

## Visualization



### See, discover and explore deeper insights within large, complex data sets

Enterprises move into 2011 with information at the forefront of their agendas. According to a recent Gartner survey, increasing the use of information and analytics is one of the top three business priorities<sup>1</sup>. Data volumes continue to explode, as unstructured content proliferates via collaboration, productivity and social channels. And while organizations are making headway on enterprise information management and broad analytics solutions, much potential insight is buried within static reports that are accessible only by a small fraction of the organization<sup>2</sup>.

This static, tabular approach runs counter to fundamental patterns of human thinking; our brains have been tuned to recognize shapes, detect movement and use touch to explore surroundings and make connections. Thus, the true value of business intelligence is often lost as companies struggle to communicate complicated concepts and empower more stakeholders.

Visualization refers to the innovative use of images and interactive technology to explore large, high-density datasets. Through multi-touch interfaces, mobile device views and social network communities, organizations are enabling users to see, explore and share relationships and insights in new ways. Spatial and temporal context add physical location and sequencing to the analysis over time, allowing patterns to be uncovered based on the source,

flow and evolution of information. Intuitive touch or gesture-based drill-downs and on-the-fly relationship mapping add immediacy to the analysis, encouraging manipulation and higher-order understanding instead of static or passive views.

Though a long-established discipline, visualization deserves a fresh look in 2011, partly due to the evolution of the underlying tools. In-memory databases and distributed MapReduce processing now allow trillions of records and petabytes of data to be sorted, joined and queried. Visualization suites complement business intelligence and analytics platforms, offering rich graphics, 3-D perspectives, interactivity and usability on par with leading consumer experiences – often with deployment channels on smartphones, tablets and other mobile devices.

Another difference in 2011 is the rich potential represented by unstructured data, whereby organizations can tap into millions of internal emails, instant messages and documents, as well as trillions of Facebook objects (100 billion page views per day<sup>3</sup>), Twitter tweets (90 million per day<sup>4</sup>), text messages, blogs and other content of potential concern to the enterprise. In the face of so many loose connections and non-intuitive correlations, visualization is proving to be an excellent mechanism to make sense of unstructured data and feed it into decision making and process improvement activities.

### History repeating itself?

Visualization has deep roots going back to society's earliest maps, scientific charts and instructional illustrations – many designed to convey complex information in ways that simplify, communicate and foster understanding. In computer science, visualization has been attempted for decades, but has been limited by graphical horsepower, CPU, memory and storage constraints.

	What were the challenges?	What's different in 2011?
<b>Spreadsheet/database chart builders</b>	<ul style="list-style-type: none"> <li>Restricted to essentially four variables: x and y axis, size and coloring of plotted points.</li> <li>Viewpoints typically restricted to static, siloed data – leaving little room for alternatives.</li> <li>Limited ability to interact with the data – some drill-down, but queries and views were generally fixed.</li> </ul>	<ul style="list-style-type: none"> <li>Three dimensional visual and interactive elements allow for many variables to be considered for any given analysis.</li> <li>Visualization tools have continued to add features and toolkits – from stand-alone packages (e.g., SAS, ILOG) to productivity tool plug-ins (e.g., Excel) to cloud services (e.g., ManyEyes, Google, Tableau Public).</li> <li>Tools allow information acquisition (with requisite cleansing and correlation) or real-time integration to connect relevant data, inside and outside of organizational boundaries.</li> <li>High degrees of interactivity, both for drilling down and on-the-fly editing of core dimensions of the analysis.</li> </ul>
<b>Business intelligence/reporting</b>	<ul style="list-style-type: none"> <li>Tools required power users to perform self-guided queries and explore the data universe – demanding detailed knowledge of underlying data structures and SQL.</li> <li>Primary focus on historical reporting – with tabular text or chart/histogram output. Without spatial and temporal context, many patterns were impossible to recognize.</li> <li>Computational and storage bottlenecks either restricted the complexity of analysis or the size of data sets (or both).</li> </ul>	<ul style="list-style-type: none"> <li>Business intelligence solutions are often part of rich analytics suites – which include visualization tools designed with business analysts and end-users in mind. Data structures are abstracted based on enterprise objects and metrics; 4GL languages allow drag and drop exploration.</li> <li>The last few years have seen consolidation in the ERP/BI space (e.g., SAP and Business Objects, Oracle and Hyperion, IBM and Cognos, SPSS). As product lines are becoming integrated, organizations have easier access to, and an easier time feeding into, tools capable of driving visualization.</li> <li>Natural links to performance management and predictive modeling tools, allowing not just confirmation of intuition, but discovery and insight.</li> <li>High-performance appliances, in-memory analytics solutions, cloud-based infrastructure as a service and distributed data processing solutions have introduced cost-effective means to remove technology constraints.</li> </ul>

