discovery and visualization tasks.

STATE OF THE MARKET—DATA DISCOVERY AND DATA VISUALIZATION

The world is visual

The use of graphics, symbols, and figures for representing data has deep historical and academic roots. Data discovery and visualization has been used in fields ranging from cartography and history to economics and general science (figure 1), the historically has been about looking for new ways to enhance knowledge and obtain insights or transform data into useful and actionable information.

“Numbers have an important story to tell. They rely on you to give them a clear and convincing voice.”

Stephen Few, Founder,

Perceptual Edge

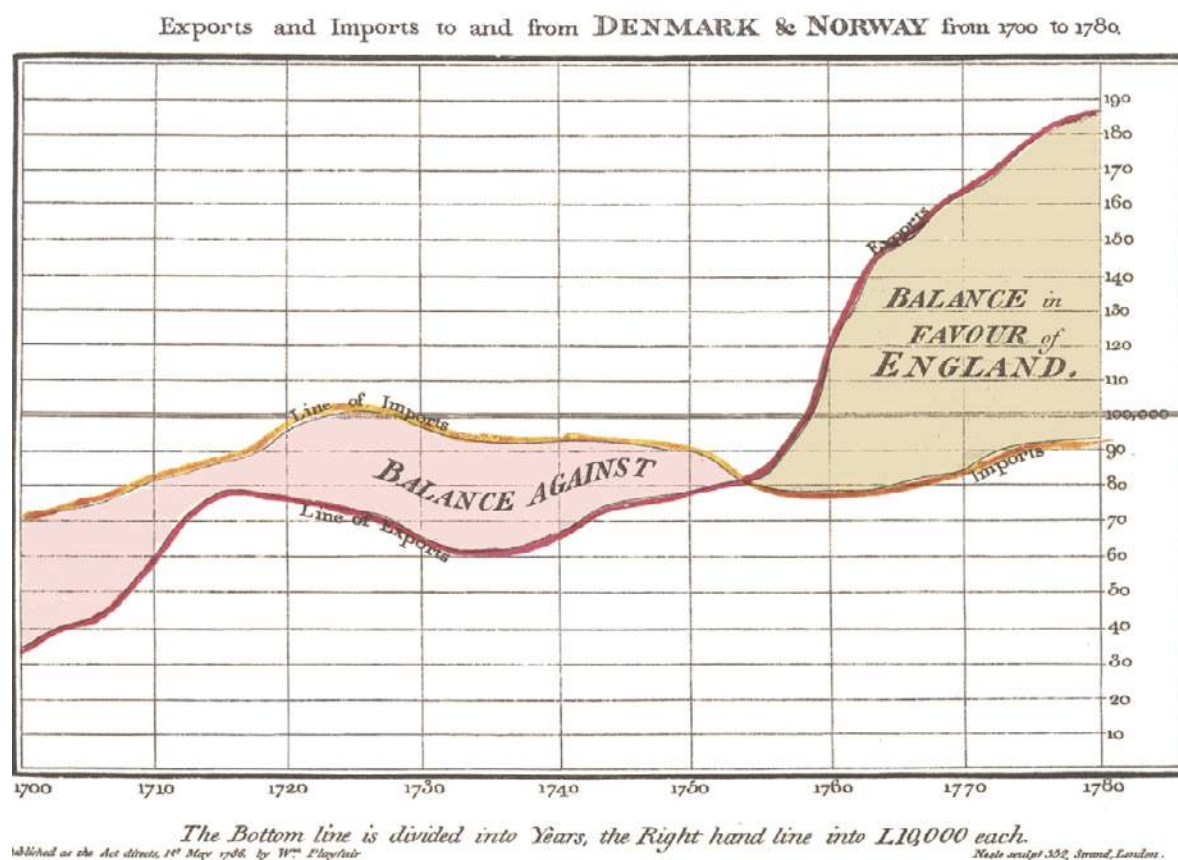


Figure 1. Trade-balance time-series chart, published in Commercial and Political Atlas (1786) by William Playfair

Data discovery and visualization techniques and solutions have come a long way—evolving dramatically from simple bar and time-series charts to the advanced and interactive dashboards that we have today connecting millions, if not billions, of data points originating from different sources. Today people across many organizations are increasingly adopting the use of charts and graphical elements to visualize data, such as financial data, and interact with information. Tools and software solutions are evolving at a rapid pace, and continuously reshaping the way organizations treat, analyze, and process data in order to gain insights and drive vital conversations and decisions.

The use of graphics can signal trends and suggest courses of action that will improve an organization's finances. Effective data dashboards and scorecards can allow upper management and operational management to have a full business view at a glance. These tools can also present effective ways to group, slice and dice, and intuitively process data—and enable trends, patterns, and anomalies to become more apparent. Graphical information can present data clearly and effectively, so that it is more intuitive, enabling users to interpret large amounts of data more efficiently.

Over the course of the last two decades, the fields of data visualization and data discovery have expanded in a number of ways. There has been an increase in the specific types of tools and functionalities available to users for data analysis. These include data discovery applications, dashboarding and scorecarding tools (see example in figure 2), as well as advanced analytics solutions. All of these use different techniques and methodologies to present information at different levels of detail as needed. Data visualization and data discovery have also expanded to serve a wider number of lines of business and industries.



Figure 2. IBM Cognos Business Intelligence data dashboard and scorecarding (courtesy of IBM)

These are exciting yet challenging times for the analytics and data management market. Software providers need to continuously improve upon the myriad of innovative solutions with different capabilities already available on the market for users to unravel the secret messages inherent in data. Users need to be able to view and analyze relevant, contextual, and up-to-date company data to inform their understanding of the state of the business for better decision making.

Today, businesses, researchers, and individuals have a variety of tools at their disposal for exploring their data—dashboards and data discovery tools, scorecard applications, and analytics suites, among other software tools. Still, organizations need guidance to ensure that they exploit data discovery and visualization tools to their fullest potential for the best possible business advantage.

But there are numerous caveats. The discovery of innovative ways to collect, analyze, and visualize data comes with not only many benefits, but also new challenges regarding data privacy, governance, and misuse of data. The stage is set for a new era of BI and analytics solutions that acknowledges that, yes, the world is visual.

Data discovery and visualization: An academic perspective

Why the visual representation of knowledge?

Researchers from the University of Berkeley estimate that about 1 exabyte (1 million terabytes) of data is generated every year and most of it is available in digital form. As a result, technological advances must keep pace in order to allow today's computer systems to support the storage of increasingly larger amounts of data.

Nowadays, data is recorded from a vast number of sources and much of it is registered automatically—via sensors, monitoring systems, enterprise software solutions, mobile devices, etc. Even simple common daily transactions—such as paying by credit card, using the telephone, or placing an order via the web—are now typically registered by computers. The data is collected because people and organizations believe that it is a potential source of valuable information and can provide knowledge, insights, competitive advantage, or value of some sort. Still, finding the value within data can be a difficult task.

Due to their transactional nature, many traditional data management systems focus on showing just small portions of the data. And most of this data is presented in text format to explain specific transactions of interest (receipts, notes, individual patient records). The amount of data that can be displayed on screen will be at most in the range of a hundred data items. Another problem arises from the nature of the data itself. A limiting factor of data presentation is the increasing parameterization of data (according to time, place, type, etc.), increasing not only the volume but also the complexity of the data, resulting in data with increasing dimensionality.

Traditional data management systems are not very effective for dealing with data sets containing thousands or even millions of data items to be analyzed. It is simply impossible to explore these large amounts of data in an effective way; the data becomes useless and large databases become mere data repositories.

Using a method for visualizing data can allow the user to gain insight and come up with new ideas and hypotheses about what the data means. Exploring data in a visual way calls for an integrative process between the individual human and the software system—the user applies his/her perceptual abilities and transforms the data in a way that helps to better study large data sets. In addition, using visual discovery and data visualization can prove to be effective in at least three ways:

- Data visualization and discovery doesn't require an understanding of complex mathematical or statistical algorithms or parameters, enabling users to exploit them with a good level of efficiency. This is because they are intuitive by nature.
- Data discovery and visualization tools and techniques can make it easy for users to handle heterogeneous and noisy data.
- Visual data exploration techniques can provide a higher degree of confidence in the findings from the exploration process.

Thus, data discovery and visualization techniques and software tools can allow for faster data exploration with an acceptable degree of accuracy, as well as produce findings that are self-explanatory and do not require much analysis to derive value, as shown in the image below (figure 3).



Figure 3. Example of faster data exploration with an acceptable degree of accuracy (courtesy of Dundas)

What is data visualization and discovery?

The main concept of data visualization and data discovery techniques and tools is to present the data in a visual form. And the main goal of this concept is to enable users to directly interact with the data, obtain insights from the data, reach conclusions based on the data, and perhaps even make important decisions based on the data. And while data visualization emphasizes how the data is laid out, data discovery techniques emphasize how data can be explored, particularly for large datasets.

Data discovery can be especially useful when there is not much information about the data, and when the goals of the exploration process are not precisely defined—making it possible to immediately adjust these goals as needed. Thus, data discovery and data visualization tools are increasingly on high demand. Nowadays, they are indispensable complementary tools to more automated exploration techniques, such as data mining, and traditional data analysis techniques, such as BI tools.

The visual information seeking mantra

Perhaps one reason why data visualization and discovery can be so easy to perform while being so powerful is that it usually follows an interactive process. [Ben Shneiderman from the University of Maryland](#), calls this process the *Visual Information Seeking Mantra*. The mantra states three main steps for visual data discovery (figure 4):

- **Overview first.** The user needs to get an overview of the data to identify patterns and focus his/her attention on one or more of these patterns.
- **Zoom and filter.** To analyze the patterns, the user needs to drill down and filter the data to get access to the details.
- **Details on-demand.** Depending on the visualization, the details on-demand technique can provide additional information about a certain data point without changing or modifying the original view, thereby adding context and clarity.

Based on this mantra, Mr. Shneiderman proposes that the data discovery process comprises seven tasks by data type taxonomy (dimensional aspects discussed below):

- **Overview:** Gain an overview of the entire collection.
- **Zoom:** Zoom in on items of interest
- **Filter:** Filter out uninteresting items.
- **Details-on-demand:** Select an item or group and get details
- **Relate:** View relationships between items.
- **History:** Keep a history of actions to support undo
- **Extract:** Allow extraction of subcollections of data and of the query parameters

He also proposes that there are six types of data in the context of data visualization:

- **1-dimensional.** For linear data types, including textual documents, program source code, and alphabetical lists of names organized in a sequential manner.
- **2-dimensional.** For planar or map data, including geographic maps, floor plans, or newspaper layouts.
- **3-dimensional.** For real-world objects such as molecules, buildings, and body parts.

- **Temporal.** For timelines, which are vital for visual representation.
- **Multidimensional.** For data that is mostly configured within relational and statistical databases.
- **Tree.** For data that is organized in hierarchies or tree structures, such as file directories or nodes within a network.

Data discovery and visualization technologies may be used for all three steps of the data exploration process. Essentially, data visualization techniques can be useful for showing an overview of the data, while the process of discovery allows for zooming in and filtering data to show the data on-demand. This in turn allows the user to identify and further explore interesting data subsets by drilling down to get the details about the data.



Figure 4. Most discovery and visualization solutions apply the Visual Information Seeking Mantra (courtesy of TIBCO Spotfire Metrics)

As these techniques and software technologies have evolved, the mantra has undergone many changes (some of which are discussed in the next sections of this guide). However, the Visual Information Seeking Mantra remains the fundamental starting point for considering the development and/or the use of data visualization and discovery technologies. In addition, current visualization technologies can provide the functionality not only for each one of these steps but also for closing the gaps between them. For example, they can give users the ability to collect, store, and analyze the data within the same solution or provide tools to mix both automated and manual discovery techniques, such as including trend lines within the discovery and visualization process.

And as these data discovery and visualization technologies and techniques have evolved, their adoption has increased significantly in many areas of research and in many industries. They have become a vital tool for complementing—not replacing—other automated data discovery techniques, such as data mining, predictive analysis, and machine learning. This evolution has also enabled the emergence of new trends in business software, mainly in the BI and analytics field, reinforcing the pervasiveness and evolution—due to ease of use—of self-service analytics tools and applications.

Data discovery and visualization as a practice

Knowing some of the basics of data discovery and visualization allows for understanding the importance of this area in any analytics cycle and how it fits within the practice of many disciplines, whether in research or in business. In this context, it is necessary to first consider data discovery and visualization as a practice and not just as a functional part of a particular type of software tool. In other words, data visualization needs to be considered not merely as a product—but as a discipline. This perspective implies that it is more than a set of functions and features. In this light, data discovery and visualization tools need to use the data to tell a story, and that story needs to be accurate, appealing, timely, and, most importantly, relevant.

Developing the right data visualization strategy entails ensuring that the approach complements the rest of the analytics platform and delivers on what is expected from the analytics infrastructure. From an analytics perspective, ideally the process of data discovery and visualization needs to offer:

- An accurate abstraction and interpretation of a real situation, issue, or scenario
- A simplified view that can be used for understanding, analysis, and potential explanation
- An environment for exploration of new potential business opportunities
- A tool for discovery of new analytic avenues—i.e., new trends and facts
- A possible indication of appropriate action

Despite the evolution of software and hardware technology for providing new methods for data visualization, new more impactful and more efficient visualization models still need to be devised. Regardless of the technological innovation, the underlying principles remain the same—enabling users to achieve knowledge and wisdom from the analysis of information.

Data discovery and visualization in the context of BI and analytics

A large number of organizations have already implemented or are in the process of implementing a BI or analytics solution of some kind. Of course the main goal is to enable business analysts, decision makers, and other information workers to monitor, understand, and improve the performance of their business.

As businesses have increased their demand for and consumption of data, a large proportion of this data has fallen outside the reach and scope of traditional BI solutions. This is not to say that some traditional BI solutions do not have the flexibility that a flexible and versatile data discovery and visualization solution has. But data analysis today has been complicated by the different sources and formats of the data that is now available to companies. These sources can range from structured database tables and semi-structured forms to unstructured documents such as free-form text.

Data discovery and visualization solutions can enable rapid and more intuitive exploration and analysis of this widely varied data. It can also provide more interactive and flexible ways to analyze data and uncover insights, affording a new level of visibility into data and business processes. Some benefits may include:

- Easier access to recent data. Data can be delivered in real time or near real time. Users then can analyze and make decisions based on the most recent data at their disposal.
- Increased insight and visibility into the repository of data to help users to find the right data for analysis.
- Data sources (assets) can be reused and discoveries saved—avoiding having to recreate the discovery process each time, thereby helping companies to reduce costs.
- Information workers can create user-oriented discovery artifacts to enable business professionals exploit the available data. This can lead to higher adoption rates and faster time to value of data discovery and visualization solutions.

In the context of incorporating new technologies into the BI and analytics practices of the business, the basic principles of data management remain the same:

- Data is the source of information, and therefore of knowledge and wisdom (figure 5). As such, data must be presented appropriately, in the right context, and at the right time to facilitate decision making and encourage appropriate action.
- Maintaining high-quality data throughout the entire process—from collection to delivery—is key to deriving the highest possible value.
- The success of a BI and analytics solution in producing value depends on how data is not only processed but also delivered and consumed.

