Insights from Complexity

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EXECUTIVE SUMMARY: *The quality and timeliness of business decision-making depend on the insights that can be drawn from the oceans of information available. Today's technology challenge is no longer opening access to information; rather, it is opening access to insight. This transformation creates an environment where organizations can anticipate change, rather than simply react to it. This white paper for senior executives, including CEOs and CIOs, describes an environment where they can make better informed decisions, because software not only makes data more accessible it also reveals relationships between data.*

OVERVIEW

In nearly every field, technology provides a way to examine and analyze the most granular elements, tasks, and decisions. The result is a wealth of new information—and new complexities to deal with. For instance, new instruments let us look deep into the cell and see how the basic mechanisms of life work. In turn, new classes of questions are created for every new answer. Breakthrough tools in astronomy reveal similar detail in the cosmos, forcing what was once considered doctrine to be reconsidered. In the same way, tools in business are expanding the view of managers and workers by giving them access to information and releasing them from the historical isolation of their functions.

Consider how information technology picks up data from probes and sensors across processes to reveal complex views of everything from batch processes inside a factory to the details in handoffs within the supply chain. Or how software facilitates rich conversations between organizations and their customers and results in new business models, many of which are information-driven themselves.

The relationships between people and functions are also becoming more complex as organizations outsource more work or hire contract workers and vendors to fill other needs. The Just-in-Time movement born in manufacturing is now used everywhere from sourcing material to sourcing people and executing on marketing and sales. The management of resources to be delivered as needed requires models that reflect relationships and handoffs that anticipate deliveries, miscues, or other issues, because in many situations today simply reacting to a problem is not only unacceptable, it may prove disastrous. If turned inward, software provides vast amounts of information about the performance of infrastructure, the movement of information, and the behavior of people who use it.

All of this data is driving the next level of innovation in software: deriving insight from complexity. No longer is it sufficient to make data available,

"Data is driving the next level of innovation in software: deriving insight from complexity."

to create dashboards that reveal the complexities of a business. Today's executives, managers, and other business professionals demand new ways to make sense of the information. They adopt key performance indicators (KPIs) as a process that sifts through data, allowing them to focus on the most important information. Sometimes, the most important information does not come from a single source. It is an index of sources that exposes a function's health along multiple, interrelated dimensions. And in some cases, even KPIs fail to capture true causal effects, because not all of the data required to understand the business is owned by the business. Today's organization is feeling pressure to open its perspective and find new ways to gain insight from this complexity. Tomorrow, the insights driven by data will mean the difference between a strong competitive position and survival. Gaining insights from complexity will no longer be a luxury; it will be a necessity.

KEY ISSUES OF GAINING INSIGHT FROM COMPLEXITY

The challenges of deriving insights from the increasing amounts of data and media can be categorized into the following three broad steps:

Finding the sources of insight. Identifying the components of the ever richer data environment that will unlock patterns of behavior that reveal new opportunities.

Moving from insight to action. Visualizing data to spot trends, listening to customers for insight and feedback, and using data to drive business decisions—but above all, collaborating with colleagues and partners to make sure that the insights turn into value.

Staying productive in an information-rich environment. Managing content, context, and contacts; dealing with interruptions; and keeping data up to date.

DRIVING FORCES

Several forces are shaping the need to gain insights from complexity, including transparency as an opportunity, insight as a competitive differentiator, emerging sources of data, and revealing relationships through visualization.

TRANSPARENCY AS AN OPPORTUNITY

Regulations like Sarbanes-Oxley and Basel II require organizations to make more of their operating data available to the public and to regulatory agencies, often forcing them to rethink their internal systems to reach compliance. The same is true of reporting concepts like Triple Bottom Line and International Financial Reporting Standards (IFRS).

Regulatory mandates condition businesses to see transparency as a challenge and a burden, but transparency can be an opportunity to better understand the operating environment and create new value. As business relationships become closer, organizations are negotiating partnerships that expose more of their internal operations to partners. Organizations may take this opportunity to examine their internal processes and find meaningful patterns in their data.

INSIGHT AS A COMPETITIVE DIFFERENTIATOR

Organizations can take advantage of the wealth of data available to see opportunities that competitors miss. Cost and effectiveness are always important drivers of business performance, but understanding where costs are located or which processes are least efficient is difficult without deeply understanding their structures. The penetration of IT systems into the deepest reaches of the business, with the immediate purpose of driving particular efficiencies through automation, is also producing a flood of highly detailed operational data as a byproduct (see Chart 1 "Operational BI Fuels Efficiency and Productivity").