### Technology implications

Tools for rendering and displaying complex visuals are a natural part of this trend. Beyond the presentation layer, visualization requires foundational Enterprise Information Management and Information Automation disciplines – as well as means to integrate data silos within and beyond the organization<sup>5</sup>.

Topic	Discussion
<b>Master data management</b>	Insights from sophisticated visualization solutions will only be as good as the underlying data. If entity-level relationships are not understood at the structural level, nuanced correlations and associations will be almost impossible to achieve at the business level. Even worse: the analysis will yield flat-out wrong conclusions based on faulty data.
<b>Data quality</b>	Any derived understanding will be compromised if the source data is dirty, inconsistent or of unknown quality. That's why leading organizations are adopting tiers of trust zones for data. Acknowledging a lack of control over external and unstructured data, different puzzle pieces are allowed to be included as a part of the analysis, but stakeholders are made aware of potential issues with the integrity of the data sources.
<b>Integration</b>	Ability to link multiple internal – and increasingly external – data sources to feed into the palette of information to be visualized. On-premise solutions typically feature batch and transaction-level movement of information between physical repositories driven by data, service or event based interfaces. If one or more cloud solutions are also potential sources, an external "integration-as-a-service" platform will likely become part of the technology landscape (e.g., CastIron, Boomi, Pervasive).
<b>In-memory, distributed and cloud-based infrastructure</b>	Infrastructure is needed to support processing of large data volumes – using either column-based compression optimizations, map reduce or elastic scale of the operating environment. These allow for high-performance computing characteristics at a relatively low cost, enabling complex visualizations and analysis.
<b>Visualization rendering and interaction tools</b>	Either as extensions to broader information suites or as stand-alone niches addressing the presentation and manipulation of complex analyses, visualization tools must be a part of the strategic information landscape. Many of these tools feature mobile application access – ranging from viewing pre-defined outputs to actively exploring the data universe.

### Lessons from the frontlines

#### Matter of life and death

The University of Maryland launched the Similan effort to “enable discovery and exploration of similar records in temporal categorical dataset.”<sup>6</sup> In other words, they wanted to enable searches based on a sequence of events – specifically, to be able to look through patients’ electronic health records and find incidents of a specific pattern of treatments and symptoms that might be representative of an overarching disease or condition. For example, patients that predispose themselves to contrast-induced nephropathy would start with normal creatinine levels, then undergo radiation therapy and then have low creatinine levels within five days. Unfortunately, patient histories and charts were not easily searchable by event sequences.