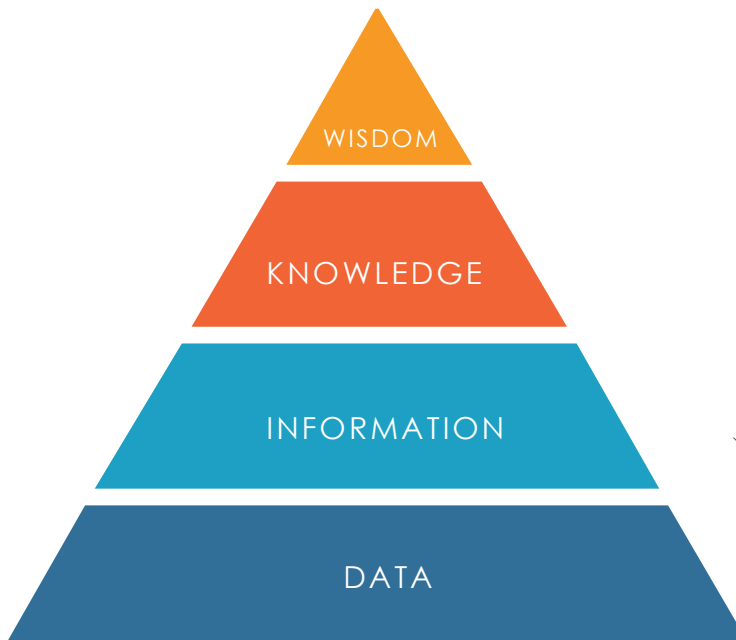


Figure 5. Knowledge pyramid

As analytics and BI practices evolve, it is becoming increasingly evident that a data discovery and visualization tool is needed for delivering data to its final consumer, whether this is an information worker, a business analyst, or a decision maker. Multiformat, multipurpose information must be generated to supply information in the form of the right story to the right people at the right time.

In modern analytics and BI infrastructures, data discovery and visualization capabilities are perhaps the most important vehicle for delivering and transforming data into knowledge. They are fundamental requirements for gaining an understanding of increasingly complex business processes and for generating insight to encourage more informed decision making.

In [Designing Data Visualizations](#), Noah Iliinsky and Julie Steele define important aspects of discovery and visualization as follows:

“ Explanatory visualization: Data visualizations that are used to transmit information or a point of view from the designer to the reader. Explanatory visualizations typically have a specific ‘story’ or information that they are intended to transmit.

Exploratory visualization: Data visualizations that are used by the designer for self-informative purposes to discover patterns, trends, or sub-problems in a data-set. Exploratory visualizations typically don’t have an already-known story. ”

So having data discovery and visualization capabilities allows modern businesses to either arrive at answers to specific questions based on the explanatory nature of visualizations, or to discover new questions and solutions via their exploratory nature (figure 6).

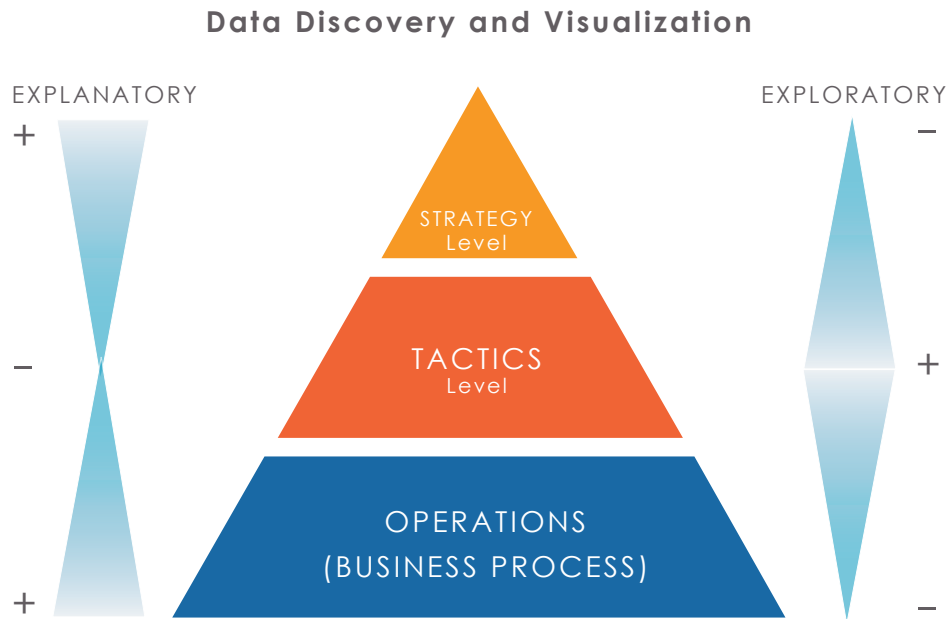


Figure 6. Explanatory versus exploratory visualization usage

Explanatory visualization processes, such as reports and data-driven dashboards, tend to have strong presence in operational and strategic processes or levels. Here the data plays an explanatory role, to facilitate decision making that not only drives and enhances operations, but also improves the business's strategy over the long term. On the other hand, information workers, such as business analysts and data scientists, can “play” with data for tactical purposes: to discover trends and uncover new questions worth asking—for exploratory purposes.

Data visualization in decision making

The practice of data visualization has been progressively taking on a key role in the decision-making process. While improving decision making at executive levels, data visualization also helps to expand the reach of analytics throughout an organization. As a result, the data visualization process is becoming a more relevant and integral aspect of the BI toolset.

The intrinsically dual nature of data visualization—explanatory and exploratory—enables information workers and especially decision makers to base their production on clear and concise visuals. These visuals can be more effective than showing raw data within text

reports or complex electronic sheets. Visual mechanisms can also be used easily for further exploration if additional data is needed to make informed decisions. While decision makers do not necessarily produce the data visuals, they hold them in great regard. Modern tools provide highly interactive data visualization capabilities that enable fast and useful analysis cycles.

The importance of data visualization can be felt in all areas of the organization. Data visualization can have a significant effect on major aspects of decisions made at all levels of the organization—from operational to executive decisions. It has proven critical for:

- Improving operational efficiency
- Detecting and responding to business change
- Identifying business opportunities
- Measuring and monitoring business productivity
- Increasing compliance to both internal and external regulations

Finally, data visualization helps to align the complete decision-making structure, and can even enable more accurate communication company-wide.

DATA DISCOVERY AND VISUALIZATION IN THE BUSINESS PLACE

The right practices and the right tools

Encouraging the use of data discovery and visualization strategies, practices, and solutions is an essential aspect of a modern BI and analytics initiative. Both explanatory and exploratory data visualization tasks can help users discover and resolve problems, analyze large sets of data easier and faster, and obtain results in real time or near real time due to the extreme speed of new hardware and software technologies.

Moreover, having effective data discovery and visualization tools in place helps to not only solve issues but also pose new relevant questions. This encourages the discovery and research process to go beyond pre-established data analysis tasks to explore new patterns and trends that can potentially boost business efficiency. So in essence, data discovery and visualization solutions are a critical component to the BI and analytics process and are paramount to effective data delivery, yet they also incentivize the spirit of original research of data analysis.

Data discovery and visualization tools can allow workers at all levels of the organization—from BI specialists who need to generate the right report, to data scientists who want to explore the data—to use data analysis tools according to their needs. This may include, for example, financial analysts who need real-time information presented in a clear graphical way and data scientists who combine the capabilities for visual slice-and-dice data sets with mining elements such as forecasts and trends.

Challenges

As with any software technology, data discovery and visualization solutions are associated with various challenges. These challenges must be overcome to ensure the efficient practice and operation of data discovery and visualization from both the application and technology perspectives.

A main challenge in a BI and analytics context is to ensure the consistent analysis of data from multiple perspectives and assumptions. The goal is to achieve an understanding of past and present business scenarios and allow for collaborating in all aspects of the analytical process: monitoring, forecasting, and identifying specific recurrences. Under these circumstances, the effectiveness of data discovery and visualization tools also has to do with addressing the following needs:

- **Achieve real-time analytics.** Creating new use cases for data discovery and visualization as well as using new tools that can provide responses at high speed, and be more adaptive and flexible.
- **Gain data discovery and visualization insights into big data projects,** where it is both important and more challenging because of not only the volume of data that must be analyzed but also the diversity of sources and formats of the data (figure 7).
- **Make BI and analytics way more agile** as overall information workers (BI teams, business analysts, data scientists, and decision makers) need to rely on faster and more iterative and efficient methods of turning data into actual business value.



Figure 7. Data discovery and visualization in big data projects (courtesy of SAP [SAP Lumira])

Today's information workers have already recognized the vital importance of data discovery and visualization. While there is a need for better tools and methods, the efficiency and results of these efforts can vary widely depending on the knowledge and practices applied. A good tool must be accompanied by a good method. Data discovery processes are being performed more frequently and in more diverse ways as a complement to every step of the business process. Data discovery and analytics applications can help, for example, analysts to obtain insights and understand the history and development of the stock market. They can also support the decision-making process of an organization—by monitoring the stock market in real time to help take proper actions to gain a specific competitive advantage or gain insights for establishing a more general tactic or strategy.

Also, in many cases, the discovery process can and must become a cycle where the analysis of data to find answers to specific questions helps uncover new areas that require closer examination and new questions that need to be addressed. This results in the collection and analysis of new data sets to produce an ever-improving cycle of discovery.

From a more technical point of view, some of the challenges reside in ensuring that a data visualization strategy contemplates the necessary elements:

- Ensuring a proper **data governance** approach. As users increase their demands for data exploration and gain access to larger and comprehensive datasets for achieving new insights, frustration can quickly set in when access to new data is restricted or denied by the information technology (IT) department. The role of IT is to ensure that all enterprise data is accurate, complete, but, most importantly, secure. With the increase in data volumes, this mandate sometimes places a big burden on IT—to manage the manpower and storage requirements, management costs, as well as data protection issues. And many times it is within data protection in the context of data discovery and visualizations that conflict emerges. This conflict often relates to restrictions and limitations to data availability. IT must find a balance between ensuring that high-quality data is secure from internal as well as external threats while satisfying users' need to access and analyze the data.
- Ensuring efficient and proper **data quality** processes to avoiding uncertainty and provide reliability in data as much as possible. There is a strong association between the quality of the data source and the quality of the information (insights) it can generate. In almost all application fields—ranging from natural sciences to business and information security—data is processed and arranged in many ways and passed through different stages. Ensuring that data is passed through the necessary quality stages is vital to maintaining a clean and efficient discovery and visualization process—from beginning to end.

- Ensuring a full understanding of both the **business logic** and the **problem-solving mechanism**. Problems ought to be solved by understanding not only the data discovery and visualization technology but also the logic, reasoning, and methodologies within diverse fields of business knowledge, problem solving, decision engineering, and decision management, and others disciplines in which the data discovery and visualization technology is being used.
- Ensuring **user adoption and acceptability** to enable new data discovery and visualization techniques to be widely used within an organization. The advantages and proper use of data discovery and visualization tools need to be communicated effectively to all the potential users.
- Ensuring **continuous evaluation** and comparison with previous and parallel systems to enable the continuity and improvement of the data discovery and visualization solution.

In addition, rather than solving these problems individually, it is more important to have an integrated approach or initiative that can provide global solutions to address challenges (despite the difficulty that might represent in the short term). The reality is that the vast majority of these types of solutions need to be effectively integrated within a larger number of solutions, including databases of different flavors, enterprise software solutions, automated analysis tools, and many others. Data discovery and visualization solutions need to fit within a comprehensive BI or data management solution.

Organizational benefits

Data discovery and visualization tools have to keep revolutionizing the BI market in a very significant way—facilitating the provision of self-service BI capabilities. A widespread trend in this area is the simplification of business intelligence—empowering knowledge workers to use data as needed and effectively reduce and simplify processing time from data collection to decision making.

In this sense, some of the clear benefits of these types of tools can be reflected in many aspects of both traditional and modern BI processes. They play an important role in the following:

- Increasing operational efficiency.
- Increasing effectiveness for detecting/responding to business changes.
- Increasing collaboration for identifying business opportunities.
- Increasing means for measuring/monitoring business productivity.

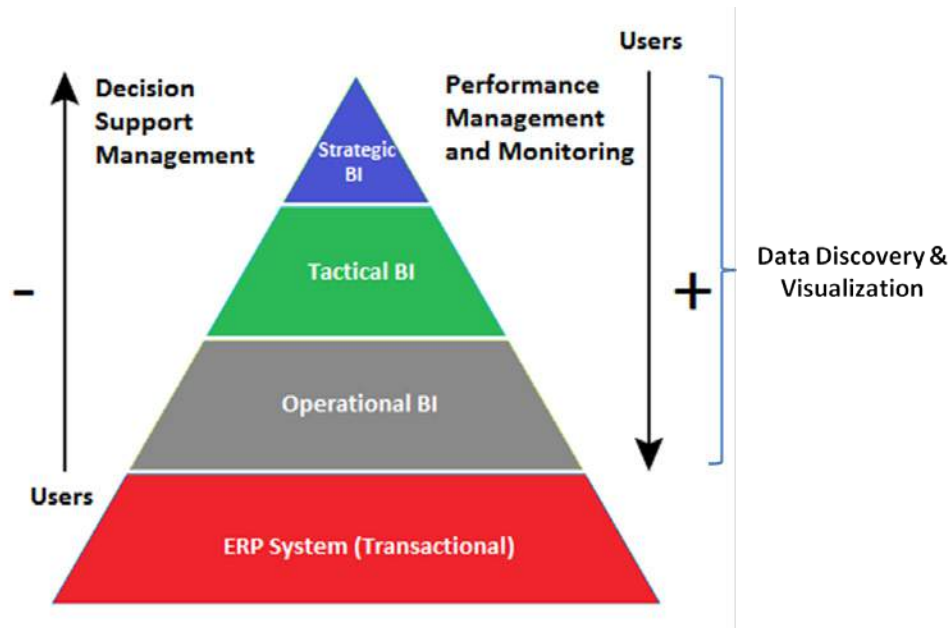


Figure 8. Data discovery and visualization solutions are key players in encouraging the use of data analysis in all stages of the business

The increasing adoption of data discovery and visualization technologies, along with other automated analytics techniques such as predictive and machine learning, are encouraging the so-called datification phenomena. Described by Kenneth Cukier and Viktor Mayer-Schönberger in articles such as [The Rise of Big Data](#), these phenomena denote the organization's ability for processing data from all types of sources and all types of formats as being limited only by the creative and analytic abilities of its users. This represents a real shift to the traditional approaches to data in BI and analytics.

Trends

As data discovery and visualization technologies have evolved in many business and industries, some clear trends have emerged as important factors driving the adoption of these tools. Below is a list of important trends based on my observations of the industry:

- **Mobile.** Continuous increase of usage of data discovery and visualization tools within mobile devices—enabling users to consume data independently of the device (figure 9).
- **Self-service plus automated analysis.** An increase in the merging of automated (mainly predictive analysis and machine learning techniques along with other techniques) within self-service and interactive visualizations—granting access of advanced analytics tools to a wider and inexperienced user audience while closing gaps within some analytics processes (figure 10).

