

**AMBIENT BUSINESS INTELLIGENCE:  
PERVASIVE TECHNOLOGY TO SURROUND AND INFORM**



By Neil Raden  
Hired Brains Research  
October 2006

## ABOUT THE AUTHOR



Neil Raden is the founder of Hired Brains, Inc., <http://www.hiredbrains.com>. Hired Brains provides consulting, systems integration and implementation services in Business Intelligence for clients worldwide. Hired Brains Research provides consulting, market research, product marketing and advisory services to the Business Intelligence and Semantic Technology industries. Based in Santa Barbara, CA, Raden is an active consultant and widely published author and speaker. He welcomes your comments at [nraden@hiredbrains.com](mailto:nraden@hiredbrains.com) .

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## EXECUTIVE SUMMARY

Business Intelligence (BI) is poised for a giant leap forward, and it is not a moment too soon. BI currently exists in a comfort zone, largely immune from the intense scrutiny and benchmarking applied to other enterprise software. However, the functions that partition application software are blurring as technology races forward and the convergence of operational and analytical processing is already underway. This will very shortly require BI to step up to much more demanding duties. Enterprise computing is entering another period of rapid innovation and demands on all organizations to do more, faster, with less are piling up.

For example, rather than just measuring business results after-the-fact, which is the primary role of BI today, next generation BI will advise and drive businesses with embedded analytics, real-time decision tools and vastly improved capabilities for people in every corner of the organization, and beyond it. The idea of “Ambient Business Intelligence” simply means that it will surround and inform, even in ways that may not be perceived directly. The value of BI will no longer be assessed by its functionality or “ease of use,” it will be valued by what it can deliver for an organization at the top line and the bottom line.

The importance of BI is what it does for an organization. As organizations evolve towards architectures composed of loosely coupled<sup>1</sup>, distributed services, the need for decision automation will be critical. Decisioning software is the domain of BI. Freeing BI from the all-encompassing embrace of the data warehouse, with its persistent, data-centric methodology and go-slow development pace, and placing it all over the enterprise – in processes, before processes and after processes, frees BI to finally provide all of the analytical, informative, investigative and collaborative benefits that organizations need. To do that will require making BI more nimble, more able to communicate with other services and to become considerably smarter. BI everywhere, ambient BI, is the needed ingredient for SOA to succeed.

## GETTING THERE

Fueling this next generation of BI is a combination of technology-driven factors:

- **Managing From Abundance:** Computing resources are plentiful now, but most BI practices are still based on a model of scarcity, including restricting access to detail data, limiting the number of users or processes, slow addition of data resources over time, stacked architectures with excessive embedded latency, obsolete methodologies and restricted access to operational data in place. These approaches still pervade thinking in BI and limit the progress of tools unnecessarily, but innovators are already breaking through:
- **New enterprise architectures**, based on Web Services and Service-Oriented Architecture (SOA), will cause the distinction between operational and analytical processing to blur, requiring BI to “get real” in real time and cooperate with operational processes. This leads to vastly increasing the number of people (and automated attendants) dependent on BI and ramping up of BI architectures to handle the load

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<sup>1</sup> In SOA lingo, loosely coupled means that services can cooperate provided they adhere to the standards for exposing their functions and data, regardless of which technology was used to develop them and what platform they reside on.

- **Increasing volumes of data** from both new technologies (RFID, web analytics, for example) and the ever-rising expectations of examining minute details of operations will obsolete BI tools based on a PC model or “suites” of tools with ineffective and incompatible metadata or “fat servers” that scale poorly and fail to utilize other resources, such as relational databases, federation schemes, grids and caches to share the workload.
- **Blurring of Operational and BI processes:** As “applications” become composites of loosely coupled services, it will become increasingly difficult to distinguish between purely operational and analytical applications. Many operations need to be informed and many analytical processes need to follow up with some operational action. The loop needs to be closed and the latency removed.
- A continuing environment of IT **spending based on ROI/TCO<sup>2</sup> factors**. BI was a vague but appealing promise over the last decade, now it has to prove its worth like any other investment. While in the past, BI investments were based on cost-savings or avoidance estimates, going forward, the emphasis must be on revenue and/or opportunity enhancement as the easy “low-hanging fruit” has mostly been picked in the past decade.