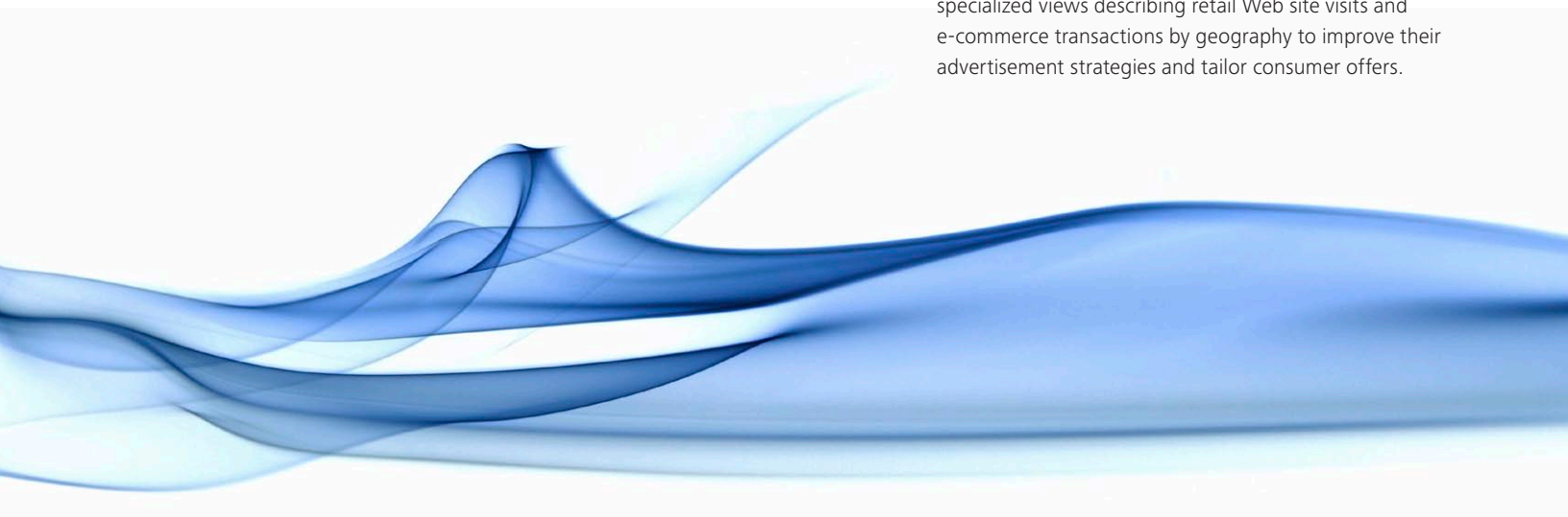
Enter Similan. By allowing visual representations of events mapped against time, backed with effective search tools and animated event flows, the desired pattern is easier to recognize. Beyond healthcare applications, there are wide-ranging possibilities for commercial use of this technology, including events such as product line launches, M&A transactions, retail store openings, or corporate downsizings.

#### Living, breathing (digestible) almanac

IBM created a tool to showcase the power of visualization based on publically available data from the CIA’s World Factbook, providing analysis comparing Gross Domestic Product (GDP) and population growth across the globe<sup>7</sup>. It compares the effectiveness of online analytical processing (OLAP)-based bar charts with integrated, spatial interfaces of the same data. A tree map shows GDP per country via rectangles of varying sizes, with color coding to represent varying population growth velocities. The view effectively communicates thousands of data points. By allowing the same analysis to be mapped spatially to the globe, new patterns can be detected based on regional activities, patterns that would not be apparent in the continental view. While each perspective has its strong points, the ability to switch from one to another allows for a wider range of analysis, and more potential for insight. Finally, drill-down is possible for any given country – providing end-user access to low-level detail.

#### Metering the Internet

Akamai’s Internet visualization tools provide a view into multiple dimensions of online performance: overall web traffic, net usage indices based on transaction and content type and individual site visitation, response and application performance<sup>8</sup>. By providing real-time visibility into traffic, correlation to past performance for trending analysis and the ability to use touch-based gestures to investigate regions and activity over time, the complexity of two billion Internet users’ habits is made simple and actionable. Organizations are taking advantage of specialized views describing retail Web site visits and e-commerce transactions by geography to improve their advertisement strategies and tailor consumer offers.



### Where do you start?

Visualization is a largely untapped source of value, with current efforts typically focused on historical reporting, dash-boarding or predictive modeling. Establishing tools to improve consumption, increase exploration and better understanding of these activities is frequently an afterthought for organizations. It is often assumed that the analytics tools themselves will provide visualization capabilities out of the box, an assumption that does not generally hold up. Similar to the 2011 Technology Trend on User Engagement, consumerization and generational forces are driving radical new expectations for information access. The good news: these new developments can yield tremendous value for the organization, particularly when applied to the largely green-field terrain of unstructured data.