CHART 1: Operational BI Fuels Efficiency and Productivity

Companies ranked the top benefits of operational business intelligence in the following order:

1.	Improves operational efficiency
2.	Enables workers to be more proactive
3.	Provides better customer service
4.	Catches problems before they escalate
5.	Increases business transparency

Source: Survey of 423 companies by TDWI

Organizations can gain insights by looking at how this data alters over time in response to different inputs and changes to external conditions—even if those inputs and conditions do not seem at first to have a causal relationship to operations. By discovering these hidden cause-and-effect relationships, decision-makers can quickly implement new strategies that may seem counterintuitive but actually result in improved performance and increased efficiency.

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Cost is not the only differentiator, though. Courteous, personal service is always appreciated by customers. But to really impress their customers, organizations will need to prove that they know their customers and can even anticipate the needs of those customers. Customer knowledge

becomes manifest when an employee engages with a customer or when technology uses its knowledge of the customer to create a more personalized experience (see Chart 2, "How Companies Use Customer Information").

CHART 2: How Companies Use Customer Information

The top six strategic applications of customer information by marketers include the following:

- Up-selling and cross-selling
- Segmenting and targeting
- Driving retention, loyalty, and promotional programs
- Identifying new opportunities and unmet needs
- Improving customer service
- Shaping personalized and customized communications

Source: Survey by the Chief Marketing Officer (CMO) Council

The key is aligning data with strategy, whether this means learning about customers and engaging them or learning about cost structures. For some organizations, their customer insights and data will be a source of value in and of themselves, allowing each company to create new lines of business around its knowledge of customers, markets, or operations.

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EMERGING SOURCES OF DATA

Information is increasing at an exponential rate, and it can be divided into the following categories:

Emerging. Technologies such as radio-frequency identification (RFID), global positioning systems (GPS), digital instruments, vehicle-based telematics systems, and surveillance equipment create enormous volumes of new information that managers can use to measure performance and drive decision-making.

Legacy Data. Legacy data from stand-alone systems, mainframes, and paper records is becoming more visible across the business as it is integrated into data warehouses.

Mobile Sources. Media-equipped mobile devices, such as smartphones, digital cameras, and portable gaming equipment, create entirely new channels. Camera phones feed a growing body of rich-media content that

consumes storage resources and is more difficult to tag and track than structured data.

Collaboration. E-mail, instant messaging, workspaces, wikis, blogs, social networks, Web content management, and document repositories produce large amounts of unstructured data. These sources also produce metadata that reports on the state of content, its categories, and the relationships between data stored in thousands of locations. Over time, as better tools allow people to search data quickly and accurately, the way they view content will completely change.

REVEALING RELATIONSHIPS THROUGH VISUALIZATION

Distributed computing, which harnesses the unused processing power of networks of desktop PCs and devices along with data center assets, provides the raw horsepower for industrial-strength number-crunching without the costs of ownership. Moving forward, this means that data-based decision-making is no longer dependent on the ability to afford overwhelming IT assets; anyone with the talent to ask the right questions can have access to the insights gleaned from quantitative analysis.

FINDING INSIGHTS HIDDEN IN YOUR DATA

In many cases, organizations can turn to their own data about customers or processes. Business intelligence techniques can be applied to any kind of data stored in a database and, very often, to other data, such as e-mails, memos, and presentations. It is common today for an organization to examine its customer records in new and unique ways to discover which products are most profitable, which customers are most valuable, or what new products, processes, or services can be introduced. In some industries—for example, insurance—the insight may lead to not taking a customer, because of the risk their past behavior predicts.

People armed with enough information and the right tools can accurately forecast market conditions with confidence. For example, the Web site FareCast, recently acquired by Microsoft® Corporation, has developed a method for analyzing potential changes in ticket prices on specific air routes, so it sells insurance to offset the risk of overpaying. FareCast uses mostly public data in its calculations; the company's value derives from the relationships that human experts see within the data to provide unique insights and services to air travelers.[1]

There are many examples of how unexpected insights can be gleaned from data, including areas outside of business. For instance, researchers at

[1] For more information on FareCast's business model, see http://www.farecast.com/about/ourTechnology

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the Institute of Crime Science, University College London, have found through computer simulations that burglaries actually spread very much like contagious diseases. The research reveals that crime is the result of human behavior combined with the physical spaces in which criminals find themselves, and not as much about the psychological makeup of the criminal. Crime, in some ways then, is a normal outcome of social interactions and the way societies evolve.[2] Insights like this are just waiting to be plucked from databases.