Whether you believe in “**real-time**” or “right time” (a fuzzy concept that holds that data has to be available with no more latency than needed by an application), current batch-oriented data handling and report-generation cannot provide the speed and agility demanded by next generation business processes BI must evolve quickly to a business orientation rather than its current focus on IT process and data as the driver, and reporting as the deliverable. It is important to not only measure business processes after the fact, but to drive them. Instead of discussions about OLAP or BI Platform Standardization or Ad Hoc Query or even the term “users,” which in other disciplines would be considered demeaning, next generation BI will be described with terms like model-driven, robust, mobile (implying platform agnosticity) and guided navigation:

- **Model-driven:** Today, BI is clearly data-driven. Data warehouse “stage” or “present” data or, in the worst cases, users get “data extracts.” The interaction is at the data level. Little to no effort is made to join data elements together into any sort of coherent set of models. In a model-driven approach, the models themselves are the key elements and data is populated into them, but the actors interact at the model level, with relationships, rules, hierarchies. In going about their work, knowledge workers need to assemble and examine a great deal of information and bits of data are only a small part, often only tangential to the analysis.
- **Mobile:** At this point, it shouldn’t matter where or on what device a person (or a process) needs a BI service. The visual interface is almost incidental, but existing BI are heavily weighted to the user interface, often to the detriment of the underlying engine. That has to be reversed. Consider Google, the lightest UI in the universe with 3 billion users.
- **Robust:** Why BI has attracted so few adherents to date is the subject of much debate, but with the entire fabric of enterprise computing changing completely, it doesn’t really matter. This time, BI is not an option, it has to work. No one can afford to inform themselves by typing data into a spreadsheet or waiting for a weekly report. When your company’s business involves hundreds or even thousands of partners and customers working with you in real

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<sup>2</sup> ROI: Return on Investment ; TCO: Total Cost of Ownership

time, there is no time to look things over via fax. It doesn't matter if you're pricing lots of plastic syringes from China, managing a battlefield 8000 miles away or monitoring the world's financial markets, there isn't time to drill down to look for anomalies, you need an electronic assistant to do it for you.

- **Guided Navigation:** One problem with BI is that the user interfaces demo well, but once it goes into production and the number of analyses starts to build up, it gets very difficult to find things and it becomes very difficult to determine if there is duplication of effort. Simple keyword searches or the creation of nested folders are inadequate because they don't scale very well. In the next generation of BI, guided navigation that incorporates the best of what we've learned from the Web and research into how people search and find things will allow for massively scalable BI that is easy to use and very effective.

Three billion people a day use the Consumer Web, a set of applications infinitely more complex and infinitely more simple to use than most corporate BI applications. BI is still based on rigid, stacked, serial architectures, designed like an assembly line, and as flexible as poured concrete.

Current generation BI was mostly driven by two factors. First, there was a need to reduce the cost of expensive reporting processes from proprietary platforms and applications. IT organizations desired to relocate the reporting role to functional areas within the organization, relying on non-IT staff to pick up the responsibility. This involved the second factor, relying on people within the organization to adopt this new technology and approach without any perceived new functional capability. These same people were already generating most if not all of the needed reporting the hard way – with spreadsheets, and the BI tools never convinced them they could replace the functionality they already had.

While BI is currently deployed in most large organizations, its dispersion follows a predictable pattern. A small number of highly skilled practitioners drawn from the ranks of IT, external consultants and some internal non-technical business people provide all of the development and administrative effort while the vast majority of the “users” merely view the output and/or export it to spreadsheets. Industry surveys peg the actual penetration of BI at 20-25% of the potential number of people who could benefit from its use, which is somewhat overstated as only a small number of the licensed users use the tools for their interactive, exploratory or modeling features. The idea of employee self-service with interactive access to data through BI has fallen short of its goal in most organizations. There are many exceptions, though, and there is no clear consensus on the causes or remedies. In studies conducted by Hired Brains in 2003-2004, our findings clearly showed that that BI failed to provide a compelling solution to business users' needs, as reported by the business users. Whether this is an authentic problem or the result of reluctance on their part to migrate to an otherwise useful solution is irrelevant. The fact remains that the investment in BI was not successful in those cases<sup>3</sup>.