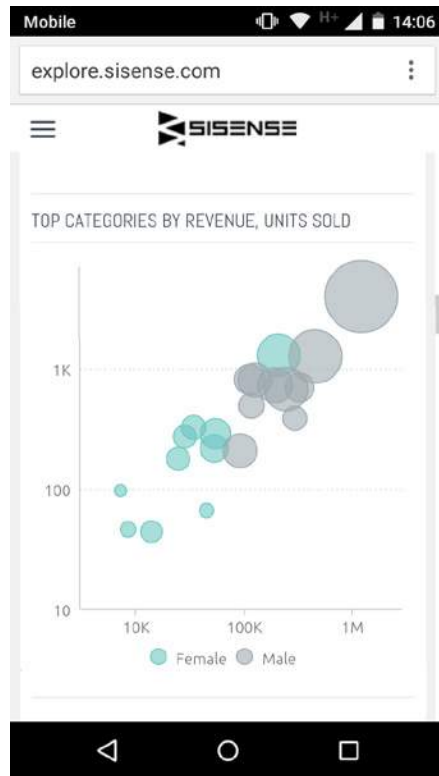


Figure 9. Data discovery and visualization on a mobile device (courtesy of Sisense)

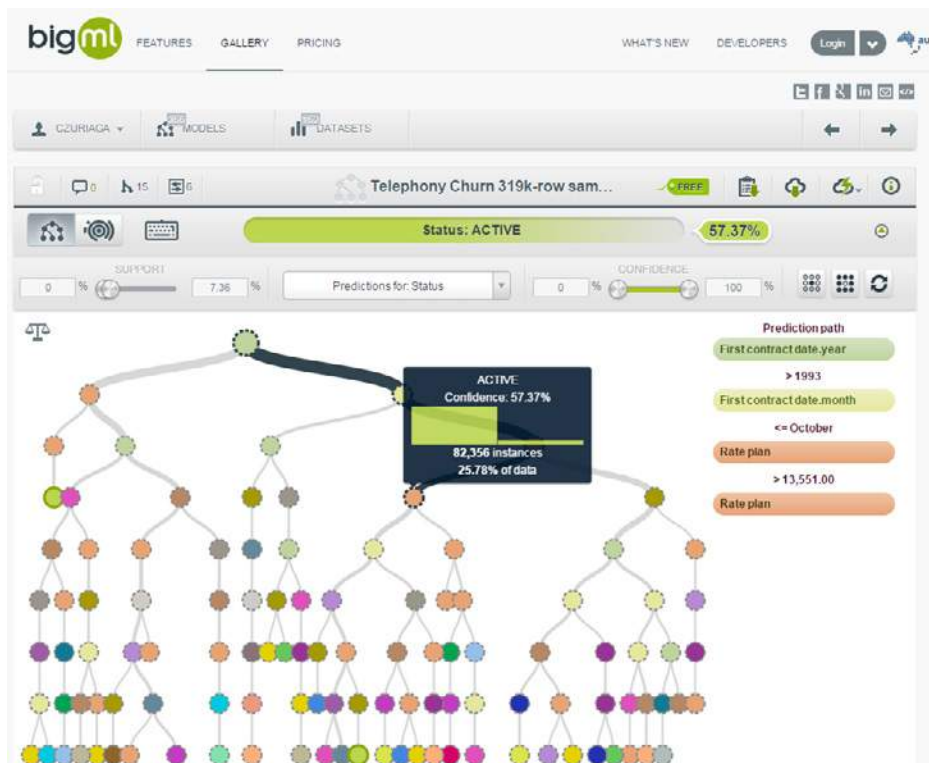


Figure 10. Data discovery and machine learning via BigML (partial image; [full image available](#), courtesy of BigML)

- **Guidance tools.** The incorporation of tools for helping users through the process of analysis (guided analysis). This can range from automatic recommendation of graphs based on the type of data to the selection of a specific predictive algorithm based on a best practice scenario. Many software providers of data discovery tools are increasingly offering these guidance tools in their software packages.
- **Story telling.** Many software providers are expanding the capabilities of data visualization tools beyond the ability to show data in an effective way—to enabling users to build a full story about or scenario around the data. From creating connected series of visualizations to full-blown slide-like presentations, some data visualization products seek to empower users by enabling them to build the full story behind the data (figure 10).
- **Data mashups.** The need for faster elaboration of analytics processes has created a need for new and diverse sources of data. In some cases, data needs to be analyzed on the spot without having a rigorous data quality and profiling process. One example of this would be for sampling or analyzing a very recent event. More and more software providers are enabling the collection of data from both conventional and “unconventional” sources to produce new visualizations in real time. This creates mashups of data visualized in real time. These collections of data can help organizations gain immediate insight into emerging trends and business opportunities.



Figure 11. Tableau's storytelling capabilities in preview thumbnails (courtesy of Tableau)

Other trends currently being adopted by some organizations include the incorporation of even more advanced analytics capabilities such as cognitive computing techniques. The case of IBM Watson is an example that can have a huge potential impact over the analytics and business intelligence market.

Watson Analytics, an advanced analytics solution offered by IBM, is what the company calls a “smart data discovery” solution. It uses a mix of analytics techniques and methods such as predictive analytics, machine learning, and advanced cognitive techniques like neural networks and artificial intelligence to automate the process that goes from collection, through analysis, to insight. The potential of Watson resides in the system’s ability to start the analytics process via a simple query, even a simple question in natural language.

The tool has the potential to be applied in multiple scenarios and use cases. For example, Watson Analytics can help companies to expedite their risk management strategies. In this case, it can help a utilities company, for example, reduce employee turnover, number of accidents of a fleet, or asset downtime by analyzing data in real time and detecting failure patterns within the company.

These and other cases are just a few of the large number of potential applications of technologies such as IBM Watson Analytics. Other relatively new offerings include CognitiveScale and the manufacturing-based solution SaffronStreamline. CognitiveScale delivers cognitive applications in the cloud via its Cognitive Cloud Fabric offering. And SaffronStreamline applies and combines semantic connection and raw statistical frequency techniques to offer systems that adapt as new data is received.

While a significant number of new and innovative solutions are already having a large impact on the market, new offerings are taking the software industry for surprise and rapidly evolving the data discovery and visualization market. Without a doubt, we are far from hearing the last word on these types of solutions.

DATA DISCOVERY AND VISUALIZATION SOLUTIONS

This buyer's guide provides a comparison of the general capabilities of 10 vendors of data discovery and visualization solutions that are considered to be innovative.

Besides some general considerations on the vendor solutions featured, including geographic coverage, licensing and pricing schemas used, and whether the solution complies with established regulations, this guide also explores some of the most important capabilities to consider when evaluating data discovery and visualization solutions, including data security and data movement as well as integration with big data sources.

These vendors have extensive functional coverage and/or have a strongly marketed presence in the cloud BI and analytics software space. This is by no means an exhaustive set of all vendors that exist in the market. Not all solutions currently available in the market can be included here due to space limitations.

Please note that the information provided here is intended as a guide only, and is meant as a starting point for software evaluation. To determine whether a particular solution meets your organization's specific requirements, you will need to conduct a more comprehensive evaluation and comparison analysis (and consider factors such as reliability of partner network, implementation, and maintenance and support services, among others).

Data Discovery and Visualization Solutions		InetSoft	Qlik	GoodData Corporation	Microsoft
Criteria		Style Intelligence	Qlik Sense	Analytics Distribution Platform	Power BI
Region Served	North America	S	S	S	S
	Central and South America	S	S	T Via TOTVS	S
	Asia-Pacific	S	S	S	S
	Europe, the Middle East, and Africa	S	S	S	S
Delivery Mode	On premise	S	S	NS	S
	SaaS (multitenant/virtual)	NS	S Free version only	S	S
	PaaS (hosted via a public cloud provider)				
	Amazon AWS	S	S	NS	NS
	Google Cloud Platform	NS	S	NS	NS
	Red Hat OpenShift	NS	S	NS	NS
	Rackspace	NS	S	S	NS
	Windows Azure	NS	S	NS	S
	Other	NS	S	T GoodData operates its own private cloud; hardware is provided by Rackspace	NS
Licensing and Pricing	Subscription-based				
	By user/role	S	S Perpetual, not subscription	S	S
	By node/server	S	S Perpetual, not subscription	S	NS
	Consumption-based				
	By data storage/access	NS	NS	S	NS
	By processor/data usage	S	NS	NS	NS
Security	Encryption of data at rest and data in transit	S	S	S	S
	Role/User-based security	S	S	S	S
Data Movement	Data is hosted within internal repository	NS	S	S	NS
	Data is passed from the source to the BI app	S	S	S	S
Analysis	OLAP services	S	S The associative model—not cube based—delivers unrestricted exploration and discovery	S	S
	In-memory analytics capabilities	S	S	S	S
	Operational analytics/BI capabilities	S	S	S	S
Advanced Analytics	Predictive analytics	T	T	S	S
	Data mining	T	S	A Via Vertica and connection with R	S
	Machine learning	NS	NS	S	S
	Text/Sentiment analytics	T	T	S	S
Data Visualization & Discovery	Interactive visualization	S	S	S	S
	Visual drill-down/up/across	S	S	S	S
	Chart and visual recommendations	S	S	S	S
	Reporting and analysis	S	S	S	S
	Dashboarding	S	S	S	S
	Metrics and KPI creation on the fly	S	S	S	S
	Sorting and ranking	S	S	S	S
	Addition of unstructured data	T	T	S	S
	Enterprise data search	NS	S Global search within BI app across all dimensions	S	S
	Geospatial capabilities	T	S	S	S
	Collaboration over data and analysis	S	S	S	S
	Microsoft Office integration	S	S	S	S
	Storytelling features	NS	S	S	S
	Guided discovery	NS	S	S	NS
	Data preparation	S	S	S	S
	Metadata management	S	S	S	S
	Data quality	NS	S	S	NS
	Data integration	S	S	S	S
	Offline capabilities	NS	S Qlik Sense Desktop for Windows	NS	S
Big Data Integration	Hadoop	S	S	S	S
	Hive	S	S	S	S
	HBase	T	S	S	S
	Cassandra	T	S	S	S

S Supported | A Supported with additional application | T Supported with third-party provider (partner) | NS Not supported

BI, business intelligence; KPI, key performance indicator; OLAP, online analytical processing; PaaS, platform as a service; SaaS, software as a service.

Data Discovery and Visualization Solutions		Dundas	IBM	IBM	SAP
Criteria		Dundas BI	Cognos Business Intelligence	Watson Analytics	SAP Lumira
Region Served	North America	S	S	S	S
	Central and South America	S	S	S	S
	Asia-Pacific	S	S	S	S
	Europe, the Middle East, and Africa	S	S	S	S
Delivery Mode	On premise	S	S	NS	S
	SaaS (multitenant/virtual)	NS	S	S	S
	PaaS (hosted via a public cloud provider)				
	Amazon AWS	S	NS	NS	S
	Google Cloud Platform	S	NS	NS	NS
	Red Hat OpenShift	NS	NS	NS	NS
	Rackspace	S	NS	NS	NS
	Windows Azure	S	NS	NS	S
	Other	NS	NS	NS	S SAP HANA Enterprise Cloud
Licensing and Pricing	Subscription-based				
	By user/role	S	S	S	S
	By node/server	NS	NS	NS	NS
	Consumption-based				
	By data storage/access	NS	NS	S	S
	By processor/data usage	NS	NS	NS	NS
Security	Encryption of data at rest and data in transit	S	S	S	S
	Role/User-based security	S	S	S	S
Data Movement	Data is hosted within internal repository	S	S	S	S
	Data is passed from the source to the BI app	S	S	NS	S
Analysis	OLAP services	S	S	NS	T
	In-memory analytics capabilities	S	A	S	S
	Operational analytics/BI capabilities	S	S	NS	A
Advanced Analytics	Predictive analytics	S	A	S	S
	Data mining	NS	A	S	A
	Machine learning	NS	NS	NS	A
	Text/Sentiment analytics	NS	A	NS	A
Data Visualization & Discovery	Interactive visualization	S	S	S	S
	Visual drill-down/up/across	S	S	S	S
	Chart and visual recommendations	NS	S	S	S
	Reporting and analysis	S	S	S	S
	Dashboarding	S	S	S	S
	Metrics and KPI creation on the fly	S	A	NS	S
	Sorting and ranking	S	S	S	S
	Addition of unstructured data	T	NS	NS	S
	Enterprise data search	S	NS	NS	A
	Geospatial capabilities	S	S	NS	S
	Collaboration over data and analysis	S	S	S	A
	Microsoft Office integration	S	S	S	A
	Storytelling features	S	NS	S	S
	Guided discovery	S	A	S	S
	Data preparation	S	NS	S	S
	Metadata management	S	S	NS	A
	Data quality	A	A	S	S
	Data integration	S	S	NS	S
	Offline capabilities	NS	S	NS	S
Big Data Integration	Hadoop	T	S	NS	S
	Hive	S	S	S	S
	HBase	T	NS	NS	T
	Cassandra	T	NS	NS	T

S Supported | A Supported with additional application | T Supported with third-party provider (partner) | NS Not supported

BI, business intelligence; KPI, key performance indicator; OLAP, online analytical processing; PaaS, platform as a service; SaaS, software as a service.

Data Discovery and Visualization Solutions		SAP	Sisense	Tableau	Panorama Software
Criteria		BusinessObjects Business Intelligence	Sisense	Tableau Server, Desktop, Online	Panorama Necto
Region Served	North America	S	S	S	S
	Central and South America	S	S	S	T
	Asia-Pacific	S	S	S	S
	Europe, the Middle East, and Africa	S	S	S	S
Delivery Mode	On premise	S	S	S	S
	SaaS (multitenant/virtual)	A SAP HANA Enterprise Cloud	NS	S	S
	PaaS (hosted via a public cloud provider)				
	Amazon AWS	S	S	T	S
	Google Cloud Platform	NS	NS	NS	NS
	Red Hat OpenShift	NS	NS	NS	NS
	Rackspace	NS	S	NS	NS
	Windows Azure	S	S	NS	S
	Other	NS	S	NS	S
Licensing and Pricing	Subscription-based				
	By user/role	S SAP HANA Enterprise Cloud & AWS via Decision First	NS Scalable annual pricing	S	S
	By node/server	NS	NS Scalable annual pricing	NS	S
	Consumption-based				
	By data storage/access	S Concurrent sessions	S	NS	NS
	By processor/data usage	S In old license	S	NS	NS
Security	Encryption of data at rest and data in transit	S	S	S	S
	Role/User-based security	S	S	S	S
Data Movement	Data is hosted within internal repository	S Lumira Server	S	NS	NS
	Data is passed from the source to the BI app	S	S	S	S
Analysis	OLAP services	S	NS	S	S
	In-memory analytics capabilities	A SAP HANA optional	S	S	S
	Operational analytics/BI capabilities	S	S	S	S
Advanced Analytics	Predictive analytics	A Via SAP HANA	S	T	S
	Data mining	A Via SAP HANA	S	T	NS
	Machine learning	A Via SAP HANA	NS	NS	S
	Text/Sentiment analytics	A Via SAP HANA	T	T	NS
Data Visualization & Discovery	Interactive visualization	S	S	S	S
	Visual drill-down/up/across	S	S	S	S
	Chart and visual recommendations	S	S	S	S
	Reporting and analysis	S	S	S	S
	Dashboarding	S	S	S	S
	Metrics and KPI creation on the fly	S	S	S	S
	Sorting and ranking	S	S	S	S
	Addition of unstructured data	S	S	NS	S
	Enterprise data search	A	S	S	S
	Geospatial capabilities	S	S	S	S
	Collaboration over data and analysis	A	S	S	S
	Microsoft Office integration	S	T	S	S
	Storytelling features	S	T	S	S
	Guided discovery	S	S	S	S
	Data preparation	S	S	S	S
	Metadata management	A	S	S	S
	Data quality	A Via SAP Data Services	NS	S	S
	Data integration	A Via SAP Data Services	S	T	S
	Offline capabilities	S	S	S	NS
Big Data Integration	Hadoop	T Via Apache HIVE	S	S	S
	Hive	A Via SAP HANA	S	S	S
	HBase	T Via Apache HIVE	A	S	S
	Cassandra	T Via Apache HIVE	A	S	NS

S Supported | A Supported with additional application | T Supported with third-party provider (partner) | NS Not supported

BI, business intelligence; KPI, key performance indicator; OLAP, online analytical processing; PaaS, platform as a service; SaaS, software as a service.