THINK OF NETWORKS OF PEOPLE, NOT JUST DATA

Data is only valuable if the insights derived from it can be applied by people in the organization. In the rush to champion the power of quantitative thinking and data systems, it is easy to overlook the decisive role that human insight still plays. The data may be shouting insights and knowledge, but it might as well be silent if the right people are not there to listen. As Yaneer Bar-Yam, head of the New England Complex Systems Institute in Cambridge, Massachusetts, says: "One of the most profound results of complex systems research is that when systems are highly complex, individuals matter."[3]

People are also critical inputs to business intelligence when they form "human sensor networks" to rally around a political issue, save a television show from cancelation, or provide feedback and share information on products. One recent example of human sensor networks comes from the San Diego fires of 2007, where cell phones, Internet search, online discussion groups, text messages, Web forums, blogs, and photo sharing kept the community and rescue workers informed about the fire at a level of detail that would not have been possible without technology.[4]

MODEL HUMAN BEHAVIOR TO DRIVE BUSINESS DECISIONS

Statistical sampling techniques can forecast the behavior of everyone from air travelers to Web surfers to baseball players. For example, it may not be immediately obvious that demand for foods like Pop-Tarts will spike in the wake of a natural disaster, but Wal-Mart has data showing that this is true and, consequently, keeps plenty of inventory in the pipeline during hurricane season in the southeastern United States.

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[2] Buchanan, Mark. "Sin cities: The geometry of crime." *New Scientist*, April 30, 2008. http://www.newscientist.com/article.ns?id=mg19826541.000&print=true

[3] MacKenzie, Debora."Will a pandemic bring down civilization?" *New Scientist*, April 5, 2008. http://www.newscientist.com/article.ns?id=mg19826501.400&print=true

[4] Palmer, Jason. "Emergency 2.0 is coming to a website near you," *New Scientist*, May 2, 2008. http://technology.newscientist.com/article.ns?id=mg19826545.900&print=true

Procter & Gamble, during its acquisition of Gillette, spent over a year analyzing data and found that supply chain, workforce, and customer synergies were factors in determining the price P&G would pay for Gillette.[5] Indeed, companies as diverse as Amazon, Lowe's, and Harrah's use information gleaned from customer transactions to anticipate customer preferences. This approach helps these companies and others like them develop effective responses to recover at-risk customer relationships and reduce turnover costs.

MOVING FROM INSIGHT TO ACTION

Discovering something new in a data set is interesting, but it is not impactful unless the organization incorporates that insight into how it does business. Even when systems are well-integrated in the back office and businesses can keep up with the proliferation of new data, transforming that information into useful, actionable business intelligence can be a challenge. It depends on a combination of data access, easy-to-use tools, and people who are able to ask the right questions, spot the relevant trends, draw the right conclusions, and get others to take action.

With the wealth of data available, keeping a tight rein on business intelligence is not the right choice. New tools democratize business intelligence, permitting ever widening circles of people to use the resulting knowledge to the company's benefit.

Business intelligence needs to be integrated with collaboration so that the right people and the right processes can leverage the new insight. By bringing business data together with technologies that people already use—including spreadsheets, e-mail, and shared workspaces—organizations can adopt business intelligence solutions across a wide cross-section of their employees. The benefits of collaboration will extend beyond the team responsible for the data or the function (see Chart 3, "Incorporating BI into Current Work Processes").

"Business intelligence needs to be integrated with collaboration so that the right people and the right processes can leverage the new insight."

[5] Davenport, Thomas H. and Harris, J. *Competing on Analytics*. Boston, MA: Harvard Business School Press, 2007.

CHART 3: Incorporating BI into Current Work Processes

Companies that have a high use of business intelligence make the tools easy to use with familiar technology (% of companies reporting high use of BI and things they have done to accelerate usage).

54%	Integration with Microsoft Office Excel® and Microsoft Office
46%	Data delivered via a dashboard
44%	BI output embedded in process
44%	High degree of report interactivity and self-service
39%	Robust charting and visualization
38%	Thin clients access to live reports
33%	Reports delivered via e-mail

Source: Survey of 678 companies by TDWI

Two keys to this collaboration are visualizing relationships and looking beyond traditional metrics.