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<sup>3</sup> There is a significant body of research in the business community, beyond the technology sector, documenting the degree of this problem. One recent study, from Booz Allen Hamilton, determined that most large organizations are “unhealthy,” meaning that everyone in the organization says all the right things, but does none of them, which the study blames, primarily, on inadequate information flows. See <http://www.orgdna.com/downloads/GlobalCheckUp-OrqHealthNov2005.pdf> for a copy of the report.

Fortunately, the landscape is changing rapidly. Business processing and BI are becoming co-dependent. Each is incomplete without the other. Spreadsheets can no longer be a substitute for BI, though they will continue to be the premier personal modeling tool. Fixed reporting will finally make its way to the dustbin as an unworkable and expensive mechanism for distributing information. Portals, dashboards and other information-intensive, personally configurable tools will be the preferred medium for sharing and disseminating information.

Forward-looking organizations are already moving towards SOA based on standards, such as Web Services. SOA is not a technology, it's an architecture that allows for the exchange of information between different services regardless of their underlying technology, by operating under a set of open standards<sup>4</sup>. Though there are many issues to be worked out with SOA, such as security and performance, its loosely coupled organization and communication through a shared directory and description of services means that sharing resources, not only across the enterprise, but beyond it, is an achievable reality. Rather than a complete overhaul of the enterprise architecture, most organizations will approach SOA on a tactical basis, where BI is a good candidate, rather than a mission-critical operational system. But even for organizations that will be slow to move to SOA, installing software packages from vendors with built in SOA features allows them to move in that direction piecemeal. BI tools will need to drop their proprietary interfaces, data structures and languages, opening up their offerings to other services.

One caveat, though, is that many products will claim to be ready for SOA long before they truly are. Some BI tools are ready for the next generation already:

- Those that have rationalized data access as a multi-tracked effort
- Can speak in many dialects and protocols
- Have migrated their functions to scalable servers with thin clients
- Can provide useful models out-of-the-box while assuring forward compatibility for customizations.

They may lack all of the needed hooks or wrappers to be SOA-ready, but doing so is fairly simple – it's the internals that really count. Others will need to develop completely new products or, even worse case, apply heavy wrappers to enable their products to appear in an SOA, but perform so poorly because of their ill-adapted architecture that all of the potential benefit of SOA is lost. Some other problems they may encounter are:

- Incumbents with a large legacy base, the classic Innovator's Dilemma, where a substantial portion of their resources are devoted to maintaining their legacy base
- A visible weakness in BI software to date is metadata. Though metadata may be employed internally to enhance usability, outward-looking metadata is weak.

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<sup>4</sup> What is truly remarkable about SOA and WebServices is how quickly and completely the major vendors have embraced these open standards which allows for such widespread innovation to happen so quickly and to separate SOA from pure hype-ware

- Many BI “platforms” or “suites” are the result of acquisitions and mergers and represent incompatible architectures that are difficult to maintain and upgrade
- Older software architectures and mindsets of the architects are reluctant to let go of the approaches taken originally, especially when those approaches are the core of the firm’s competitive advantage historically

### ***What Is Driving the Next Generation of BI?***

Some BI products have been developed in the last year or two, some within the past 5-10 years and some can trace their heritage back over twenty-five years. Spreadsheets first appeared in business in the 70’s. Some BI tools were designed for mainframes and gradually ported to other systems, with no real gain in function. Needless to say, some have kept up with technology and even innovated, others have not. There are, however, a few themes in BI that reveal its age. Dependence on proprietary data structures and access methods, lack of scalability, rigid interfaces, poor integration both between modules and with the rest of the enterprise, poor security provision, performance problems, read-only – these are all evident in BI tools today.

Let’s look at the major drivers behind next generation BI.