ASSESSING YOUR DATA MANAGEMENT AND DISCOVERY READINESS

From small to medium businesses (SMBs) to large corporations, one of the biggest challenges today is the “data management and discovery” aspect of an organization. In many organizations, data comes from an increasing number of (and increasingly disparate) sources. These sources can be enterprise resource planning (ERP) systems, customer relationship management (CRM) applications, workforce automation systems, etc.

Today, organizations are generating an increasing amount of data. This is because they are generating more data transactions, and there is more interaction between systems—both internal and external to the organization. To be able to discover and visualize data properly, companies need to effectively manage their data. Most of the time, an organization’s inability to manage its data as needed reflects difficulty (or impossibility) with obtaining a snapshot of the business at any given moment. But it also has to do with being unable to obtain the necessary insight for planning and taking action. The end result is that the decision-making process, business performance, and the ability to predict and forecast are all impeded.

While organizations are eager to grow, they may risk losing control over the business and its infrastructure if the proper measures are not in place for expanding their corporate applications. This is especially pertinent for those applications that enable data discovery and analysis as well as the creation of frameworks for strategic planning and decision improvement. Regardless of the number of triggers present in your organization for improving data discovery and visualization technologies, it is necessary to address three fundamental questions:

- Where do you stand in regard to properly handling data?
- What are your urgent data management needs?
- How do you evolve from reactively to proactively handling your organization’s data?

To answer these questions, it is important to consider the maturity level of your data management infrastructure and strategy. This will help you to describe, explain, and evaluate the growth cycle of your current BI infrastructure across the different stages of the data management process. It will therefore serve as the basis for establishing how your data discovery and visualization capabilities can evolve and for addressing specific high-priority needs.

The data readiness assessment questionnaire included in this guide provides a quick overview of some of the criteria to consider when assessing the maturity of your current data management and discovery platform solution. It can help you determine how well your organization is dealing with data for analysis, discovery, and visualization.

For each BI element, identify the closest match to your organization's profile and add the corresponding number of points (indicated under each question). Tally your total score, and then refer to the legend below this grid for your results.

Phase		√	Value
Data Management	Data is stored and collected from source systems (ERP systems, CRM applications, etc.) with no integration		2
	Data is collected from enterprise systems (ERP, CRM, etc.) and copied into special repositories (data marts)		2
	Data is collected from source systems (ERP, CRM, etc.) into a more sophisticated repositories (data warehouses, enterprise information management [EIM] systems)		6
	Data is collected from source systems (ERP, CRM, etc.) and there is a corporate data management strategy (data warehouses, enterprise information management [EIM] systems, data marts) in place to serve different business needs		8
Data Collection	Data is collected by a combination of manual and automatic processes		2
	Data is collected mainly using automatic extraction, transformation, and loading processes		6
	Data is collected from a wide variety of sources, both historical and real time (social media sources, business activity monitoring [BAM] systems, etc.)		8
	Data is collected in different formats (structured, unstructured)		10
Data Quality	No data quality and cleansing strategy		2
	Basic data quality and cleansing strategies are applied for basic validation		2
	Reliable data cleansing and data quality processes are in place		6
	Robust data cleansing and data quality processes are in place		8
	Corporate data quality strategy is in place		10
Common BI Functionality	Spreadsheets are the main tool for data manipulation and analysis		2
	Extensive use of spreadsheets, combined with other applications, for data manipulation and analysis		2
	Infrequent use of spreadsheets (i.e., for specific tasks only)		10
	Basic use of reporting and analysis tools		2
	Reporting tools are commonly available for information delivery		6
	Extensive use of reporting and analysis tools for information delivery and data research		8
	Basic use of online analytical processing (OLAP) cubes and interactive data analysis tools		2
	Extensive use of OLAP cubes and interactive data analysis tools		6
	Dashboards and scorecards display business metrics and basic key performance indicators (KPIs)		2
	Use of dashboards and scorecards to display business metrics and basic KPIs		6

Phase		√	Value
Data Discovery & Visualization	Data is available for analysis using traditional batch processes, with significant latency (several hours, days) between time of collection and time to analysis		2
	Data is available for analysis, with minor latency (several minutes, a couple hours) between time of collection and time to analysis		6
	Data is available for analysis, with minimal latency (a couple minutes, seconds, real time) between time of collection and time to analysis		8
	Users (mostly business) have basic access to discovery and visualization tools for performing interactive analysis of data only for informational purposes (basic data sampling)		2
	Users (business, decision makers) have access to discovery and visualization tools for performing interactive analysis of data with direct impact on decisions		6
	Users (business, decision makers, and data scientists) have extensive access to discovery and visualization tools for performing interactive analysis of data with direct impact on decisions as part of a decision-support process		8
	Data discovery and visualization tools generally work in isolation from other advanced automated analytics features (if these advanced tools exist)		2
	Data discovery and visualization tools are embedded within other advanced automated analytics features and used as part of the decision-making process		6
	Data discovery and visualization tools are embedded within other advanced automated analytics features and are essential to the decision-making process		10
	Data discovery and visualization are used sparsely across the organization—mostly at individual levels		2
	Data discovery and visualization tools are used narrowly within specific business units		6
	Data discovery and visualization tools are part of each individual business unit of an organization		8
	Data discovery and visualization tools are an essential component of the BI platform and strategy of an organization		10
Advanced BI	Use of predictive data analytics		2
	Use of forecasting techniques and tools		4
	Use of industry vertical-specific predictive analytics		6
	Use of data, text, and Web mining		8
	Extensive use of planning and budgeting applications		2
	Performance management strategy is in place, including balanced scorecards, etc.		4
	Performance is managed at or near real time		6
	It's possible to view the performance of specific business processes		8
	It's possible to manage performance at all levels of the organization		10
	Total		

30 or less points—Usable Data

There is a basic or no formal implementation of BI processes. Data is collected and treated in raw form, and there is lack of data quality, which frequently causes frustration. The information generated is often not of adequate quality to guide the organization's business strategies or business performance improvement. It mainly serves for accountability purposes.

31 to 50 points—Reactive Data

There is a basic or more formal BI process in place, and data is treated with a basic and systematic approach. Still, data flows too slowly to be useful information. The organization's BI process is limited to reacting to actual and/or historical conditions. Data is gathered from internal sources, which does not reflect all the levels of information required for improving the performance of the business.

51 to 90 points—Proactive Data

There is a more robust BI strategy in place. The cycle from data collection to information generation is automatic, and many of the processes for this purpose have already been established and improved upon. Organizations are now starting to do more than just review historical information. They can analyze scenarios, do basic predictions and forecasting, and implement new technologies for these purposes. Organizations at this stage have come to realize the importance of data as a valuable asset, and are frequently working to deploy data-related initiatives (data quality, corporate data management, and data discovery and visualization).

91 or more points—Strategic Data

Organizations at this stage already have a robust BI process in place. Data management initiatives are a common part of the corporate life. These types of organizations are now mainly looking for ways to tighten all levels of leadership—from operational to strategic—and are putting special emphasis on aligning their data strategies with their tactical and strategic goals. There is a search for initiatives that will let them use information as a real competitive advantage by processing data in real time and gathering information from external sources such as social media channels. Organizations at this stage are trying to solve corporate issues such as big data handling and information governance.

Please note that the information provided here is intended as a guide only, and is meant as a starting point for a self-assessment. To perform a complete assessment of the data management capabilities of your organization, you will need to conduct a more comprehensive evaluation.

TEC Resources

TEC Analyst Reviews

Dundas: BI Software with Intuitive, Interactive Data Visualization and Analytics

Dundas: TEC Certification Report: Dundas BI for Business Intelligence

IBM: Data Visualization: When Data Speaks Business

IBM: IBM Analytics for Higher Education: Increasing Student Retention and Growing

Tableau: Version 9.0 Expands Tableau's Analytics and BI Reach

Related White Papers

A New Generation of Business Analytics: Beyond BI and Data Discovery Tools

Making Big Data Actionable: How Data Visualization and Other Tools Change the Game

The Next Stage in Creating the Value-added Finance Function: Turning Data into Insight and Business Actions

Business Intelligence Software Evaluation Tools

Note: The tools below are for general BI software solutions, some of which may include data discovery and visualization applications.

Request for Proposal (RFP) Templates

Get detailed, customizable enterprise software feature lists for your BI software evaluation

Software Evaluation Reports

Get side-by-side comparisons of BI enterprise software solutions

In-depth Software Evaluation

Use TEC's online software evaluation system, TEC Advisor, to see how BI software solutions address your company's unique business requirements. **Start your online evaluation now.**

Five Essentials to Selecting the Best Software Solution for Your Company

Software selection is among the most important decisions companies ever have to make. Technology is not just a framework for business processes but a tool that can be used to improve processes, increase competitive advantage, and better the bottom line.

Denis Rousseau, Director of Project Delivery, Selection Services, at Technology Evaluation Centers (TEC), has helped dozens of companies with their software selection projects in a career spanning more than 25 years. He has developed five guiding principles that he says can make or break success in enterprise software selection.

1. Examine your motives

The first step in a software selection process is to closely examine the rationale for acquiring a new software solution. “The very first question to ask—and make sure really gets answered—is ‘why are we acquiring a new system?’ Is it because of expansion at the manufacturing plant, getting rid of an old system because it no longer suits your needs, or because of a recent acquisition? If you can’t make a real business case for it, the process later on won’t work,” says Rousseau.

This is a critical stage in software selection, because it allows for the most important foundations—clarity and commitment. A unified focus with clear objectives. When this decision is made well and communicated to the right people, you empower the process from the beginning and set off on the right foot.

2. Make it a business decision, not an IT decision

Upper management commonly misperceives software selection as the territory of the information technology (IT) department alone. But assigning the work chiefly to IT without involving all affected departments can mean the final selection decision is both uninformed and unsupported by the final users: the very worst scenario for what amounts to a very big decision.

To avoid strong resistance during software implementation, or even worse, having to make a “bad fit” software system mesh with your business processes, it’s wise to realize from the outset that software selection needs to be a holistic business decision with high-level sponsorship. That means all C-level executives and implicated department managers need to be involved from the start, including in the initial decision to move ahead.

3. Deploy the right team

Rousseau has identified three key roles to fill when starting the enterprise software selection process in earnest: a *sponsor*, a *project manager*, and *internal subject matter experts*.

Every software selection project needs a sponsor. He or she should come from a level of management that has influence over all the areas of the organization that will be supported by the new system. This may be a C-level executive if the solution is to be used to standardize business processes in a smaller company. Or it may be the head of a specific division if the solution will involve limited operations. The sponsor will add visible support to the selection process, and can help to work out any higher issues that arise.

The software selection process also requires a dedicated *project manager* to oversee the process from start to finish. The project manager may come from within the organization or be brought in from the outside. He or she is responsible for ensuring the appropriate resources are identified and assigned to different phases of the project, tasks are coordinated in a logical manner, milestones are achieved as anticipated, and emerging issues are promptly addressed. Communicating the project plan and their role within the overall plan to all participants is key.

Lastly, Rousseau emphasizes that you must spend time identifying the people in your company who are *subject matter experts (SMEs)*—knowledgeable staff with a deep understanding of how the business works on a daily basis. He recommends casting a wide net when identifying these SMEs, as they may include senior staff with years of inside knowledge of the business as a whole, or junior employees with the vision to imagine how new software may create efficient change.

With their specific expertise in company processes, these stakeholders play a key role in the crucial requirements-gathering phase. “People who actually understand the business processes best need to be involved at the start, respected as opinion leaders, and conceived of as the future power users of the solution,” says Rousseau.

4. Let your business requirements write the map

In the beginning stages, the only criteria appropriate to consider are the features and functions needed to support the relevant business processes. Everything else is secondary, including cost, cautions Rousseau. “There’s no point purchasing a solution in your price range if it doesn’t do what you need it to. Focus first on defining your business requirements to the exclusion of all else.”

Rousseau emphasizes that the thoroughness of the requirements-mapping phase is crucial to success, and that this is where most companies fall short. “You have to establish a basis for comparison which includes critical deal-breaking items. It’s the small details that can make a system entirely unsuitable,” says Rousseau, recalling the case of a coffee producer who selected an accounting solution without realizing it could not handle their unique accounting-periods calendar.

Taking inventory of business processes and establishing subsequent requirements sounds simple but can be surprisingly difficult, especially from the inside. Experts in business process management and software selection can shorten the time it takes to elicit clarity from SMEs and other stakeholders, which brings us to the last of Rousseau’s essential guidelines.

5. Match the sales proficiency of software vendors with software selection expertise

Much like commercial real estate or mergers and acquisitions, enterprise software selection should be understood as a unique area of specialization with its own experts, methodologies, and sets of tools. Software vendors are highly specialized sales professionals who should be met with equal proficiency on the buyer’s side.

Would you allow someone without any experience to do your materials selection and purchasing for you? Probably not. “Just the same,” says Rousseau, “don’t leave software selection to someone without the necessary experience to be efficient and effective the first time around. Consider who is in charge of your next software selection initiative, and if they don’t have extensive experience in this area, look to get them the help they need.”

That help may come in several forms. Software industry analysts can shed light on what’s available and trending in software application areas, and can tailor to specific industries and verticals. Tools like decision support systems are available to focus your selection process and define your business requirements. And selection consultants come armed with incomparable expertise in selection methodology, vendor tactics, and best practices for optimal outcomes.

“Don’t leave software selection to someone without the necessary experience to be efficient and effective the first time around.”

Denis Rousseau, Director of Project Delivery, Selection Services, Technology Evaluation Centers

As Rousseau concludes, “Software selection is a high-stakes gambit. I’ve seen costly disasters and fantastic successes. But you can significantly improve the risk-to-reward ratio if you think carefully about your motives, involve the right staff, let your business requirements lead, and bring in some form of expertise to even the playing field.”

Read more about TEC’s [approach to software selection and assessment](#).

To learn more about our enterprise software evaluation and selection services, visit the [TEC website](#) or [email us](#).

“Software selection is a high-stakes gambit. But you can significantly improve the risk-to-reward ratio if you think carefully about your motives, involve the right staff, let your business requirements lead, and bring in some form of expertise to even the playing field.”

Denis Rousseau, Director of Project
Delivery, Selection Services,
Technology Evaluation Centers



CASEBOOK

Easy Data Discovery with Smart Data Transitions

Data animations and transitions

What does your data communicate? Can you see the correlations and insights hiding in your data? Visual analytics tools that let you explore data, rather than simply view it, result in a better understanding of the underlying data as well as providing opportunities for deeper insights. Smooth, animated data transitions makes interactive data analysis and visualization even easier, allowing users to easily follow data changes and quickly see data correlations and trends.

In their visualization study, “Animated Transitions in Statistical Data Graphics,” Jeffrey Heer and George G. Robertson of the University of California, Berkeley (2007) conducted two controlled experiments to assess the efficacy of animated transitions. They found that participants significantly preferred animation over static transitions and that appropriately designed animated transitions significantly improve graphical perception of analysis. Their study provides strong evidence that, “with careful design, animated transitions can improve graphical perception of changes between statistical data graphics.” In their study they noted that, “overall, subjects were highly enthusiastic about animated data graphics, and felt that it facilitated both improved understanding and increased engagement. The vast majority of participants wanted to use animated data graphics in their own analysis and presentation.”

Data discovery and animation in data visualization

Data discovery allows you to quickly and easily analyze your data in a meaningful way. Data discovery is typically easier when the data is visualized (rather than when the data is in a tabular display, row by row). The discovery process is powered by interactions such as filter, sort, drill-down/up, zoom, etc. These interactions help you to understand how the data behaves under different scenarios and ultimately enables you to gain insight and draw some conclusions.