Visualizing relationships. Relationship mapping software enables the visual representation of relationships and influence within organizations. People appear as circles of larger or smaller size depending on their influence, with lines of connection to various points at varying degrees of thickness depending on the strength of the connection. These maps provide greater insight into the true patterns of communication within a group than the traditional organization chart, and they can be a valuable tool in managing human resources.[6]

Looking beyond traditional metrics. Some organizations are now reexamining their business models as senior executives realize that data from their operations and customers can be a source of new revenue. Beyond that, insight will come from data and information across the company's holdings and from its interactions with customers and suppliers (see chart 4, "BI Spreading Throughout Organizations"). Strategic implications come from looking past the traditional KPIs, operational performance metrics, financial measures, and reporting requirements.

"Strategic implications come from looking past the traditional KPIs, operational performance metrics, financial measures, and reporting requirements."

[6] Hindo, Brian. "Mapping the Crowd." *BusinessWeek*, November 15, 2007. http://www.businessweek.com/innovate/content/nov2007/id20071114_879795.htm?chan=innovation_special+report+--+in_in

CHART 4: BI Spreading Throughout Organizations

Business intelligence applications are moving beyond analysts and top executives to even suppliers and customers (% of companies reporting access provided to specific roles).

54%	Business and financial analysts
44%	Executives
43%	Managers
28%	Inside staff
23%	Field staff
11%	Customers
8%	Suppliers

Source: Howson, Cindy. *Successful Business Intelligence: Secrets to Making BI a Killer App*. New York, NY: The McGraw-Hill Companies, 2008.

MANAGING INTERRUPTIONS BECOMES CRUCIAL

Information workers are swamped with e-mail, instant messages, text messages, online meetings, RSS feeds, project workflow notifications, team workspaces, blogs, and social networks. The ongoing question is how to stay up to date with useful communications technologies without being overwhelmed by them. A study at the Institute for the Future of the Mind at Oxford University found that people of all ages have a hard time refocusing on highly cognitive work after being interrupted. That means companies need to manage interruptions just as they manage the other parts of a task, such as content, data, and project plans.

There is no uniform opinion about the best ways to work in an information-rich environment. Although some senior managers assume from their own experiences that it is easier to work without distractions, people accustomed to multitasking may prefer a dynamic workstyle to stay engaged even at the expensive of productivity. Also, interruptions sometimes lead to more opportunities. For example, is a sales representative creating more value by filling in a monthly expense report or answering an instant message that interrupts him in the middle of that task and turns out to be a hot lead on a new order?

It is important that the IT infrastructure be flexible enough to rapidly incorporate new forms of communication without disturbing the core

"It is important that the IT infrastructure be flexible enough to rapidly incorporate new forms of communication without disturbing the core business functions or threatening security or privacy."

business functions or threatening security or privacy. The way to stay productive in an information-rich environment is to adopt a platform that permits a secure, and managed, core while facilitating adaptation at the edge, where employees and customers meet, where process meets process, where requirement meets requirement. Here, exceptions and change move too fast for core systems, but people can quickly adapt to whatever they encounter.

STRATEGIC TECHNOLOGIES TO DRIVE INSIGHTS

The following technologies can help organizations gather data from diverse sources and use it to drive business insights that lead to competitive advantage while not disrupting workers' concentration and workflow:

Business intelligence and analytics to make data accessible and useful to people in their roles.

Open data sources to allow businesses and consumers to map proprietary data against licensed or public data.

Unified collaboration platform to simplify the way people interact and share data.

Scalable data architecture to simplify the incorporation of new sources and types of data.

5 TOOLS FOR TURNING COMPLEXITY INTO INSIGHT

The business intelligence and analytics tools that companies use to turn complexity into insight fall into five classes: enterprise systems, analytic technologies, business data in portals and information work applications, visualization, and simulation.

ENTERPRISE SYSTEMS

Customer-facing workers, such as sales professionals, customer service representatives, retail associates, or service providers, all benefit from business data that allows them to anticipate and exceed customer expectations in any given transaction. Customer relationship management (CRM) can point toward not only effective strategies for delivering personalized service but also up-sell and cross-sell opportunities that even seasoned sales professionals might miss. CRM data should be easily available in the applications that people know and use, such as the e-mail or unified communications client, so that the information will be at the worker's fingertips when the customer calls.

