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While there is no general consensus with respect to how big “big data” is, or can be, not many in the business would disagree that managing these huge amounts of data represents a challenge.

Software providers are developing advanced analytics techniques and tools to answer the growing need to manage these enormous and diverse volumes of data. The new breed of solutions, called big data analytics, is allowing analysts, researchers, and other information workers to collect and analyze data that was previously deemed inaccessible or extremely difficult to work with.

The 2016 TEC Business Intelligence Buyer’s Guide explores the big data analytics software market, including the increasing role, importance, and value of big data analytics in the organization; an analysis of the big data analytics market; an overview of software solutions in this market; and considerations for evaluating a new big data analytics solution.

This guide presents some of the most important functional components of today’s most popular big data analytics solutions. It also offers a comprehensive comparison chart of the features and functions of the different big data analytics software solutions currently available on the market, which can help organizations gain insights from large and complex sets of data.
My distinguished friend and colleague, Professor Tom Davenport, author of the classic work *Competing on Analytics*, calls our present moment “the era of analytics.” Thank goodness for that. For many years, analytics and data-based decision making was too often relegated to the sidelines and back offices when it came to corporate strategy and business decisions. Analytics was viewed by many executives as an intriguing sideline rather than a mission-critical capability.

Well, times change. The rapid and accelerating proliferation of data, from varied new sources as well as traditional sources, along with new agile methods that have put data into the hands of business decision makers quickly and inexpensively, have radically altered the business equation, and given rise to what we now commonly refer to as big data.

The survey findings confirm the strong and growing acceptance of big data analytics within the mainstream business economy. Some highlights:

### Big data has achieved mainstream adoption.

The percentage of firms reporting that they have a big data initiative in production has nearly doubled in just two years, rising sharply from 31.4% in 2013 to 62.5% in 2015. Nearly 70% of firms now view big data as very important or mission critical to their success.

### Business insight and speed are the main drivers of big data investment.

Nearly 27% of firms expect to invest more than $50 million (USD) in big data and analytics initiatives in 2017. As investments in big data rise sharply, executives are expecting greater insights (37%), and the ability to act faster on these insights (30%), citing needs for faster time to insight, faster time to decision, and faster speed to market as key drivers of big data investment.

### New data management approaches enable greater agility.

As firms seek to integrate more data, the availability of new data management approaches, like Hadoop, is enabling greater agility and nimbleness. Nearly 31% of firms cited agility as their top technical driver for big data investment.

New environments facilitate data discovery. Big data continues to alter data management, as traditional enterprise data warehouse approaches are augmented by data hubs, analytical sandboxes, big data labs, and big data centers of excellence. The percentage of firms that now employ one or more non-traditional approaches to facilitate data discovery has grown from just over 50% in 2013 to nearly 75% in 2015.
Leadership for big data is coming from the top. The newfound importance of big data and analytics is evidenced by top-of-the-house sponsorship for big data initiatives. Nearly 92% of executives reported that big data sponsorship starts at the top, with the following leadership breakdown—chief executive officer (CEO) 16.1%, chief operating officer (COO) 10.7%, CIO 19.6%, chief marketing officer (CMO) 10.7%, and CDO 14.3%. In fact, the percentage of firms reporting the establishment of a CDO function skyrocketed from just 12% in 2012 to 54% in 2015.

Clearly, the big data analytics moment has arrived. Big data has given rise to a transformation of business intelligence driven by speed, agility, and accelerated time to insight. Taken together, this perfect storm of big data analytics is driving business innovation and transformation at increasing speed. Firms that leverage their data assets and act quickly will be well positioned to lead the future.

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Intelligence in the New Business Era

According to IDC, digital data growth is estimated to be doubling every two years, so that by 2020 it will reach 44 zettabytes (or 44 trillion gigabytes). This poses the daunting task of storing, managing, processing, and analyzing these vast amounts of data that are flowing at an increasingly high speed.

As software providers continue to develop new data management solutions and work on improving existing solutions to be able to manage the large sets of data that are becoming commonplace in the business realm, it is no secret that the next big thing in big data relates to the analysis of these enormous and diverse volumes of data.

Analyzing data from various sources to discover patterns and provide insights is not a new concept. But as the need to do this over large and varied data sets has grown, new advanced analytics techniques and tools are emerging in the software provider market landscape. This new breed of solutions, called big data analytics, is allowing analysts, researchers, and other information workers to collect and analyze data that was previously deemed inaccessible or extremely difficult to work with.

The use of big data analytics can lead to reliable and efficient solutions for analyzing big data repositories. And effective ways to visualize the newly discovered data can have a real and positive impact on the way organizations make use of data as an asset for improving operations, performance, and decision making.

In 2013 IDC estimated that of the useful data in the data universe, perhaps only 5% was particularly valuable. But the market intelligence provider predicts that percentage to more than double by 2020 as companies take advantage of new analytics and big data technologies and new sources of data, and apply them to new parts of their organizations.