Data animations enable you to easily convey changes over time or the transitions between states and help to show a full data process and path where it is difficult to express with static graphics or text alone. The concept of data animation has been known for a while in the data visualization space but is often used only for the sake of making the data visualization look a bit more visually appealing (“sexy”) rather than contributing to the data discovery process. Oftentimes, users would like to make sure that gauge needles can be animated just because it looks “cool.” Often after they start using the animation on the visualizations they “get tired” of those animations as the “cool” effect is not as exciting as it was at first; now it’s just a waste of time as they need to wait until the animation is done loading the data so they can see the actual data value. The data transitions in Dundas BI are designed to allow the user to comprehend each type of change made to a visualization when the data changes. These real-time, animated changes are readily visible, greatly enhancing data analysis. Dundas BI data transitions ensure that users quickly understand the relationship between the current and previous views without effort, see trends more easily, and present their data more effectively.

Data discovery becomes much smarter with animations and transition changes added to your data visualization, including

- Change the axes of the chart
- Reorder the data or filter the data
- Change the data or re-visualize the data

Each data transition is independent and allows users to explore and interact for an in-depth data discovery and analysis.

Dundas BI features a canvas-like environment where users can drag and drop measures, dimensions, or predefined metric sets and then customize for discovery. The visual discovery environment within Dundas BI includes an intuitive drag-and-drop dashboard designer to provide visual data discovery. To make visualizations more immediately explorable, the “Re-visualize” button and visualizations menu in Dundas BI provides the ability for users to sort, filter, and drill up and down, with best-practice animations that visually show the user the impact of changing dimensions within visualization outputs.

“Data transitions can readily support your data discovery by helping you better understand the effect of the interaction you applied to your data.”

How data transitions enable data discovery

At Dundas we believe that data transitions, if applied correctly can do much more than just add cool effects to your data visualizations. Data transitions can readily support your data discovery by helping you better understand the effect of the interaction you applied to your data. A well-known example is the illustration by Hans Rosling of “200 Years That Changed the World.” In this example, Rosling uses interactive animations to visualize how all the countries of the world have developed since 1809, showing the change in life expectancy and income per person over the last two centuries. Rosling demonstrates how moving the data points over time can help the user better understand the trend changes that may be too complex to spot compared to a single image or a series of static images. See [200 Countries, 200 Years, 4 Minutes](#).

“A good data visualization will let you interact directly with that data, drill down into its details, see it from multiple perspectives, and draw your own conclusions.”

Data transitions in Dundas BI

In Dundas BI, transitions are built-in and designed to easily allow the user to identify and comprehend each type of change made to a visualization when the data changes. Data transitions are applied by default on any data interaction users may apply. Each interaction will drive a transition that helps the user better understand the data changes he/she just triggered, for example, a drill down. A drill down breaks the data into distinct categories. For example, when the user selects a certain time period and point showing data at the quarter level and wants to drill down to see the data at the month level, instead of having the chart show the data across all the months of the selected quarter at once or using a random animation, Dundas BI chart is using smart transition that will display the changes to the user in stages:

Stage 1: The user notices that higher number in the third quarter and wants to drill down into it to break it down.

Stage 2: The user will notice the data points change by having all the non-selected quarter data points disappear and having the selected quarter data point split into 3 different points (one for each month of that quarter). This helps the user notice what the selected data points represent (in this case 3 different months).

Stage 3: The axis range will now change to reflect the appropriate range of the new data points (the 3 months). This is important as the user may start by viewing data at the one level that could, for example, range in the millions and then drill down into another level that ranges in the thousands. Having the transition done in stages rather than at once will help the user notice the range change and better grasp the magnitude of the data points.



Similar concepts apply for other data interactions:

Drill Up—The data points will be joined to form one data point that reflects the level change and appropriate grouping at the new level.

Sorting—The data point movements are staggered or spread out slightly to allow the eyes a better chance to follow each movement.

Filtering a Trend—Newly added data points will show in order to reflect the trend changes over time.

Re-visualizing from a Stacked Bar to a Side-by-side Bar Chart—The stacked bars will split up into the different series but keep the grouping cluster, helping support the user's understanding of the different series and the overall group they belong to.

Visual encoding such as shape, color, and size can be used to visually differentiate data dimensions. It's important that users clearly understand why a change is happening, and what is changing, so that the data transition is easily followed and data discovery is enhanced.

Benefits of animated data transitions

- Improves perception of changes between statistical data graphics
- Helps tell the story of data changes through time in a meaningful way
- Improves user interaction and understanding
- Enhances visual presentation and communication of the cause-and-effect relationships

A good data visualization will let you interact directly with that data, drill down into its details, see it from multiple perspectives, and draw your own conclusions. Interactive visualizations offer different ways to segment, filter, zoom, aggregate, analyze, and extract the data; they make it possible to view the data set from different perspectives or scales simultaneously.

"In a visualization, animation might help a viewer work through the logic behind an idea by showing the intermediate steps and transitions, or show how data collected over time changes. A moving image might offer a fresh perspective, or invite users to look deeper into the data presented" according to Danyel Fisher in *Animation for Visualization: Opportunities and Drawbacks*.

Built-in transitions, like in Dundas BI, provide the exploring user a better understanding of the data when conducting data discovery. They help explain a point vividly and dramatically. The user clearly sees what is transforming without having to think about it. The eyes will just follow the changes, helping the mind better identify the true impact of your data interactions and resulting data values.

Dundas BI's powerful visualization capabilities include best-practice animations and data transitions to illustrate how data changes as metrics and dimensions are adjusted. With these built-in data analytics tools along with the ability to easily design and customize interactive data visualizations, dashboards, and reports, users are empowered to analyze, collaborate, and present their data, information, and results more thoroughly, effectively gaining deeper insight, and, ultimately, improving business performance.

About Dundas

Dundas Data Visualization is a leading, global provider of Business Intelligence (BI) and Data Visualization solutions. Dundas offers easy to use self-service, single BI experience allowing users to connect, interact and visualize powerful dashboards, reports and advanced data analytics for any data, on any device. Our flexible BI platform is fully supported by a consultative and best practice solutions approach. For over 20 years, Dundas has been helping organizations discover deeper insights faster, make better decisions and achieve greater success. www.dundas.com



Case Study

GoodData Customer Success Story

Demandbase: Revolutionizing the Marketing and Sales Game

Optimizing B2B marketing through real-time insight

Demandbase is uniquely positioned as a business-to-business (B2B) solution that brings together advertising, marketing, and sales data from different silos into an easy-to-visualize single source of truth. In 2014, it set out to help B2B marketers better measure, attract, and engage the companies it wished to convert into paying customers. As a whole, the industry was ripe for a new way to pinpoint and reach the right people at the right companies—by attracting and engaging them during the 2/3 of the B2B buying cycle that happens anonymously. Demandbase was able to provide B2B marketers with self-service analytics to track advertising, web engagement, and conversion and provide a comprehensive view of how its advertising and marketing programs are driving target accounts through the marketing funnel.

According to Andy Woods, Director of Product Management, “Demandbase knows the steps to develop and implement an account-based marketing strategy to help companies win at the modern B2B Marketing game. What we needed was to provide our customers with actionable insights quickly. So, we looked to partner with an analytics provider who could give us a full end-to-end platform and the ability to go to market in a matter of weeks.”

By embedding insights powered by GoodData within its software-as-a-service (SaaS) product, Performance Manager, Demandbase quickly delivered a cloud-based solution that solved a huge and frustrating challenge for marketers who historically were unable to see their entire funnel. With GoodData, Demandbase customers can now grasp a full understanding of their marketing mix/spend and how it impacts sales.

At a Glance

Company: Account-based
Marketing SaaS, 140 employees

Customer Since: 2013

Solution: Powered by GoodData

Use Case: B2B Marketing and Sales ROI

Favorite Metric:

- Pipeline Risk Report
- Targets vs. Activity
- Opportunity vs. Traffic

Best Features:

- Single source of truth
- Ability to visualize problems
- Ability to make changes quickly

Results:

- Quick implementation and time to market
- Allowed Demandbase to start speaking in the C-suite
- Increased visibility into marketing effectiveness across the enterprise

“Our insights help clients see if they’re connecting with the people they want to be talking to,” explains Chief Product Officer Avanish Sahai. “GoodData also gives us the ability to very quickly adjust, change, and visualize in different ways. It’s a huge advantage to be able to easily explore, test, mock up, and see what resonates best with our customers.”

Attracting the right eyes

Demandbase connects to installed customer relationship management (CRM), content management, and marketing automation systems—for the first time linking ad and website activity directly with sales activity and revenue. Partnering with GoodData, Demandbase can provide visualizations showing complete end-to-end insight into marketing performance and its impact on revenue. “Our customers can see how all their marketing programs are performing across the funnel—in one unified view,” explains Sahai. “GoodData visualizations in our Demandbase interface help them see what’s working, look for trends that require research, fix bottlenecks, and replicate successes.”

For instance, the insights found in the Demandbase Performance Manager helped Motorola make changes to better attract, engage, convert, and measure target accounts to increase web engagement by 300% using personalized content. Another customer, DocuSign, increased its sales pipeline 22%, by dynamically delivering the right message to target accounts at the right time in their buying cycle. And a third client, Brocade, used GoodData insights to see where to best deliver relevant content to target accounts, reducing the bounce rate 53% and increasing click-throughs by 144%.

Marketing and Sales finally speak the same language

“Lack of Sales and Marketing alignment is an ongoing issue that can seriously hinder business growth,” explains Woods. “Both Sales and Marketing need a single source of truth in order to partner effectively together and generate revenue for the company.”

Since GoodData can accept unlimited data sources, Demandbase is able to give customers a single source of truth for all things marketing across their enterprise. That unified knowledge base makes it possible for Sales and Marketing to collaborate and be successful.

Demandbase enables its clients to market and measure the way sales sells—by account. Woods says that Marketing typically collects mass quantities of data that didn’t align with sales priorities. “Now with GoodData insight, there is one source of truth across the enterprise which lets them capture and share more useful and richer data, which has helped some of our customers increase conversions by more than 200%.”

“GoodData gives us the ability to very quickly adjust, change, and visualize in different ways. It’s a huge advantage to be able to easily explore, test, mock up, and see what resonates best with our customers.”

Avanish Sahai,
Chief Product Officer,
Demandbase

About GoodData

GoodData® provides groundbreaking BI for data monetization to enterprises, independent software vendors, and system integrators who seek to quickly create and distribute valuable information to large networks of customers and partners. Our real-time analytics distribution platform is highly scalable and secure - allowing companies like Target, Discovery International and Zendesk to deploy engaging data products that are guided by GoodData's expertise in delivering widely-adopted analytics solutions.

“Analytics are table stakes in our business. We needed GoodData to be able to deliver the ongoing custom features our B2B clients expect.”

Avanish Sahai,
Chief Product Officer,
Demandbase



GoodData

Deciphering the world of social media, One conversation at a time

Semeon Analytics captures the **essence** of conversations within their context enabling **precise** interpretation and actionable **insights**

Unlocking the impact of social intelligence, for business success

Natural Language Processing powered by multilingual **semantic analysis**; we understand Arabic as well as we do English.

Filtering Techniques perfected to **reduce noise**, weed-out spam and listen to the **conversations that matter most**.

Unique patented algorithms to measure and ingest large scale unstructured data turning it into relevant **concepts**.



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Using Visualization to Understand Big Data

By T. Alan Keahey, PhD, IBM Visualization Science and Systems Expert

Introduction

Studies have shown that the human short-term memory is capable of holding 3–7 items in place simultaneously, which means that people can only juggle a few items in their heads before they start to lose track of them. Visualization creates encodings of data into visual channels that people can view and understand. This process *externalizes* the data and enables people to think about and manipulate the data at a higher level. This externalization enables humans to think more complex thoughts about larger amounts of information than would otherwise be possible.¹

Visualization exploits the human visual system to provide an intuitive, immediate, and language-independent way to view and show your data. It is an essential tool for understanding information. The human visual system is by far the richest, most immediate, highest bandwidth pipeline into the human mind. The amount of brain capacity that is devoted to processing visual input far exceeds that of the other human senses. Some scientific estimates suggest that the human visual system is capable of processing about 9 megabits of information per second, which corresponds to close to 1 million letters of text per second.

Visualization research over the past decades has discovered a wide range of effective visualization techniques that go far beyond the basic pie, bar, and line charts used so pervasively in spreadsheets and dashboards. These techniques are especially useful now that most organizations are being confronted with big data. The majority of organizations are struggling to make sense of output from data sources that include radiofrequency identification (RFID) communications, social media text, customer surveys, streaming video, and more, along with data captured over very long periods of time. For the IBM Institute for Business Value report on big data, IBM surveyed more than 1,100 business and information technology (IT) professionals and found that less than 26 percent of respondents who had active big data efforts could analyze extremely unstructured data such as voice and video and just 35 percent could analyze streaming data.² Visualization plays

a key role in enabling the understanding of these complex data analytics, and it can convey the key analytical nuggets of information to other people in the organization who have less expertise in analytics.

When companies can analyze big data, they benefit. In that same IBM survey, 63 percent of respondents reported that they believe that understanding and exploiting big data effectively can create a competitive advantage for their organizations.³ Big data analysis can help them improve decision making, create a 360-degree view of their customers, improve security and surveillance, analyze operations, and augment data warehousing. Visualization can play a vital role in using big data to get a complete view of your customer. This paper covers how.

Using the visualization of big data for a complete picture

Businesses in the modern economy require a fuller picture than ever of their customers in order to compete. Such a picture requires a complete understanding of not only how each customer is transacting with your company, but how each customer is finding out about offerings, comparing alternatives, discussing products and services in their social networks, and interacting with related products and services. Each of these aspects represents a separate analytics task that can be difficult for business users without an analytics background to master; when combined, the challenges become even greater for obtaining this 360-degree view of your customers.

Visualization can play a key role by making the individual analytic components understandable and by tying them together into a comprehensible “big picture.” In addition, visualization can be used in several distinct ways to help tame the scale and complexity of the data so that it can be interpreted more easily. To understand how, you can start with a simple customer data set and add more views of the customer, including those from big data.

Simple customer data

Many dashboards and reporting tools show data simply as a set of one or more basic charts, such as the bar, line, or pie chart. These work fine for conveying basic information such as historical key performance indicators (KPIs); however, their effectiveness becomes more limited when you want to understand multiple KPIs or other measures in a bigger picture. Combining many simple charts into a single page can quickly lead to overwhelming clutter.

If they are placed on different pages so a user must navigate them, he or she can have problems with internally integrating them or relating the different measures on different pages to one another. The bar chart and line chart can be extended at this point (figure 1) to show a single measure for multiple categories in a single chart by means of a variety of common techniques, including stacked or clustered bar charts and multiple series line and area charts.

These techniques can typically be used to show 4–8 categories in a single chart; however, for many big data scenarios, the number of measures (columns in a spreadsheet) can run into the thousands. In these cases, no single visualization technique is adequate for conveying the raw data. Some sort of analytical or dimensional reduction technique should be applied to the data first before attempting to apply visualization. A wide variety of such data reduction techniques are available that can be applied, including segmentation, clustering, linear regression, and more. The idea behind these is to come up with a mathematical model that reduces the complexity of the data, either the number of dimensions or the number of data points, while still capturing the essential characteristics of the data.