- **Business purpose first.** The types of tools and disciplines needed for visualization will be determined by the business problems to be addressed. That is critical to informing stakeholders and determining the degree of focus on communication clarity, how much to invest in exploration and manipulation, how mobile scenarios fit in and which visualization techniques are applicable. The range of possibilities is enormous – from simple Tree Maps and Bézier curves to advanced solutions like the University of California at Santa Clara’s AlloSphere<sup>9</sup>, a self-enclosed research center with two five meter radius hemispheres allowing fully immersive visual and auditory exploration of complex data sets (e.g., electron spin/bonding, brain activity, etc).
- **Know your audience.** Choosing the right visualization technique has everything to do with what you are trying to do. Is the intent to clearly convey findings? Or to enable others to discover their own insights? Will it be leisurely consumed from a desktop in a corner office or by someone in the field to help resolve immediate, pressing issues? Clearly understand your audience – and their intended usage – to guide scope and design.
- **Information management mandate.** Worse than not having the answer to a question, is to have false confidence in an answer that is compromised. That’s why master data management and data quality are crucial parts of the visualization story. Luckily, it is feasible to address information management in phases aligned with the scope of the business problems ahead. Just think through enterprise implications from the start so the journey can be accretive, not a series of redundant or divergent efforts.
- **Explore.** There are many open source options for exploring the potential benefits of visualization: ManyEyes, Tableau Public, Google Public Data Explorer and other services allow either exploration of public information or importing of private data for visualization and manipulation. Just keep in mind that normal security and privacy considerations apply for any sensitive intellectual property. Dedicated players like Qlikview, Spotfire, Roambi and offerings from IBM, SAP, Oracle and others, provide tools for rapid prototyping. Tool decisions should be based on existing technology footprints and expected use cases. By experimenting with several platforms, the business can be better educated on the art of the possible – driving an informed vision and investment roadmap.

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## Learn more

This is an excerpt from *Tech Trends 2011 – The natural convergence of business and IT*. Visit [www.deloitte.com/us/2011techtrends](http://www.deloitte.com/us/2011techtrends) to explore other top technology trends.

## Bottom line

The promise of visualization has been a long time coming, but the results often fall short of the business' imagination. With the mix of rich new tools, the rising quality of enterprise information and analytics, the untapped potential of unstructured data and the incentive of mobile use – the deck is finally stacked to make good on that promise. However, the richest visual presentation is of no use if the content is flawed.

Organizations with solid information foundations can use visualization to leap-frog competitors. Laggards can use the allure of visualization as strong reason to finally shore up data management concerns. Regardless of which category your organization falls into, your employees, customers and partners will soon expect access and transparency to information that can be explored, manipulated and acted upon. Leading companies will be in a position to profit from getting it right.

## Endnotes

- <sup>1</sup> Mike Vizard, *Gartner 2010 CIO Survey: A Time of Great IT Transition*, <http://www.itbusinessedge.com/cm/blogs/vizard/gartner-2010-cio-survey-a-time-of-great-it-transition?cs=38795> (January 19, 2010).
- <sup>2</sup> Additional information is available in Deloitte Consulting LLP (2011), "Tech Trends 2011: The natural convergence of business and IT", <http://www.deloitte.com/us/2011techtrends>, Chapter 6.
- <sup>3</sup> Chris Crum, *Facebook Gets 100 Billion Hits Per Day*, <http://www.webpronews.com/topnews/2010/07/21/facebook-gets-100-billion-hits-per-day> (July 21, 2010).
- <sup>4</sup> Leena Rao, *Twitter Seeing 90 Million Tweets Per Day, 25 Percent Contain Links*, <http://techcrunch.com/2010/09/14/twitter-seeing-90-million-tweets-per-day/> (September 14, 2010).
- <sup>5</sup> Additional information is available in Deloitte Consulting LLP (2010), "Depth Perception: A dozen technology trends shaping business and IT in 2010", <http://www.deloitte.com/us/2010technologytrends>, Chapter 1.
- <sup>6</sup> Visit <http://www.cs.umd.edu/hcil/similar/>
- <sup>7</sup> Visit <http://visunetdemos.demos.ibm.com/blogsamples/factbook2/FactBookSE.html>
- <sup>8</sup> Visit <http://www.akamai.com/html/technology/nui/retail/index.html>
- <sup>9</sup> Visit <http://www.allosphere.ucsb.edu/>

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