Today, nearly every organization in every vertical industry is exploring the potential of analytics using large data sets for business intelligence analysis and insights. As big data analytics becomes a key part of modern data management practices, selecting the right solution is both a challenge and an opportunity for today’s organizations.

The best qualification of a prophet is to have a good memory.

—George Saville
A Bit About Big Data

Before we continue, let’s establish some basics regarding what big data is and is not. There is no general consensus as to how big “big data” is. Some companies deal with data volumes on the order of terabytes or even petabytes. While managing huge amounts of data can be difficult, advances in analytics technologies mean big data may not represent the challenge it once was.

For some organizations, a big data problem may be more than an issue of size: the speed of data generation, ingestion, and outcome; the complexity of its structure or lack of it; the diversity of the data; and its demand for computing resources together challenge the efficiency and effectiveness of a traditional relational database. For large data sets, things as simple as data storage and movement between repositories can have a huge impact on an organization’s resources.

Managing big data means handling, processing, and analyzing complex data sets to derive more value. It requires special strategies and tools, and must be considered from a broader perspective than mere size.

Gartner defined big data with the three Vs:

- **Volume**—refers to the increasing amount of data to be handled. Even before the boom of big data, several organizations were storing terrific volumes of information in the hope that they would someday have the means to deal with it. Today, in addition to generating large amounts of data internally, organizations are also gathering data from social media, sensors, and other external sources.

- **Velocity**—implies data can move at different speeds. Traditionally, batch processes were used to move data, which implied a latency period between data collection and consumption. Today, latency is being reduced, and as data is collected using different methods (batch, near real time, etc.) and from different sources, latency can differ depending on the need for data, the type of data being collected, and other factors. As different data require different processing times, it is now possible to balance these data requirements to provide real-time or near real-time insight within specific time frames, a common need in modern organizations.

- **Variety**—indicates how the data that organizations collect has changed in several ways. More internal systems have data (primarily structured) that needs to be collected and analyzed, and internal and external sources are increasingly producing data (semi-structured or poly-structured)—such as social media data, like blog posts and tweets, as well as data coming from automated systems, sensors, and even plain-text documents—that may also need to be collected and analyzed.

Since big data was originally defined, another two attributes have emerged and need to be described: Value and Veracity.

The need to find “Value” within big data sources has spurred the development of several novel or alternative analytics methods that were generally not used with more traditional data management. Methods such as data mining, machine learning, and deep learning have led to the development of such disciplines in their own right.

The “Veracity” of the data being stored and processed is another important attribute. It is integral that the data be adequate for analysis; have the necessary attributes to be considered reliable and valid; and be taken from the right sources, at the right frequency, and in the right format.
From a technological point of view, big data requires a full set of tools and solutions to do the following:

- Collect (ingest) large volumes of data from a wide number of sources: social media feeds, sensors, plain-text documents, and much more
- Store the data, commonly using some alternative to a traditional relational database management system (RDBMS) such as Hadoop, NoSQL databases, etc.
- Pre-process data samples for quality, consistency, and preparation, which can include validation of formats (e.g., time and dates), identification of blank fields, etc.
- Process the data, using a big data analytics solution for analysis, visualization, and discovery

In many ways, big data has served as a catalyst for the introduction of new technologies, processes, and skills to the existing information and data management ecosystem. Big data technologies do not replace previous data technologies so much as they develop and enhance existing data management architectures and expand their data management power.

For this reason, big data should not be treated in a silo, and these new analytics capabilities should not be architected in isolation. A big data project involves a series of activities and processes that involve the management of large and complex data sets:

- Data ingestion from diverse sources such as:
  - Near real-time transaction events
  - Sensor-based real-time events
  - Real-time data streams
  - Social media channels (Twitter, Facebook, etc.)
- Data storage, using a data repository best suited for the type of data involved:
  - Hadoop Distributed File System (HDFS), using Hadoop and other storage platforms
  - File system
  - Data warehouse
  - RDBMS
  - NoSQL database
- Data processing, which includes defining
  - Type of use for the data
  - Technical requirements
  - Targeted business processes
  - Data ownership

From a technical point of view, an organization must consider several factors when developing the orientation of a big data strategy and defining its need for a big data platform or infrastructure. The following table shows some of the considerations that can help define the flavor of a big data solution, particularly in terms of the type of data a solution is needed for (table 1).
Organizations that want to benefit from big data are obliged to adopt new technologies, processes, and skills to accommodate these new data management architectures.

New data management technologies—such as the so-called NoSQL databases or Hadoop, the “framework for distributed processing of datasets” from Apache—are being deployed globally and in large numbers, forming an important cornerstone of the big data trend.

Big data projects, then, go beyond the mere storage or collection of data aspects—and involve more comprehensive operations such as data preparation and processing. The ultimate goal is to leverage big data: mine it, find patterns, and make sense of complex data sets. This is the realm of big data analytics.