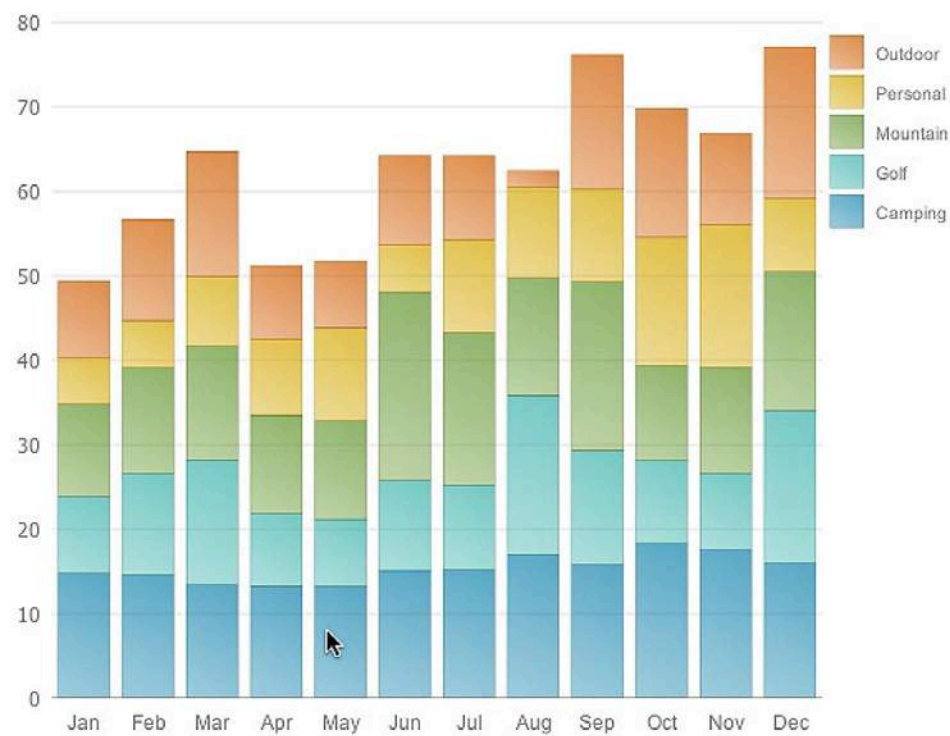


Figure 1. A bar chart to show a single measure for multiple sales categories.

Adding time to the customer equation

Customer patterns are often tied to time cycles, such as the 24-hour diurnal cycle or monthly payroll cycles. Although line charts can be used to convey these patterns over time, other more advanced visual metaphors can more realistically convey these temporal (that is, time-based) patterns. The radar chart (figure 2) is often a good choice for showing regularly cyclical data such as daily data over a weekly timeframe, or monthly data over a yearly time frame. Care should be taken with hourly data, however, because it might confuse viewers who are used to the 12-hour clock cycle.



Figure 2. A radar chart that shows weekly cycles of sales data that are arranged in a circular fashion.

The calendar also provides a powerful and well-known metaphor for showing time. One effective visualization uses a “heat map” scale and color to encode calendar days with a value (figure 3). The result is a very compact, intuitive visual representation that conveys weekly and monthly patterns effectively, whether for just a few months of data or for many years.

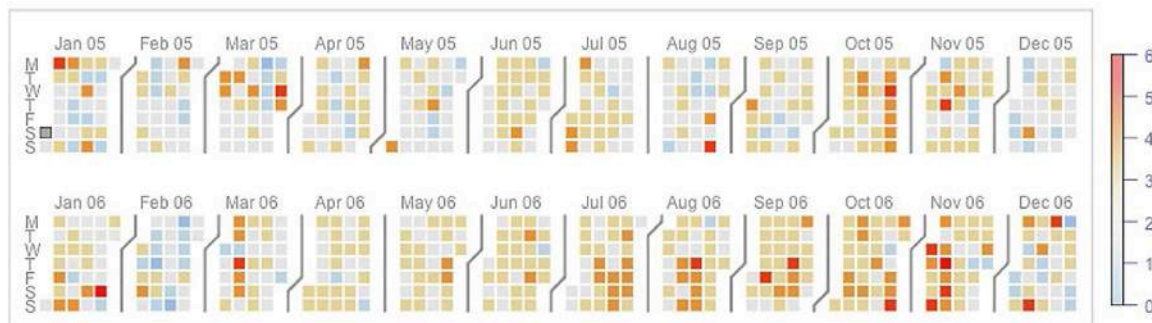


Figure 3. Calendar heat map example that shows two years of changes (in percentages) in customer web orders by year (row), month (column), day of week (sub row), week (sub column), and day.

Compare the calendar heat map with a line chart (figure 4) that has the same information and you can see how effective the heat map can be.

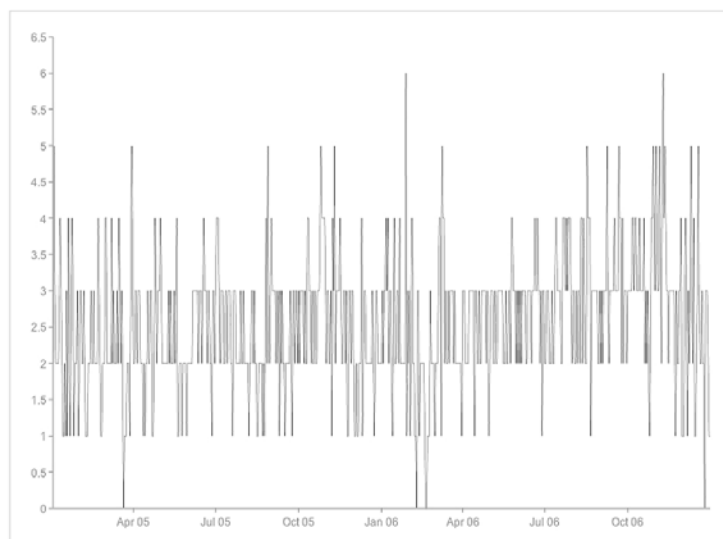


Figure 4. Chart view of the same data shown in the Calendar Heat Map in figure 3.

Understanding customer sentiment

Getting a complete view of your customers requires more than just understanding the key transaction metrics. You must track what your customers (potential and actual) are saying about your company, products, and services, along with what they are saying about your competition. This form of big data can be collected from a number of sources, including call center logs, social media, and customer surveys. Sentiment analysis and other techniques can be used to process this big data to extract patterns, and visualization is an essential tool for conveying many of those patterns to the business user.

One prominent technique extracts the key words and phrases from a set of customer communications and then tracks how the use of those words and phrases changes over time. The “theme river” visualization is well suited for showing this type of information (figure 5). The thickness of the band at a point in time corresponds to the frequency count for the associated word or phrase. With this visualization, you can get a feel for the ebbs and flows of your customer’s sentiments.

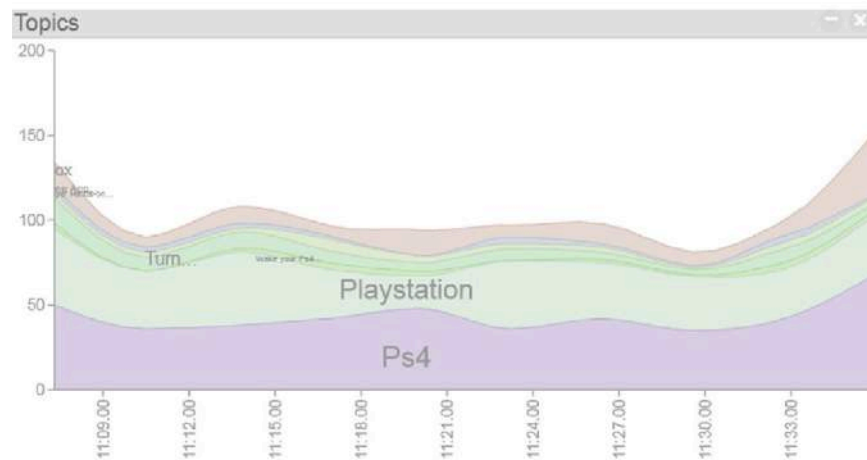


Figure 5. Theme river visualization showing phrase popularity related to gaming platforms over time.

Uncovering customer relationships

Relationships are a critically important aspect of many big data scenarios. Social networks are perhaps the most prominent example in this regard, and mastering them means that you can understand and influence not just individual customers but also their associated networks of friends and family members. These types of relationships are very difficult to understand in text or tabular format; however, applying visualization (figure 6) can make emerging network trends and patterns apparent.

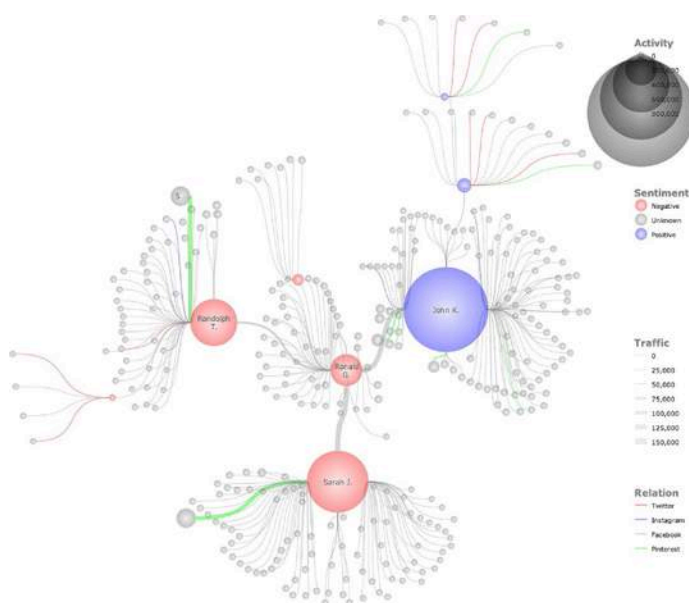


Figure 6. A social network visualization can show patterns of customer sentiment, key influencers, and their reach.

Understanding customers at different levels of detail

Hierarchies are powerful data abstractions for aggregating information into broader categories so you can make sense of it at a higher level. One way in which these hierarchies are used is to aggregate the time dimension: customer activity measured in days, then months, and then into years creates a three-level hierarchy. Another common type of hierarchy used to aggregate larger data sets into more understandable abstractions is based on geospatial properties: for example, customer sales in individual cities can be rolled into state-level sales and then into national sales. A third example involves organizing a product catalog into broad categories (outdoor, recreation, sports) and then into subcategories (baseball, tennis) and finally product. Many other hierarchies are possible.

Hierarchies are very popular in data analytics; however, they should be used with care, especially with big data, because the chosen roll-up mechanism can sometimes obscure important details at lower levels. A traditional way of enabling the understanding of information at multiple levels of hierarchical detail is to present the individual levels in a series of tabbed reports, each report showing a single section of the hierarchy (for example, all tennis products). Using visualization in hierarchies provides a fuller understanding of the information because it shows multiple levels of the hierarchy simultaneously. A wide range of visualization techniques is available for viewing hierarchies; the example here (figure 7) shows a fairly direct approach where each entity in the hierarchy is represented by a node in the chart. Size and color are used to show various properties of the nodes, and lines between the nodes show the hierarchical relationships.

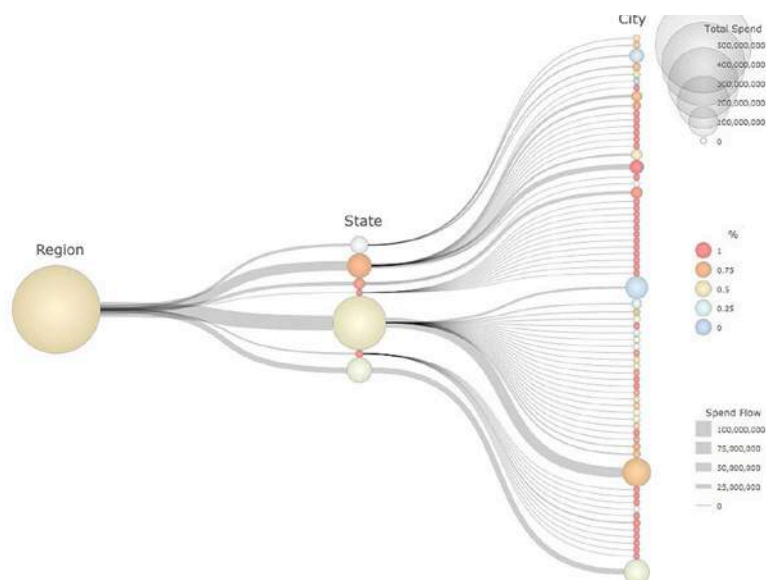


Figure 7. Hierarchy visualization of data that shows the number of targeted campaign responses on the regional, state, and city levels. Each level is represented by a bubble or bubbles.

In figure 7, bubble size indicates the number of campaign responses, and color indicates another measure such as change from prior year. Red is low, white is neutral, and blue is high.

Because of their branching structures, hierarchies are often referred to as “trees” in the visualization research community. Another very powerful and effective method for visualizing hierarchies is the tree map, in which the outer rectangle represents the sum total for the whole hierarchy and is recursively subdivided according to the divisions of the hierarchy. The size of each sub-rectangle can represent one measure, while color is often used to represent another measure of the data. Figure 8 shows a tree map of a collection of choices for streaming music and video tracks by a social network community that a media service could find useful when designing personalized offers of music and videos for download. Color represents the genres of the selected tracks, with each genre subdivided into rectangles for each artist. Size of rectangle for both genre and artist represents the number of track plays in that category.



Figure 8. Tree map view of a social network's track selections from a streaming media service.

Hundreds of different tree visualization methods have been explored in the research community, many of them finely tuned for specific types of tree data such as genome sequencing, large social graphs, and tournament matches. Some of these tree visualization methods are capable of showing hundreds or thousands or even millions of entities arranged in a hierarchical structure.

How much big data can we visualize directly?

A frequently asked question is how much big data can people view and understand directly with visualization techniques. The answer depends greatly on what type of data is being viewed, and what sorts of questions and answers the viewer wants to develop. However, for most cases, direct visualization of big data sources is not possible or effective. Visualization for large data works best with analytics techniques, which has given rise to an entire field of research known as visual analytics.

How much data can be effectively visualized directly is still worth considering, however. The answer to that depends on a number of factors: the scale and structure of the data, the size of the display device, computational scalability, collaborative and sharing needs, and the scalability of the visual layout.

Some general rules of thumb for the amount of data items that can be effectively shown with some of the common visualization techniques are:

- Pie chart: 3–10
- Bar chart: fewer than 50
- Line chart: fewer than 500
- Bubble plot: fewer than 500
- Scatter plot: fewer than 10,000

More advanced visualization techniques can show a greater number of items. These advanced styles can provide somewhere between 3–6 orders of magnitude (1,000–1,000,000 items) of direct data visualization, perhaps 9 orders of magnitude (1,000,000,000) for extremely special cases. Although the visualization can provide a significant reduction in scale, it clearly can only be part of the solution if the goal is to process a terabyte (12 orders of magnitude) or petabyte (15 orders) of big data. Analytics plays a key role by helping to reduce the size and complexity of big data to a point where it can be effectively visualized and understood. In the best scenario, the visualization and analytics are integrated so that they work seamlessly with each other.

Taming the complexity of big data with IBM

Visualization is an essential tool for making sense of big data. It provides a far richer view of big data than can be obtained from tables and statistics alone. However, the key to effective analysis of big data is the integration of visualization into analytics tools so that all kinds of users can interpret big data from a wide range of sources—clickstreams, social media, log files, videos, and more. IBM has embedded visualization capabilities in a

number of solutions and also offers extensible visualizations that can be downloaded for use in business analytics solutions. All the visualizations in this paper were created with IBM solutions and standards.

Visualization and big data solutions

Because IBM understands that big data analytics contributes significantly to competitive advantage and that visualization is a key ingredient in such analytics, IBM has embedded visualization capabilities into business analytics solutions. What makes this possible is the IBM Rapidly Adaptive Visualization Engine (RAVE).