"Customer data should be easily available in the applications that people know and use."

ANALYTICAL TECHNOLOGIES

Core technologies to analyze data include spreadsheets, online analytical processors (OLAP), statistical and quantitative algorithms, rules engines, data mining tools, text mining tools, and simulation tools. Emerging technologies, including categorization, genetic algorithms, audio and video mining, swarm intelligence, and information extraction tools, will greatly enhance traditional tools.[7]

BUSINESS DATA IN PORTALS AND INFORMATION WORK APPLICATIONS

In an Economist Business Unit study of CFOs sponsored by Microsoft, nearly 64 percent of respondents cited "ready access to data" as the most important contributor to finance empowerment. Portals make business data readily available to people in all roles, allowing them and their teams to quickly align their efforts to the strategic goals of the business. In addition, workers can make better use of enterprise data by bringing it seamlessly into the familiar desktop applications that they use for financial management and visualization, such as Microsoft Office Excel® spreadsheet software, so they do not have to disrupt tried-and-true work practices.

VISUALIZATION

Reports do not easily represent multidimensional relationships, and even less complex relationships can be more easily seen than read about. Data visualization plays an important role in understanding social systems, adding views into processes and customer relationships—not to mention the social, economic, and political relationships that organizations must track to remain cognizant of their operating environment.

SIMULATIONS

Business process owners have long simulated everything from customer queues at amusement parks to the flow of material through a Lean manufacturing operation. Over the next decade, simulation data will likely combine with experiential and sensory data to create even more complex environments. Gaming skills will become a mainstream business competency as organizations attempt to anticipate the outcomes of complex business relationships, using both realistic and abstract simulation environments.

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[7] Davenport, Thomas H. and Harris, J. *Competing on Analytics*. Boston, MA: Harvard Business School Press, 2007.

OPEN DATA SOURCES

Although data sources in isolation can be useful, their value increases significantly when combined with other data. Imagine, for example, modeling the land holdings of a large agricultural organization in combination with weather data to find the optimal place to plant a new hybrid and take maximum advantage of its yield characteristics.

More data sources will be opening. Some online game communities that open their application programming interfaces (APIs) have hundreds of developers who share their creative talents with the community, allowing people to download everything from starships to avatars. The exchange of data for business applications will soon be just as brisk.

UNIFIED COLLABORATION PLATFORMS REDUCE COMPLEXITY

Unified communications and collaboration help reduce the complexity of people-based interactions, especially as the proliferation of new channels threatens to overwhelm people's attention spans and ability to focus.

Single communication client. Giving people a single point of entry across the myriad ways of communicating via technology makes work a lot simpler, for both end users and IT. Unified communications brings together voice-based telephony, Voice over IP (VoIP), fax, e-mail, instant messaging, calendaring and meeting requests, contact information, and team memberships into a single application that is available across applications, platforms, and devices. As unified communications evolves, it will provide a common platform for managing multiple social networks and user profiles, reducing the overhead that many people currently experience when participating in a different online environments.

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Presence awareness. One of the most useful features of unified communications is presence awareness, which lets people see at a glance the availability of others in their network. This capability is especially useful when presence is integrated automatically with personal and group calendars and telephony systems. Awareness not only makes it easier to choose the right mode of communication (for example, send e-mail if the person is away, call or instant message if the person is online and not busy), it also lets people control their exposure to interruptions according to their personal preferences and priorities.

Subscription-based content. Subscription-based content enables people to control and personalize their window into the wider world of information. RSS and Atom feeds aggregate content published by Web sites, blogs, document repositories, team workspaces, and business applications that can be consumed in a browser, e-mail client, mobile

device, or information work application. Podcasts do the same for rich-media content. As a result, a lot of the complexities associated with keeping up to date in an information-rich environment will disappear, allowing people to focus on information that is relevant to their roles and interests.

INSIGHT REQUIRES A SCALABLE DATA ARCHITECTURE

Data cannot be turned into insight without a robust architecture that encompasses data warehouses, a service-oriented architecture (SOA), and metadata.