**BI, Analytics, and Big Data Analytics: What’s the Difference?**

Today, many solutions offer data analysis, but they vary in the number and type of sources from which data for analysis originates as well as the size of data that they can handle. This complexity can create confusion and conflict in determining the right tool for a specific job. There are three main types of data analysis solutions: business intelligence (BI), analytics, and big data analytics. While the distinctions between them are somewhat blurred, some key concepts can help us establish a baseline for comparing these solutions.

BI solutions used historical and structured data as a source, and were originally conceived as tools for information analysis and decision support. Extensive sets of historical data were processed, analyzed, and delivered to the user via visualization tools such as reports or dashboards. However, this type of analysis is limited in that most of the computer-assisted support involves slicing and dicing the data, generating reports, and designing dashboards.

The traditional BI approach resembles a batch process in which information follows a sequence from source to target. In general, the BI life cycle consists of specific and structured sets of components for which the essential analytics portion (analysis and data visualization) takes advantage of well-defined and structured sets of historical data (figure 1).
As business models evolve and require faster and more efficient data analysis, this schema starts to fall short. New analytics techniques and solutions have incorporated new statistical and mathematical models. These solutions go beyond reporting, dashboarding, and online analytical processing (OLAP) techniques to perform predictive analysis, forecasting, and other advanced analytics functions. Rather than replacing BI solutions, the role of business analytics solutions appears to be that of enriching existing BI architectural platforms and significantly enhancing existing data analysis software stacks. Business analytics solutions enable the expansion of analysis to larger sets of data, thus encouraging business planning and strategy development and enabling more formal analysis of potential future scenarios—and are not based merely on snapshots of the present or the past.

Perhaps one of the most interesting and applicable paths in the evolution of BI can be summed up in two words: consumerization and verticalization.

- **Consumerization.** On one hand, the combination of technology and business evolution has enabled vendors to isolate BI functions and features and encapsulate them within analytics tools. Vendors now offer applications that are easier to use, potentially integrated with office and other types of business applications, and are effortless to deploy and configure—enabling all types of business users, regardless of their analytics knowledge and business role, to pursue their own data analysis.

- **Verticalization.** Many BI software providers, thanks to their accumulated experience working with clients from different industries and lines of business (LoBs) have gained expertise in providing specific configurations and functionalities for specific business niches. This shift is also marked by a recent trend among vendors to acquire other software companies offering specialized analytics software devoted to addressing specific business needs—reinforcing their existing set of analytics tools and providing their users with specialized data analysis functionality for specific industry or business processes.
Analytics software solutions can be broadly categorized, according to the business question to be answered, into three types (figure 2):

- **Descriptive analytics.** Using historical data to identify patterns, describe trends, and generate reports—i.e., modeling and interpreting past behavior.
- **Predictive analytics.** Using present and historical data in order to predict future scenarios—i.e., predicting behavior.
- **Prescriptive analytics.** Suggesting or determining actions to be taken and their effect over the business in order to provide assistance within the decision-making process—i.e., prescribing behavior.

Analytics solutions can use a combination of these data analysis techniques for data and text mining, explanatory and predictive modeling, statistical and quantitative analysis, advanced visualization, and others. Even though advanced analytics is strongly related to big data, it is an independent discipline that aims to make sense of data and discover non-obvious or hidden patterns. The analytics discipline is a natural fit for big data, as it is suited to processing larger and heterogeneous sets of data, as required by businesses today.

To be cracked more easily, large and complex sets of data require tools for designing and implementing a mathematical model that can increase automation in the analysis process.

Big data analytics, then, refers to the application of advanced analytics techniques to big data. Data is collected from disparate sources—relational and NoSQL databases, data streams, plain-text documents, and other sources—and fed into a model. The model consumes it and processes it, and in so doing uncovers hidden trends and discovers previously unknown interrelations among datasets in order to generate predictions, prescriptions, and recommendations (figure 3).
Once the results are interpreted and evaluated, they are used to tune the existing model, or generate a new model as the preprocessed source of a new analytics cycle.

So why the hype about big data analytics? Many organizations have realized that traditional RDBMSs are not able to effectively manage these large and diverse amounts of data, while traditional BI applications don’t have the necessary power to collect insights in a timely manner. This is where a big data analytics solution comes into play. A big data analytics software solution can provide all the necessary technical capabilities for performing effective analysis of large volumes of data in shorter periods of time and with higher levels of reliability.

Big Data and Analytics: A Perfect Match

In today’s competitive market, being able to analyze and explore large amounts of data in order to understand the nature of the business has become an essential element for the viability of many organizations. Combining access to big data sources with advanced analytical services is becoming a necessity for many organizations, and a key use case for improving the accuracy of business diagnostics and effectiveness of business strategies within many areas, such as marketing, customer service, finance, accounting, and others. For example, data from both internal and external sources can be used to understand customer behavior, improve customer segmentation, help create better customized services, and gain general insights—providing a significant competitive advantage.