RAVE is increasingly used as the standard for IBM visualization capabilities because it enables the rapid development of common and new visualization types. Because interpreting big data is still an emerging concept and ways to understand it are still developing, the ability of RAVE to create new kinds of charts that are as yet unknown is especially compelling.

IBM products, such as IBM® InfoSphere® BigInsights™ and IBM SPSS® Analytic Catalyst, use visualization libraries and RAVE to enable interactive visualizations that can help you gain greater insight from your big data. InfoSphere BigInsights is software that helps firms discover and analyze business insights hidden in big data, and the solution includes visualizations to simplify analysis of the data. SPSS Analytic Catalyst automates big data preparation, chooses the proper analytics procedures, and can display the results as interactive visualizations.

Extensible visualization

With the future of big data still developing, having the capability to respond with new visualization types as you need them helps to meet the challenge of dealing with big data. An increasing number of IBM business analytics solutions, including IBM Cognos® Business Intelligence, are using new extensible visualization capabilities. Extensible visualization enables users to download new visualizations from an ever-increasing library on IBM Analytics Zone as needed. Access to this ever-changing set of visualizations frees business users and report authors from the constraints of a prescribed library of in-product visualizations and also offers opportunities to use newly developed visualizations with big data.

The chord diagram visualization (figure 9) is an example of what can be produced with extensible visualization. It is an elegant and compact way to show networks of relations between items such as products, individuals, or groups. The width of each chord shows the amount of traffic between the groups that are located around the circumference. Color on

the chords and groups can also be used to convey additional information. This particular example relates customer support request types, which are shown on the right side of the circle, to the company support group that is handling the request, which is shown on the left side of the circle. This single visualization can represent a huge amount of customer interactions over the period of a year or more.

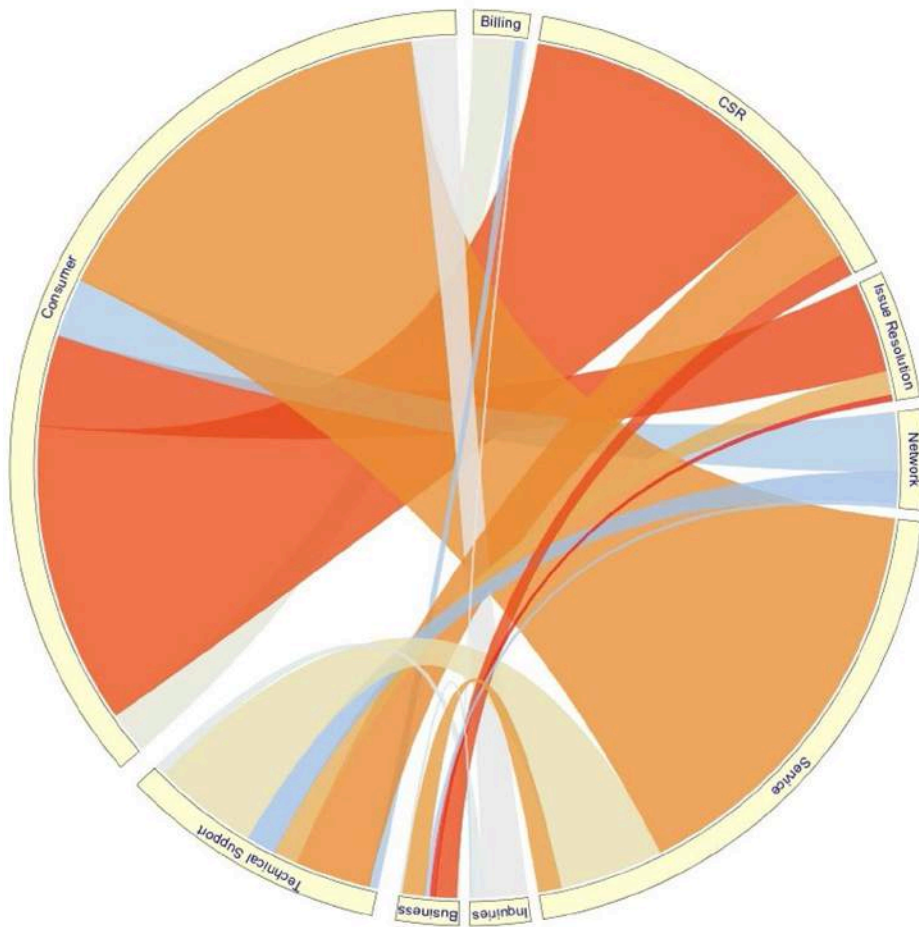


Figure 9. A chord diagram visualization created with extensible visualization technology.

Conclusion

Visualization is an essential tool for understanding information and uncovering insights hidden in your data, including your big data. With an understanding of big data, you can accomplish a number of things that can help your business, including creating a complete view of your customers. New visualization methods are available that are well suited to the particular needs of big data in many areas, such as social media analysis, geospatial

analysis, and sentiment or text analysis. These new visualization methods go far beyond the traditional tables and bar or line charts. They include radar charts, chord charts, calendar heat maps, and more. IBM technology, such as RAVE and extensible visualization capabilities, can help you create and use effective visualizations that provide you with a better understanding of your big data.

1. Donald A. Norman, *The Design of Everyday Things*. New York: 2002.
2. "Analytics: The real-world use of big data." IBM Institute for Business Value, in collaboration with Said Business School at the University of Oxford. 2012. <http://www-935.ibm.com/services/us/gbs/thoughtleadership/ibv-big-data-at-work.html>
3. "Analytics: The real-world use of big data."

Read more directly on the [IBM Website](http://www-01.ibm.com/software/analytics/many-eyes/conversations.html): <http://www-01.ibm.com/software/analytics/many-eyes/conversations.html>

For more information

To learn more about IBM and advanced visualization, visit the IBM advanced visualization web page: ibm.com/software/analytics/many-eyes/.

To learn more about extensible visualization and to see extensible visualizations that are currently available from IBM, visit the Extensible Visualization Community in the Analytics Zone: analyticszone.com/visualization.

About the Author

Dr. T. Alan Keahey has played a leading role in the research and development of highly innovative information visualization systems for close to 20 years. His experience spans a wide range of environments, including national labs research scientist, research director at a Lucent Bell Labs spin off, and founder of his own visualization research and development company. He thrives on anchoring connections between the capabilities created in research environments and the real-world needs of business customers. Alan is currently a Visualization Science and Systems Expert at the IBM Business Analytics Office of the CTO.

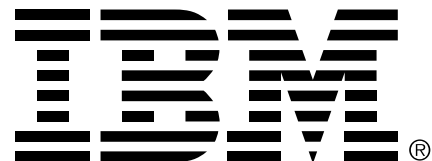
Blog: www.HolisticSofa.com

LinkedIn: www.linkedin.com/in/truviz/

About IBM Business Analytics

IBM Business Analytics software delivers data-driven insights that help organizations work smarter and outperform their peers. This comprehensive portfolio includes solutions for business intelligence, predictive analytics and decision management, performance management, and risk management.

Business Analytics solutions enable companies to identify and visualize trends and patterns in areas, such as customer analytics, that can have a profound effect on business performance. They can compare scenarios, anticipate potential threats and opportunities, better plan, budget, and forecast resources, balance risks against expected returns, and work to meet regulatory requirements. By making analytics widely available, organizations can align tactical and strategic decision making to achieve business goals. For further information, please visit ibm.com/business-analytics.



Qlik Customer Success Story

Qlik Helps the NIHR NHS Research Body Improve the “Health and Wealth of the Nation”

Solution overview

Customer Name: NIHR CRN—part of the National Health Service (NHS), United Kingdom (UK)

Industry: Life Sciences and Healthcare

Function: Executive, IT, Operations, Research & Development, Web Geography: United Kingdom

Challenges:

- Time-consuming processes to collate data from local sources into national database
- Limited insight to performance in research trial recruitment and “First patient to study process”
- Lack of understanding the feasibility or research around the UK Staff
- No platform to allow interactive questions around research and trials
- Delivering a platform available on multiple mobile devices
- Significant “data debate” throughout the organization

Solution: Business Discovery enabled by Qlik.

Provision of single source and view of data as an “open data” platform. Multiple apps delivered fit-for-purpose.

Benefits:

- Data is more visual and interactive
- Combine data, publish results, and build reports easily
- Insight: reveal patterns and trends at a glance
- Improve data quality through exploration and analysis
- Single source of “data truth”

Data source systems: Excel, SQL and Oracle Db

As part of the National Institute for Health Research (NIHR) in the UK, the Clinical Research Network (CRN) helps to provide the infrastructure that facilitates high-quality clinical research within the National Health Service (NHS). The NIHR's research enables patients to benefit from new and better treatments and aids the NHS in learning how to improve "the health and the wealth of the nation." The NIHR CRN works with researchers to launch clinical studies quickly and effectively; supports the life sciences industry in delivering its research programs; provides health professionals with research training; and works with patients to ensure their needs remain at the centre of all research activity.

Capturing disparate big data sources and delivering as a single view

Over the last six years, over 3,000,000 people have taken part in clinical research studies supported by the Clinical Research Network. In the same period, the Network has also doubled the number of recruiting studies from 1,681 to 4,107. In 2013-14, over 600,000 people were recruited to these studies, with more than 25,000 taking part in commercial clinical trials. This translates into millions of rows and columns of big data. NIHR CRN had a pressing need to be able to share this enormous amount of data effectively and efficiently with stakeholders in the NHS, as well as in academia and the life sciences industry. Richard Corbridge, CIO for the NIHR Clinical Research Network comments, "Our mandate was clear—to support research to make patients, and the NHS, better—through an intelligent system that improves transparency in public spending and increases value for money. We had support from the Government in the form of the political commitment to supporting the life sciences industry through the Health & Social Care Act 2012 / NHS Constitution 2013. Indeed the Life Sciences Strategy asks for the embedding of clinical research in all aspects of care." Healthcare in the UK is increasingly moving towards an integrated, biomedical ecosystem that places individual patients' care at the centre whilst supporting an efficient business environment comprised of the NHS, academia, research charities, and the life sciences industry.

In order for CRN to support and deliver its mandate, Richard Corbridge and his team realized that it would have to deliver a new, centralized business intelligence (BI) environment. This environment would need to connect to and capture all research, monitoring, and performance data as well as deliver superior visualization, analysis, and reporting of this data in near real time to some 10,000 authorized NHS users. Once completed and delivered, the solution would have to be extended to provide access to some of this data to the public domain. The resulting BI environment is now referred to as the "open data" platform, a system that opens up research delivery information throughout the NHS. The platform provides information that is viewed and shared digitally and accessed by anyone involved in clinical research, on demand.

“The introduction of Qlik’s Data Discovery platform has resulted in changes far beyond greater efficiency. We used to be a data-crunching organization, now we are a business intelligence organization.”

Nadine Boczkowski,
Head of BI, NIHR CRN

Corbridge explains, "Like any other government department, the NHS is tasked with running at maximum efficiency and the clinical research environment is no exception. We have a lot of study data; the number of people taking part, where patient populations are located, how long study set-up takes and so on, and it makes sense to channel this data for enhanced performance management. The primary objective was to manage performance and 'open up' the data for the NHS to support the delivery of clinical research more effectively, reducing duplication and ensuring government money was being spent efficiently. Before our open data platform, we used to know only about six weeks after the event who was recruiting and where, because data capture was time consuming, onerous, and inconsistent."

In the past, once local data from hospitals, NHS Trusts and General Practitioner surgeries had been uploaded into the national database, the information management team had to write SQL queries to produce reports, requiring them to be supplemented by temporary staff during peak periods. Corbridge adds, "We realized we needed a single source of information for everyone in order to stop the perpetual data debate!"

Qlik extends data discovery to NIHR

The decision to adopt the Business Discovery platform from Qlik was quite straightforward, as it was already providing value at over 160 NHS sites. NIHR had evaluated a number of references and was particularly impressed with the deployment at Colchester University Hospitals NHS Foundation Trust. Corbridge comments, "Apps had been built to show waiting times for key areas such as the Accident and Emergency department and where patients were in various care pathways."

This demonstrated the configurability, ease-of-use, and speed of delivery that Qlik offers. NIHR immediately recognized that linking its national NIHR database with local units as an open data platform, then sharing this data, would assist the recruitment to clinical research trials and studies. Corbridge adds, "We realized that simply providing information to the local stakeholder's app meant they could easily find and view a snapshot of data of trials available locally."

Using Qlik as the driver for this single source and view of data, updates to research information are input locally, amalgamated nationally, and made accessible to all authorized users. The data is democratized, allowing individual users to easily discover best practice data, decide on a course of action, and make improvements.

The open data platform apps at NIHR currently include: Knowledge and Information, NHS Permissions for clinical trials and studies, Portfolio Data, Find a Study, Resources, Development, and Performance.

Return on investment

6 weeks to recoup initial investment

Time to value

Zero to 800 users in less than 6 months

Time to value

Over 1,400 users in 12 months

All of the apps are provided as an easy, one-stop-shop for users, who also have access to tutorials and guidance on use and development. Corbridge highlights, “Since rollout, Qlik has delivered immediate benefits of more cohesive recruitment and better information for stakeholders. The team is no longer tied up in data preparation and they can focus their energy and efforts into how we can provide resources in a different way to organizations conducting clinical research.”

The next apps to be rolled out will deliver what NIHR refer to as the “globalization of research data”—conquering geography through data sharing around four axes:

1. Source of Truth—delivering a definitive source of truth for research reference data
2. Relationships—easily exposing each organization’s valuable data in order to improve the UK research opportunity
3. Organizations—producing a single map of organizational hierarchies
4. Terminology and Data Dictionary—creating a repository of terminology and providing a single reference of common language

Qlik’s Business Discovery platform has not only enabled a single source of business intelligence to manage big data, but has allowed NIHR to understand and accept its data, deliberate and act on its insights, and enhance the shareable data to add value and encourage innovation. NIHR now sees a pathway towards continuing to deliver more possibilities for innovation, such as providing apps for mobile devices and sharing its knowledge, processes, best practices, and results with healthcare organizations around the world.

Only a few years ago it took 120 days for research studies to go from approval to patient recruitment. Today, with the open data platform providing analytical capability, this has been dramatically reduced to just 21 days.

Corbridge concludes, “Our open data platform has already helped us to make discoveries around the way our research is managed, so we can run trials in the most effective fashion. We are so pleased with the results thus far that we are using them to set an example for similar organizations, including healthcare practices, globally. Crucially, it is helping us to turn data into information that enables insight and delivers vital business intelligence in near real time.”

Moving forward, NIHR is making clinical research and trial information available to the public via the internet. Driven by open data apps and accessible from the NIHR website, the public can also view up-to-the-minute data from clinical trials across the UK. This facilitates the “OK to ask directive” that enables patients’ requests to participate in clinical research. Corbridge adds, “This allows patients to proactively engage and interact with research on a self-serve basis.”

Corbridge's recent knowledge-sharing tour abroad provided him with valuable insights. He comments that "Early in 2014 I had the privilege of stretching my understanding in other areas of the world—across Europe, the USA, and in Russia—learning about how they are addressing their health challenges and discussing how the Qlik approach within different organizations in these countries can make a real difference. Seeing other countries looking at similar pieces of work to the UK really validated that our approach to BI is right and that we have led a trend in changing the way in which research is delivered."

Corbridge concludes, "As a CIO, I see that many analyst companies are clear in indicating that business intelligence is a number one priority in 2014. For the UK research capability, it has been for the last two years and through our partnership with Qlik that we have been able to lead the way through this innovation. Now we are ready for the next stage and the whole organization is excited about this as we have a workforce made up of "fans" of business intelligence rather than "users," which is a great driving force for making a change!"