Data warehouse. Simplifying the end-user environment depends on back-end data systems that can interoperate easily and pass data along in standard formats. Those systems include not only structured database applications and business data stores but also collaboration data (from e-mail, real-time communication systems, shared workspaces, social networks, and discussion groups), documents, and information from the hard drives of PCs connected to the enterprise network. Legacy data can be incorporated into the data warehouse through custom integration or specialized servers that translate between proprietary and standard formats. Paper-based data can be captured in digital format using optical character recognition assisted by statistical algorithms that learn and adapt to reduce errors. Other structured data can be captured at the front end of processes using digital forms that are easily designed by non-technical users and then deployed to the Web, Tablet PCs, or mobile devices. Eventually, traditional paper and writing will find a comfortable means of capturing information in a digital repository.

"Eventually, traditional paper and writing will find a comfortable means of capturing information in a digital repository."

Service-oriented architecture. A SOA enables the interchange of information across the enterprise as a "service" that can be consumed or exposed in a common framework, such as a portal or desktop application, without requiring a dedicated client. A SOA makes it faster and easier to develop integrated, composite applications that can use data within the system in innovative ways.

Metadata. In addition to the primary data, the unified logical repository should include metadata descriptions that make information visible to search engines in a variety of contexts. Metadata is also necessary to trace patterns of communication and collaboration that can then be visualized as relationship maps and to connect individual people within the network to the information, documents, and processes with which they are involved. Eventually, metadata will include security and access policies for individual documents and records; document histories including authorship, revisions, and chains of custody for auditing purposes; and

dynamic descriptions that push data out when it "wants" to be found in a particular context, rather than waiting to be discovered with the right search engine query.

TENETS FOR SUCCESS

The ability to gain insights from complexity is critical to the success of all organizations. IT is a strategic enabler of that success. Decisions about platforms, applications, and end-user environments matter—not just because they affect costs but because they can provide the capabilities, speed, and choices businesses need to compete in an uncertain world.

In a world of exponential increases in the volume of data and a competitive requirement to draw the right conclusions from that information, software adds value by assisting people and businesses in determining the right course of action. Companies seeking effective IT solutions for information overload and business intelligence should consider the following approaches:

"Software adds value by assisting people and businesses in determining the right course of action."

Make data strategic and trustworthy. Data scattered across multiple repositories and silos is hard to marshal for business value, and it makes people the point of integration across different systems and applications. Undervaluing the data is an even bigger problem. When data systems are integrated in the back office using a framework that enables interoperability and easy interchange between servers, client applications, and the Web, the infrastructure investment pays off by simplifying access for people and increasing the chances for insight.

Software as the communication hub. Unified communications technology makes software a central communication platform, capable of integrating voice, data, and real-time and asynchronous media in a single, simplified view for people. When other collaboration tools have access to presence information, so that people see who is immediately available, communication and collaboration can be more effective and timely.

Access data through productivity applications. Pervasive access to information when, where, and how it is needed, along with easy-to-use tools to glean insights from data are a foundation for confident decision-making across all levels of an organization. They are especially critical in customer-facing environments, where access to data can be the difference in delivering outstanding service or closing a sale.

Ubiquitous analytics. Organizations that give analytics and data access to only a few analysts risk not asking the right questions at the right time and missing the opportunity to take advantage of the insights hiding in data.

SOURCES OF INSIGHT

If you focus on the data coming from the following sources, you can gain insight into your business, your customers, and the world.

Data Source	What You Can Learn
Subscription Data	From watching global events to discovering trends to listening to customers, text mining on RSS feeds can provide a wide range of insight from communities of bloggers, newswires, and other sources.
Business Processes	Business processes that have been automated are a great source of insight. Trends hidden in the databases beneath these systems can unlock where and how processes go wrong or where costs are coming from.
Enterprise Systems	Systems across the organization—from financial to manufacturing to human resources to R&D—are all data-rich learning environments, where applying the right analytics can generate insights that will drive business performance, retain employees, and discover new products and services.
Instruments and Devices	More commonplace tools, instruments, and devices are becoming data-enabled and network-enabled. For example, telematics systems in vehicles, RFID tags, digital medical equipment, smart dust, digital tools, and instruments in industry and design provide precise measurements of formerly "analog" processes, which can then be factored in to data-driven strategies and decisions. Many physical objects in the future will come with, or be represented by, metadata.
Public Data	Many organizations, such as the United Nations, the World Bank, and the Organisation for Economic Co-operation and Development, provide external data that can give insights into demographics and markets. Most governments are also rich repositories of data.