How does it all fit together? Despite being big and complex, big data is still data. It is the raw material for meaningful information that fits within a coherent information supply chain. The use of big data analytics plays an important role (figure 4) in providing insight, description, prescription, and forecasting—supporting business decision making.
One of the main triggers for the design of new applications and technologies is the inability of traditional BI solutions and frameworks to manage and analyze both structured and unstructured content. The addition of advanced analytics to big data analytics solutions makes managing both types of content possible.

Some of the potential business benefits of having an effective big data analytics solution in place include:

- Identifying relevant information, which can improve the quality of decision making
- Analyzing and visualizing data from very diverse sources and in different formats
- Gaining timely insights from the vast amounts of data available—both internal (including that stored in company databases) and external (originating from external sources: the Internet, social media, remote sensors, etc.)
- Gaining real-time monitoring, analytics, and forecasting capabilities, to reinforce operational decisions and continuously align with business strategies
- Improving risk mitigation by optimizing and automating complex decision-making processes and speeding up the detection of unplanned events and issues

From the point of view of pure data management, a big data analytics solution offers:

- Increased speed and scalability
- Reliable mobility and security services
- Flexible and stable data services
- Integrated services for both structured and unstructured data

Now that we are aware of the plethora of possible benefits that the combination of big data and analytics can bring to an organization, it is not unexpected to see an increasing number of use cases for big data analytics solutions spreading along industries and LoBs (table 2), and to see more organizations and software providers discover new applications for big data analytics solutions every day.
### Use Case Description

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer churn analysis</td>
<td>Many organizations need to understand the factors leading to the loss of a customer—they need to analyze churn and predict it. Big data analytics enables companies to discover detailed customer behavior and take into account data from many sources (including external factors such as the economy, demographics, and life stage of the customer) in order to understand and predict the probable causes of customer churn.</td>
</tr>
<tr>
<td>Financial fraud detection</td>
<td>Fraud is a factor that has a big impact on the operations of financial institutions. One example of fraud would be the case of brokers selling a security back and forth at ever-increasing prices until a third party enters the action by buying the security, allowing the fraudulent brokers to quickly exit. Big data analytics is applied in many cases across multiple financial systems in order to detect patterns of account behavior and anomalies.</td>
</tr>
<tr>
<td>Loan risk analysis</td>
<td>Big data analytics can be used to collect data from many sources (such as payment history, detailed credit behavior, employment data, and financial asset disclosures) and perform full risk analysis of direct and collateral aspects of the status of an individual in order to evaluate the risk of a prospective loan or a prospective insurance policy.</td>
</tr>
<tr>
<td>Utility smart meters</td>
<td>Utility companies today have improved meters, with better quality and higher frequency of readouts. And more and better data improves the quality of analysis. Big data analytics can be used to improve dynamic load-balancing, failure response, and adaptive pricing.</td>
</tr>
<tr>
<td>Building sensors</td>
<td>One of the growing trends in the construction industry is the so-called intelligent industrial and habitational buildings, which are fitted with sensors to detect temperature, humidity, vibration, and noise. These sensors collect data every few seconds, 24 hours per day, allowing several analyses to be conducted, including the monitoring of energy usage and the usage, security, and safety of heat and air conditioning systems, enabling significant improvements in building operations and costs.</td>
</tr>
<tr>
<td>Genomics analysis</td>
<td>Big data analytics is applied to the collection and analysis of huge amounts of gene sequences to discover patterns and identify gene families.</td>
</tr>
<tr>
<td>Behavioral analytics</td>
<td>With access to data on consumer behavior, companies can learn what prompts customer loyalty, as well as customers' characteristics and purchasing habits, to improve marketing efforts and boost profits.</td>
</tr>
<tr>
<td>Customer segmentation</td>
<td>By accessing data about the consumer from multiple sources (such as social media and transaction history), companies can better segment and target their customers and make personalized offers to them.</td>
</tr>
<tr>
<td>Predictive maintenance</td>
<td>Through sensors and other machine-generated data, companies can identify when a malfunction is likely to occur. The company can then preemptively order parts and make repairs, avoiding downtime and lost profits.</td>
</tr>
</tbody>
</table>
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Adeptia
Attunity
CloverETL
DELL
IBM
Informatica
Information Builders
Jitterbit
Liaison
Microsoft
MIOsoft
Oracle
Pentaho
SAP
SAS
Software AG
Stone Bond Technologies
Syncsort
Talend

Big Data Cloud Solutions

Data Integration and Preparation Solutions

These examples are just a small sample of the vast and ever-increasing number of cases where big data analytics is being used today. It is foreseeable that in the near future a high percentage of organizations will rely on one or more types of big data analytics solutions to perform its data analysis mandates.

The Big Data Analytics Marketplace

Despite the hype about big data analytics solutions, using them is a labor-intensive task. Significant effort is needed to prepare data for analysis that will meet the specific needs of the organization. This process includes a series of steps such as the integration of different data sources within the big data infrastructure and data preparation for final analytics usage.