About Qlik

Qlik (NASDAQ: QLIK) is a leader in visual analytics. Its portfolio of products meets customers' growing needs from reporting and self-service visual analysis to guided, embedded and custom analytics. Approximately 36,000 customers rely on Qlik solutions to gain meaning out of information from varied sources, exploring the hidden relationships within data that lead to insights that ignite good ideas. Headquartered in Radnor, Pennsylvania, Qlik has offices around the world with more than 1700 partners covering more than 100 countries.

“Before our open data platform, we used to know only about six weeks after the event who was recruiting and where, because data capture was time consuming, onerous and inconsistent.”

Richard Corbridge, CIO,
NIHR Clinical Research Network



SAP Customer Success Story

State of Indiana Chooses SAP HANA Platform to Help Fight Infant Mortality

This SAP case study was originally published here: <http://news.sap.com/state-indiana-chooses-sap-hana-platform-help-fight-infant-mortality/>

The State of Indiana has chosen the SAP HANA platform as the foundation for a management initiative, driven by Governor Mike Pence, to improve data efficiency across state government. The project, dubbed the Management and Performance Hub (MPH), will empower state leaders and citizens alike to track the state's progress against government key performance indicators and be used to initiate targeted policy solutions for Hoosiers. The state's MPH initiative will make use of SAP HANA in combination with SAP Predictive Analysis and SAP Lumira software.

As part of the state's efforts to build on its foundation of strong financial and performance management, Governor Pence tasked his Office of Management and Budget (OMB) and the Indiana Office of Technology (IOT) to develop a comprehensive enterprise-wide data-driven management system. The MPH project will create a "citizen-centric" IT architecture that places government's constituents at the center of all interactions, as is increasingly the case in the private sector. The MPH project is seen as an opportunity to improve service and drive efficiency, and also as a chance to use advanced data analytics to address some of the state's most stubbornly complex governing challenges.

Currently, some state data reporting is done on a monthly basis and in some cases is not automated, requiring human staff to aid in tabulation. When the MPH project goes live, all those processes will be automated, minimizing ad hoc reporting and manual entry. State leaders and residents will be able to track government performance in near-real time, using SAP HANA. Agency heads and executive management will be able to combine and cross-check vast volumes of information to glean insights that were previously too complex to obtain.

Foremost among Indiana's complex public administration challenges is its infant mortality rate. While Indiana enjoys a strong fiscal position* and has bounced back well from the recession by growing private sector jobs**, it has persistently experienced an infant mortality rate above the U.S. average. The state plans to use insights from the MPH project to understand and address the multifaceted causes of infant mortality as they are specifically playing out for Indiana residents and communities.

"Governor Pence is a firm believer in data-driven decision making, and has challenged us to pull all agency resources and data to examine this problem in ways no government entity has ever done," said Chris Atkins, OMB Director and CFO, State of Indiana. "We knew that sorting through multiple agencies' data, and parsing more than 50 data sets would require unique and powerful solutions. When examining our processing options, SAP products kept coming to the top of the list. Its hardware and software has played an essential role in launching MPH."

The first completed project for MPH is a new transparency site, www.in.gov/mph, launched in July [2014]. Users can track progress on key performance indicators for select agencies and on Governor Pence's roadmap goals. They also will have a unified location for financial data, which previously was displayed across multiple websites.

SAP HANA, with in-memory database, data processing, and application platform capabilities, essentially eliminates data redundancy and latency. This makes it an ideal platform for quickly combining and analyzing the data in complex public administration challenges like infant mortality, which can be affected by diverse factors ranging from environmental pollutants to maternal health to crime. The combination of SAP HANA, analytics solutions from SAP, and SAP Lumira with SAP Mobile Platform is enabling state and local leaders to closely manage their communities in partnership with citizens.

Partnering with mobile citizens

In Rock Hill, South Carolina, a city of nearly 70,000 located just south of Charlotte, North Carolina, city leaders and engaged residents are also using SAP solutions to track government performance. Rock Hill, with the help of implementation partner CIPHER Business Solutions, has deployed the CitizenInsight mobile app, which combines analytics solutions from SAP, the SAP Strategy Management application and SAP solutions for enterprise performance management. Strategic planning and performance measurement play an important role in guiding budget discussions and directing employee work programs. The app, which can be [downloaded from the iTunes app store](#) by anyone, provides [scorecards](#) across city departments including public safety and public works. Using these, citizens and city leaders

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State of Indiana

can explore the city's performance against multiple measurements, encouraging citizen engagement and real-time accountability.

By continuously tracking performance, elected officials and staff are able to make informed decisions about future projects, based on data and experience. This commitment leads to a variety of successes, including tourism, redevelopment and jobs, as well as quality-of-life initiatives. In fact, Rock Hill was named on the "100 Best Communities for Young People" ranking five times by the [America's Promise Alliance](#).

"Citizens deserve to be given options to interact with their city government in a way that's convenient and reliable," said David Vebaun, City Manager, Rock Hill. "The performance dashboard offers interested citizens a user-friendly way to stay informed and connected. CitizenInsight plays a valuable role in communicating our goals, successes, and challenges in a clear, meaningful way."

CitizenInsight is also being used by leaders and citizens in the [City of Boston](#), having been designed collaboratively by the City and SAP.

*Mercatus Center, George Mason University.

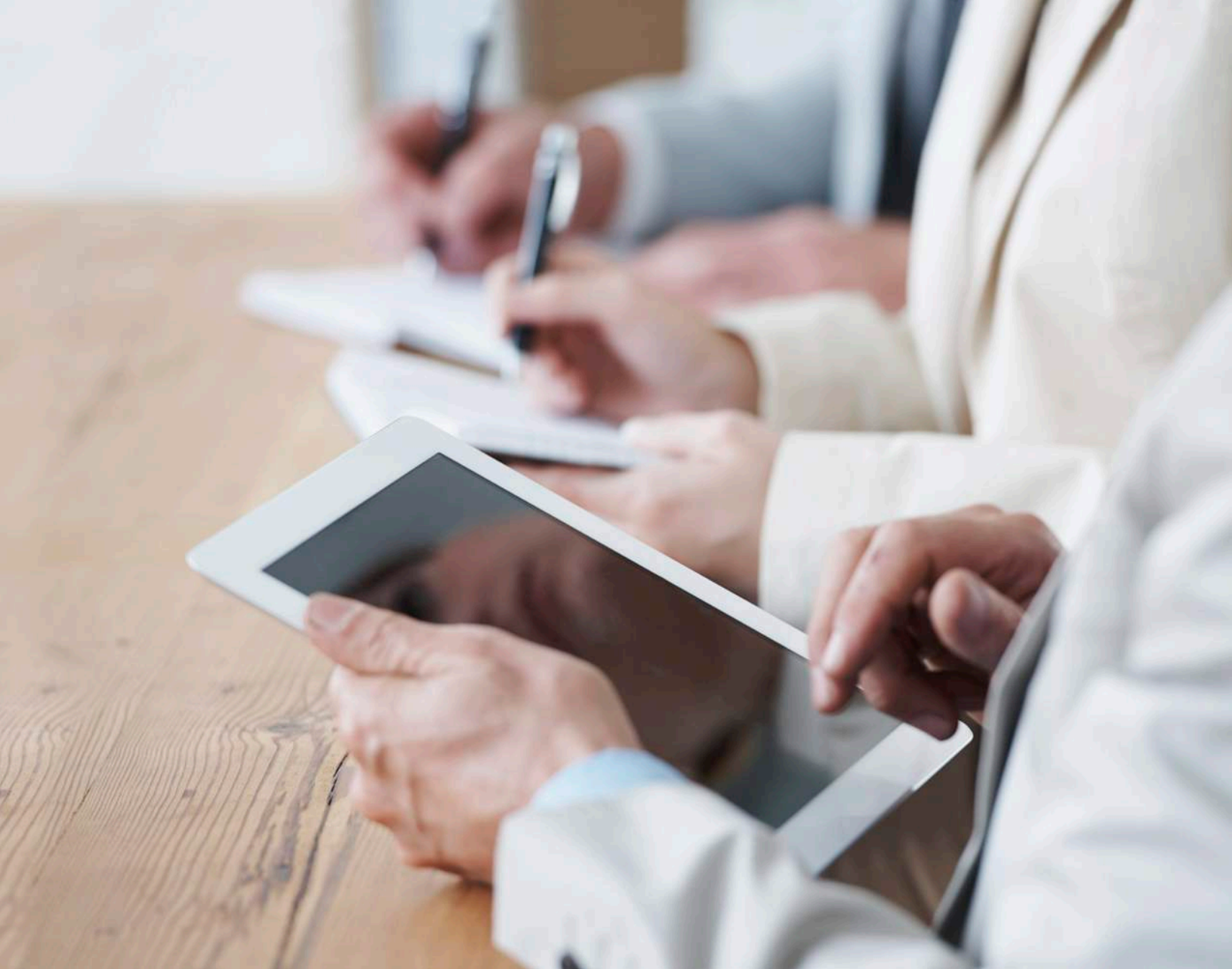
**Site Selection Magazine, May 2013.

About SAP

Founded in 1972 in Walldorf, Germany, SAP is an international provider of business software and is one of the world's largest independent software manufacturers. SAP has more than 183,000 customers in over 120 countries and employs 55,000 people at locations in more than 50 countries.

“SAP HANA, with in-memory database, data processing, and application platform capabilities, essentially eliminates data redundancy and latency. This makes it an ideal platform for quickly combining and analyzing the data in complex public administration challenges.”





VENDOR DIRECTORY

Vendor Directory

Company	Solution	Website
BIME	BIME	www.bimeanalytics.com
Birst	Birst	www.birst.com/product
BOARD Internaional	BOARD	www.board.com
Dundas	Dundas Dashboard	www.dundas.com
Dundas	Dundas BI	www.dundas.com
GoodData	GoodData Analytics Distribution Platform	www.gooddata.com/bi-software/data-visualization
IBM	IBM Cognos BI	www-01.ibm.com/software/analytics/cognos
IBM	IBM Watson Analytics	www.ibm.com/analytics
InetSoft	Style Intelligence	www.inetsoft.com/products/StyleIntelligence
Information Builders	WebFOCUS InfoAssist	www.informationbuilders.com/products/webfocus/query_analysis
Logi Analytics	Logi Info	www.logianalytics.com
Logi Analytics	Logi Vision	www.logianalytics.com
Microsoft	Power BI	https://powerbi.microsoft.com
MicroStrategy	MicroStrategy	www.microstrategy.com/analytics
OpenText (Actuate)	OpenText Analytics	www.actuate.com
Oracle	Oracle Big Data Discovery	www.oracle.com/big-data/big-data-discovery
Panorama Software	Panorama Necto	www.panorama.com/virtual-tour-2
Pentaho	Pentaho Business Analytics	www.pentaho.com/product/business-visualization-analytics
Qlik	Qlik Sense	www.qlik.com/en/explore/products/sense
Salient	Salient360	www.salient.com/technology/salient360
SAP	SAP Lumira	http://go.sap.com/product/analytics/lumira.html
SAP	SAP BusinessObjects 4.1	http://go.sap.com/solution/platform-technology/business-intelligence.html
SAS	SAS Visual Analytics	www.sas.com/en_us/software/business-intelligence/visual-analytics.html
Sisense	Sisense	www.sisense.com
Tableau Software	Tableau Server & Desktop	www.tableau.com
TARGIT	TARGIT Decision Suite	www.targit.com/en/software/decision-suite
TIBCO	TIBCO Spotfire	http://spotfire.tibco.com
Yellowfin	Yellowfin BI	www.yellowfinbi.com/YFWebsite-Business-Intelligence-and-Analytics-Platform-24427#data_Discovery

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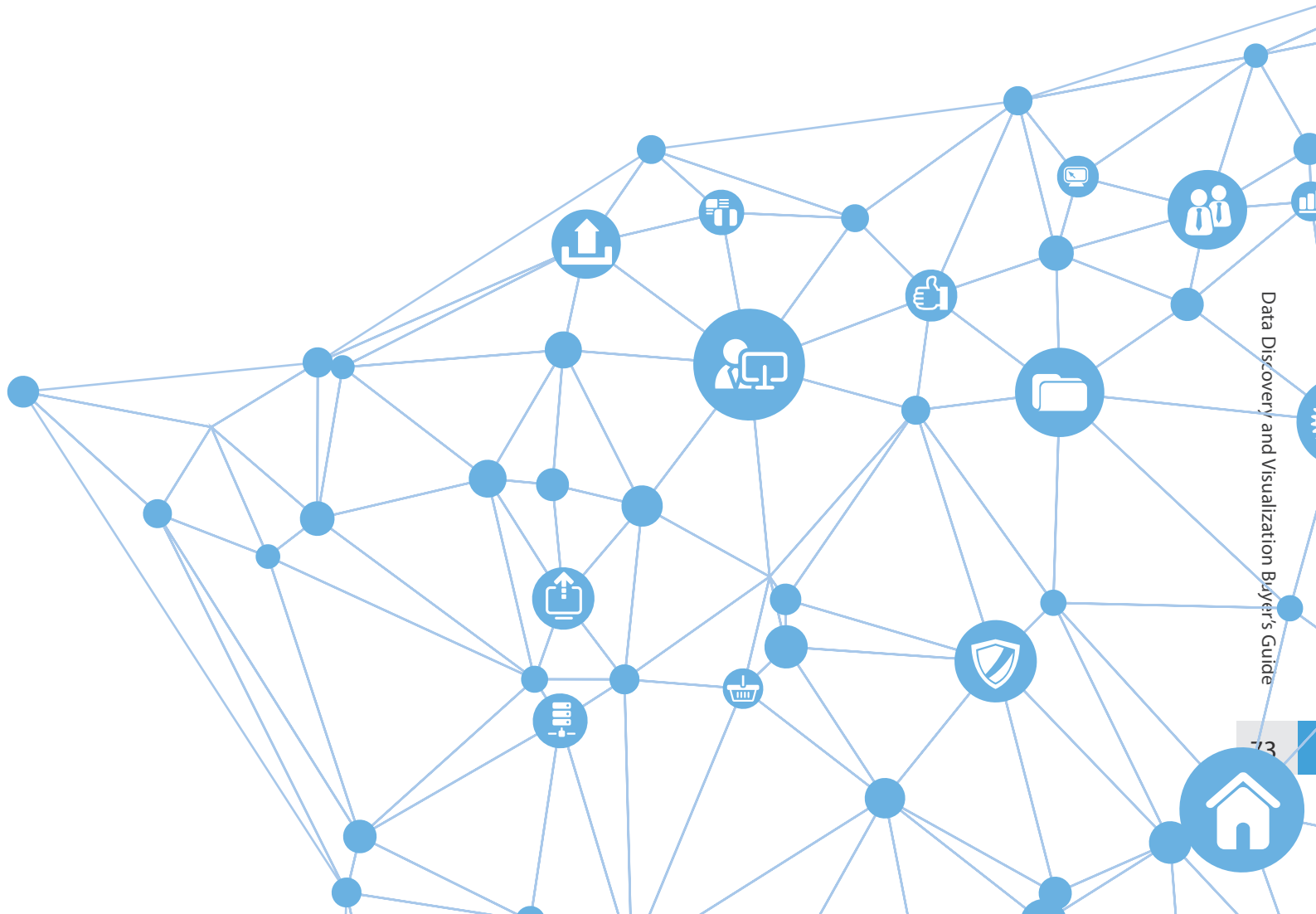


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Prior to joining TEC, García was a senior project manager and senior analyst developing BI, DWH, and data integration applications with Oracle and SAP BusinessObjects. He has also worked on projects related to the implementation of BI solutions for the private sector, including the banking and services sectors. He has had the opportunity to work with some of the most important BI and DWH tools on the market.

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