The difficulties associated with data preparation can be exacerbated with big data owing to the amount and complexity of data, which can stretch any data management platform to its limits.

Executing analytics over large amounts of data requires the use of efficient methods and tools not just to store but also to retrieve, integrate, filter, transform, and clean the data. Several solutions currently exist to deal with these issues.
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Business Intelligence: Big Data Analytics

some technical issues must be addressed—privacy, data quality and management, model tuning, etc.—the cloud can be a viable alternative for organizations that want to deploy a big data analytics solution quickly and affordably.

Several cloud deployment models can be applied to big data analytics solutions:

- **Public cloud:** The big data analytics solution will be deployed off-site within a public cloud provider. One advantage is that public cloud providers can offer high efficiency and shared resources at a very low cost. All data management and analytics services can be handled by the cloud provider, along with issues such as privacy, security, and availability.

- **Private cloud:** The big data analytics solution is deployed over a private cloud network and can be managed either by the organization itself or by a third party. A private cloud is suitable for organizations that require higher level of control over security and data privacy—i.e., ones that have specific data security and ownership requirements.

- **Hybrid cloud:** The big data analytics solution is within a cloud infrastructure that combines the resources of a public cloud with the access of a private cloud. Users can develop and deploy analytics applications using a private cloud–like environment that has the higher degree of security of a private cloud but with the elasticity of a public cloud.

Currently, an increasing number of big data analytics solutions can be found on premises, in the cloud, or both. Companies such as Oracle, Microsoft, and IBM offer big data analytics solutions both on premises and in the cloud via their own cloud infrastructures. Other software providers such as TIBCO (with Jaspersoft), MicroStrategy, and Tableau offer their big data analytics solutions via Amazon Web Services (AWS) marketplace.

**Big Data Analytics: Tools, Techniques, Procedures, and Rules**

With the recent evolution of big data, especially in the last five to seven years, an increasing number of organizations are confronted with the need for larger and more powerful data management infrastructures. Today, an organization can manage and analyze massive amounts of data to produce information that is more precise and provides insights. With such precise solutions and more advanced types of analysis (perhaps previously reserved for academics), managers are able to analyze data and leverage a more “intuitive” decision-making process.

Companies’ data analysis and usage need to be improved in key ways. The tools and procedures need to be combined with other analytics resources and disciplines, such as those for the so-called data sciences—advanced and more automatic analytics techniques. They also need to be combined with the wide number of new batch, real-time, and streaming sources. As business requirements grow, so does the need to increase the power to manage data, originally defined by the 3 Vs—volume, variety, and velocity. To meet the data challenges, an enterprise needs to apply tools that can provide the following:

- **Speed**—to handle increasing volumes of data not just quickly but also at the proper speed, according to the type of service or analysis required.

- **Scalability**—to handle larger volumes of data, not just vertical piles of data of the same form but also data of different formats, sizes, and shapes.

- **Efficiency**—to ensure more is done with less technical effort and overhead. Data is managed—collected, moved, placed, recovered, processed, and analyzed—as needed.

- **Adaptability**—to ensure business and technical requirements fit together. Information is not static and must be considered in terms of business process flow. Some of the data will flow to the enterprise data warehouse (EDW); other data won’t. Some of the data will be heavily staged and transformed; other data will be let loose. The new platform adapts to changing conditions in an agile way.
• **Veracity**—to provide greater accuracy of the results of the data analysis and increase user confidence.

• **Governability**—to ensure compliance with policies for data quality, security, and access at all levels of the data management process.

A modern data management and analytics framework (figure 5)—often called a data lake, enterprise data hub, or global corporate repository, among other terms—must take into consideration three main factors: flexibility, agility, and automation.

In recent years, a significant number of tools for performing big data analytics has arisen, along with diverse sets of new data types and databases, such as text and graph databases. Meanwhile, the number of sources has increased, as companies take advantage of the ever-decreasing cost of computing and hardware for data storage and management. Today, mobile phones, social...
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This approach is used
Also known as random
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Big Data Analytics Visualization

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 actually means. Exploring data in a visual way calls for an integrative process between the user and the system—the user applies perceptual abilities to transform 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 don’t require an understanding of complex mathematical or statistical algorithms or parameters, so users can 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 with more confidence in the findings from the exploration process.

Big data analysis often implies an automated data mining mechanism that can provide, on one hand, a mathematical approach that would allow for more confidence in the results and, on the other hand, a faster mechanism for processing large amounts of data. So based on the cycle provided in figure 3, the basis for automating the analytical process in a big data analytics solution depends on the use of advanced analytics techniques, particularly mathematical mining techniques.

Analytics Algorithms

A variety of machine learning (ML) and data mining algorithms exist and have been implemented within the vast majority of big data analytics solutions. In simple terms, machine learning is a branch of the larger discipline of artificial intelligence, which involves the design and construction of computer applications or systems that are able to learn based on their data inputs and outputs. Basically, a machine learning system learns by experience—that is, based on specific training, the system will be able to make generalizations based on its exposure to a number of cases and then be able to perform actions after new or unforeseen events, learning from historical relationships and trends.

Many mathematical algorithms or models exist in ML that can be used, depending on the type and scope of the problem to be solved. Here is a brief description of some of them, in no particular order:

• Linear regression. This approach is used to model the relationship between a scalar dependent variable (number or text) and one or more explanatory variables. This algorithm has practical applications in the fields of epidemiology, finance, environmental sciences, and others.
• Logistic regression. This model is used to estimate the probability of a binary response based on one or more predictors (independent variables). Use cases range from analyzing the factors that influence who wins a political campaign or the variables that influence admission to graduate school.
• K-means clustering. This algorithm divides a set of objects into k groups, or clusters, so that the members of each group are located nearest to their group’s center. This is a popular technique for performing cluster analysis on a dataset. Cases of its use can be found in customer and patient segmentation scenarios.
• Random forest. Also known as random decision forest, this is an ensemble approach.
that starts with using and combining decision tree techniques to reinforce performance and reliability. This algorithm excels in the classification of large data sets, and it is often used in the fields of computational biology and informatics.

- **Naive-Bayes.** More than a single algorithm or technique, it is a family of classification algorithms in which every element within the set is independent of the others. Independent means that one element's feature will not affect another element's feature.

This list is just a sample of the vast number of techniques that can be applied for performing advanced analysis over large data sets. Algorithmic models take different shapes, depending on their purpose, and different solutions may use different combinations of models in order to offer more refined techniques.

The use of different algorithms to provide comparisons can offer some surprising results about the data being used and can thus give a manager more insight into a business problem and potential solutions. So a good strategy for selecting the right algorithm is important to ensuring improved accuracy and better results from the analysis.

Well-defined goals will determine which algorithms should be used to sort out and process the information available.

### Big Data Analytics Solutions for Enterprises

By putting in place a big data analytics strategy, a company stands to gain the following benefits:

- **Cost reduction.** The deployment of a big data analytics solution brings clear cost savings to the table. Many current big data analytics offerings are based on open source software, as is the case with Hadoop and other data management solutions. While it is possible to find commercial distributions, the price offered can still be significantly lower than that of traditional commercial solutions. This has triggered price competition and has contributed to the emergence of new, cheaper technology—such as improved in-memory computing-based engines, cloud-based analytics solutions, and others. Additionally, the wide horizontal application of big data analytics and its power to perform data analysis over a wide variety of business areas and industries mean that wider analysis can be achieved with fewer resources at lower cost.

- **More direct impact on the business.** The exploitation of big data analytics solutions has made a significant impact on businesses. These solutions can serve as a vehicle for business innovation and improvement. Consider these three examples:

  - The availability of better products and brand awareness analysis can lead to improved marketing campaigns.
  - More accurate churn analysis can help produce not only improved relations with customer care professionals but also better quality of products.
  - The use of analysis of trends and hidden patterns in financial data may uncover new customer needs and lead to the development of new financial products.

### Business Intelligence: Big Data Analytics

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  - The use of analysis of trends and hidden patterns in financial data may uncover new customer needs and lead to the development of new financial products.
Big data analytics solutions can allow managers to measure and assess significantly more information—better representing the subtleties of the business, and arriving at a more accurate analysis of the current business scenario. They can then use the information generated to make more intelligent and informed decisions, enabling better strategy development and spurring the growth of the business.

An Essential Component of the Enterprise Software Stack

Organizations of all sizes can leverage these types of solutions to carry out analytics at reduced cost and over large and complex data sets. Big data analytics solutions can provide knowledge and reveal insights regarding patterns previously hidden within the sheer volume of data. Big data analytics, when combined with data science, allows companies to improve their data analysis capabilities in several facets, resulting in an accelerated increase in the usage of data and in the generation of insights for decision management and decision making. Here are some basic things to take into account when selecting a big data provider:

• **Identify your needs.** Before exploring solutions and vendors, take the time to evaluate the type of information that you require—and then determine the technology that can provide it. You first need to understand your data problem in order to solve it.

  • **Develop a plan.** Make sure your big data initiative aligns with your corporate goals. The benefits and risks must be clear upfront.

  • **Calculate the challenges and opportunities buried within your data.** Determine the most important problem in terms of the management and analysis of your vast amounts of data, and then focus on it.

Companies are eager to consume information, but they need to recognize that they have to make sense of it for it to produce business value and increase profits; increase the quality of their products; improve their services; and boost their customers’ experience. It can’t be overstated that a big data analytics solution is just one part of a complete data life cycle strategy—from data collection and analysis to its visual representation.

Assessing Your Big Data Analytics Readiness

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.

Organizations today are generating an increasing amount of data; they are processing more data transactions, and there is more interaction between systems—both internal and external to the organization. To be able to analyze data effectively, companies need to carefully 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 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 analytics technologies, it is necessary to address three fundamental questions:

• How effectively are you handling your 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 data management and analytics infrastructure across the different stages of the data management process. It will therefore serve as the basis for establishing how your data analytics 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 analysis platform solution. It can help you determine how well your organization is managing its data.

For each BI element of the questionnaire, 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.
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  By Randy Bean, Founder and CEO, NewVantage Partners

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- BI, Analytics, and Big Data Analytics: What's the Difference?
- Big Data and Analytics: A Perfect Match
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### Product Comparison

### What Sets TEC Apart

### TEC Resources

### Vendor Directory

### Technology Evaluation Centers

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### Big Data Analytics

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

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### Big Data Analytics: Business Intelligence

#### Phase

<table>
<thead>
<tr>
<th>Data Discovery and Visualization</th>
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<th>Value</th>
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<td>Data is available for analysis using traditional batch processes, with significant latency (several hours, days) between time of collection and time to analysis</td>
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<tr>
<td>Data is available for analysis, with minor latency (several minutes, a couple hours) between time of collection and time to analysis</td>
<td>6</td>
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<tr>
<td>Data is available for analysis, with minimal latency (a couple minutes, seconds, real time) between time of collection and time to analysis</td>
<td>8</td>
<td></td>
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<tr>
<td>Users (mostly business) have basic access to analytics tools for performing interactive analysis of data only for informational purposes (basic data sampling)</td>
<td>2</td>
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<tr>
<td>Users (business, decision makers) have access to analytics tools for performing interactive analysis of data with direct impact on decisions</td>
<td>6</td>
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<tr>
<td>Users (business, decision makers, and data scientists) have extensive access to analytics tools for performing interactive analysis of data with direct impact on decisions as part of a decision-support process</td>
<td>8</td>
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<table>
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<tr>
<th>Advanced BI</th>
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<tbody>
<tr>
<td>Use of predictive data analytics</td>
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<tr>
<td>Use of forecasting techniques and tools</td>
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<tr>
<td>Use of industry vertical–specific predictive analytics</td>
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<tr>
<td>Use of data, text, and Web mining</td>
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</tbody>
</table>

| 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** 10
30 or less points—Usable Data
There is a basic or no formal implementation of data management and analytics 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 data management and analytics 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 data management and analytics 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 data management and analytics 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 data management and analytics 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.
Big Data Analytics Offerings

In this buyer’s guide, we provide a comparison chart of the general capabilities of a sample of vendors considered to be innovative in the big data analytics marketplace.

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

Big data analytics solutions frequently deal with problems that require high-level capabilities, often calling on specialized resources or combinations of technologies and capabilities. It’s clear that with big data, many of the challenges for performing analytics concern adequate data management, integration, and processing. Other business considerations in evaluating a big data analytics solution concern service structure, service level agreements, deployment mode, security, and support.

The vendors described here have extensive functional coverage and/or have an extensive market presence in the analytics software space. Only a limited set of select solutions currently available on 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).
# Big Data Analytics

<table>
<thead>
<tr>
<th>Criteria</th>
<th>BeyondCore</th>
<th>Dundas BI</th>
<th>GoodData Platform</th>
<th>Cognos Analytics</th>
<th>Intelllicus MicroStrategy</th>
<th>Qlik Sense</th>
<th>BusinessObjects Analytics</th>
<th>SAP</th>
<th>Tableau</th>
<th>TIBCO Spotfire</th>
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</tbody>
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KPI, key performance indicator; OLAP, online analytical processing; SQL, structured query language.

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### TEC 2016 Buyer’s Guide

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S Supported | A Supported with additional application | T Supported with third-party provider (partner) | NS Not supported
KPI, key performance indicator; OLAP, online analytical processing; SQL, structured query language.
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### Product Comparison

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KPI, key performance indicator; OLAP, online analytical processing; SQL, structured query language.
**What Sets TEC Apart from Other Software Research Firms?**

Technology Evaluation Centers (TEC) is a unique player in the software evaluation and selection market. Unlike most other research firms, whose high-level opinion and analysis doesn’t address the specifics of your unique context, TEC offers a specialized approach to software selection.

TEC’s team of professional analysts provides deep expertise in application areas and industry segments. But we also base all conclusions on a multitude of data that fuels our quantitative decision support system. We’re experts at identifying and prioritizing complete requirements—no approximations—while following an efficient and proven project management approach.

We are enterprise software selection geeks, and we love what we do.

From Southwest Airlines to Kate Spade, and from Johns Hopkins to Honda, our clients have rewarded us with consistently high approval ratings. Here are just a few reasons why companies of all sizes appreciate the assistance and expertise of TEC for their software selection projects.

**A 360-degree Approach**

Most research firms provide high-level information and general contextualization of software solutions. They employ varying decision factors for each report, and may fail to address the subjective factors in a company’s context. Most offer general information on features and functions, leaving you to find out later how many of your specific requirements are not completely met out of the box. This can cost you valuable time and resources.

TEC considers all decision factors—your business drivers, your functional requirements list from across all teams, and your current and future ambitions—and combines them with our vast database of software functionality. We provide objective visibility on the gaps between each short-listed solution and your requirements, so you know what you’re getting into before you make a crucial software commitment.

We also take into account subjective criteria, such as ease of use, implementer and value-added reseller (VAR) considerations, corporate culture fit, and client reviews of your short-listed vendors.

**Agnostic, Data-driven Methodology**

Most other enterprise software research firms will offer lists of vendors they’re predisposed to recommend, and high-level reports that guide you towards the right group of software solutions for your enterprise.

In contrast, TEC’s software selection methodology is optimized for thoroughness and efficiency, highly defined, and time tested.

First, we are agnostic. We help you score and analyze what’s important to you, and we don’t recommend one solution over another. We don’t have to: the data speaks for itself.

We have the unique benefit of an in-house quantitative decision support system populated with extensive feature and function data from most enterprise software solutions on the market. **TEC Advisor** allows a user to indicate their detailed requirements and the degree of importance for each one. It then returns a long-list of solutions that meet your needs, showing in detail how closely each solution meets each of your requirements, and allowing you to alter requirements and priorities for on-the-fly hypotheticals. All TEC Advisor results are instantly available in report form.
Our Selection Consultants can walk you through the use of TEC Advisor, or take over the project management responsibilities of your entire enterprise software hunt.

With our help, you’ll move from a complete, efficient requirements gathering stage to a straightforward request-for-information (RFI) exercise that reflects your custom criteria. We deal with the vendors on your behalf, and facilitate live demos of short-listed solutions. The process takes into account all decision factors—including your scoring of vendor demos—and builds consensus while establishing an audit trail for complete transparency. Finally, we produce the kind of clear and thorough reporting that you can take to your CEO with confidence.

Once you’ve discovered the best software for your business, we can help make your negotiations competitive: TEC’s Selection Consultants can suggest ways to better tailor vendor agreements to your needs. We also provide implementation advice and optional formal oversight to ensure efficiency and help you avoid the infamous headaches and budget overruns of this complex stage.

Engaging a regular research firm to help you find the way to the right software solution for your company can be a bit like buying a house without a thorough inspector’s report: it may look fine on the surface, but there may be a lot of costly surprises.

Companies of all sizes have saved considerable time and money by engaging with TEC’s specialized approach to software selection at an average of two to four months from start to finish. Find out more about how TEC can help your company select and implement the right software for your business.
Enterprise performance management (EPM) software solutions play a key role in analyzing, monitoring, and improving an organization’s performance—and ultimately the bottom line. Learn about the tools and the practices that you need to put in place.

READ NOW

How an organization manages its business processes is integral to its operational efficiency and business growth. Today’s business process management (BPM) solutions offer increased automation capabilities to facilitate better decision making.

READ NOW

This report tells you how the cloud has developed and is being reshaped, the different types of clouds that are out there, and the potential downpour of BI and analytics benefits the cloud portends to hold for organizations.

READ NOW
Cloud computing has accelerated the emergence of highly innovative business intelligence (BI) and business analytics offerings while boosting the evolution and radical adaptation of existing BI and business analytics platforms.

READ NOW
# Software Reviews

## Product Note

**Dell Toad's Big Jump into the BI and Analytics Market**

Software giant Dell acquired database solutions specialist Toad in 2012. With that acquisition and others the company has been able to offer solutions that help organizations close the gap between IT and business. Learn about Dell Toad's platform infrastructure.

[READ NOW](#)

## Industry report

**BI Software with Intuitive, Interactive Data Visualization and Analytics**

Dundas BI is an end-to-end BI platform that supports an extensive number of processes across the entire BI cycle. Learn about the product's key differentiators and the advantages it can afford organizations seeking to adopt an enterprise-ready BI application.

[READ NOW](#)

## Industry Report

**IBM Cognos Analytics—Simple, Powerful, and Practical for a New Generation of Users**

Good analysis means good decision making. With IBM Cognos Analytics, IBM intends to put effective analytics tools in the hands of a new generation of business analysts, BI specialists, decision makers, and data scientists.

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## Industry Report

**SAP BW 7.4—The Role and Value of BW in SAP’s New Enterprise Data Warehouse Vision**

SAP's vision of business simplification, cloud enablement, and the future of data warehousing are explored through this extensive review of SAP Business Warehouse (BW) version 7.4, powered by SAP HANA.

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By Randy Bean, Founder and CEO, NewVantage Partners

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Use TEC’s online software evaluation system, TEC Advisor, to see how BI and Data Management software solutions address your company’s unique business requirements.

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Jorge García is a senior business intelligence (BI) and data management analyst for TEC. He has more than 20 years of experience in all phases of application development and database and data warehouse (DWH) design, as well as 9 years’ experience in project management, covering best practices and new technologies in the BI/DWH space.

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.

García is a member of the Boulder BI Brain Trust.