- **Speed:** An organization bounded by its systems and processes can set its own clock. But once those systems and processes become connected to others, partners, suppliers, customers, regulators, students and parents, responsiveness is no longer a parameter that it can set to accommodate existing ways of doing business. The externalization of all business today, thanks to the Internet, imposes new requirements for timely performance.
- **Greater volumes of data:** Total disk storage grew over 50 percent in 2005, totaling 505 petabytes worldwide, according to IDC. In one year, the sales of disk drives totaled 250 thousand terabytes. Whether the creation of new data is pushing this trend or the falling prices are having a pull effect on new data requirements is a subject of debate. What is not debatable is that there is dramatically more data for BI handle each year. What was considered scalable five years ago is commonplace now – planning for the next five years has to assume continued dramatic, even unthinkable, volumes of data. And one sobering thought – while the capacity and cost of physical devices is still shrinking, the performance of them is not keeping up. The number of bits read per millisecond is not following the same performance curve as everything else, so even smarter ideas are needed.
- **Greater numbers of “users”:** With the accelerating externalization of business, the sheer number of people who have access to BI or BI-backed applications is expanding. In addition, managing via Key Performance Indicators (KPI’s) deployed through dashboards has begun to increase the number of people regularly interacting with BI systems
- **Blurring of operational and analytical processes:** To accomplish the ramped up requirements of speed and scale, eliminating gaps, latency and handoffs is crucial. BI, traditionally applied to strategic efforts and measurement after the fact, is being engaged to drive processes with decisioning, predictive modeling and trend analysis of current and historical data, in-line with actual processes
- **Process commoditization and outsourcing:** Organizations are finding that outsourcing processes can be beneficial with the proper measurement, especially those processes that are more or less standard such as HR, payroll and travel reimbursement. BI is needed to define and trace metrics to insure regulatory and contractual compliance and value.
- **Agility:** There are systematic prerequisites to being an agile organization, but it takes analytical horsepower to know where to bend and flex and where to stand firm. Much of what passes for analysis today is derived from thinking about the status quo. Analytical models are

too hard to describe, to build and to communicate. Next generation BI has to provide the ability for analysts to render their thinking in a sharable framework that encourages, rather than impedes, participation

All of these trends imply new technical requirements for next generation BI.

## **TECHNICAL REQUIREMENTS**

The new role for BI coupled with drastic changes in the technology landscape since its invention, call for very different technology. BI is stepping up to mission critical status; its application may be out-of-the-box, or by a single function called through an open API. As a cooperative partner, it must adhere to standards in a way it has never had to before, demonstrate scalability unimaginable ten years ago, while maintaining an acceptable TCO. Needless to say, it must be more or less platform agnostic, services-ready and real-time proactive through event triggers and software agents. Open-ended analysis will continue, but the leaders in BI will play a key role in closing the loop. Stepping up to these requirements will require technical advances in abstraction, optimization, scale and performance plus new capabilities in semantics and linguistic features.

### ***Abstraction***

BI implementations are neither simple nor inexpensive. In fact, the cost of maintaining and supplementing BI after the first release exceeds the initial outlay by a substantial margin. Part of the problem, historically, has been the tight coupling of BI with a data warehouse, which tends to drive up the cost, and risk, of both projects because of their interlocking but often conflicting requirements. But once an initial data warehouse is in place and the first set of BI applications is deployed, adding new functions is a tedious business of matching data warehouse upgrade schedules with BI requirements. There is an inverse relationship between the extent of this problem and the level of abstraction employed by the BI tool in dealing with data sources and requests.

Abstraction is not a new term in data management. Many years ago, data was stored in files, and files (hopefully) had a header that described the layout of the data that followed. Each application had to process the data in the file at the physical level, byte by byte. Over time, file systems emerged, which were consistent across applications and allowed application programs to read and write to them by calling a type of abstracted file management system. It was no longer necessary to know the exact location of every piece of data. These systems eventually became databases and, not much later, relational databases, which offer complete abstraction of the physical data and processing, from their query language, SQL. Relational databases accept queries about tables and attributes, and optimize the process to complete the transaction internally, never exposing the calling application to the physical aspects of the database. The sort of abstraction that is necessary for BI, though, goes well beyond SQL. It must allow for the definition of data, models, templates, filters and events in terms that are acceptable to users across a broad spectrum and not restrict people to a model that is based in relational concepts exclusively.

Some BI tools actually require extraction from the data warehouse to yet another persistent storage medium for BI processing. This can take the form of a multidimensional database, pre-built "cubes" that are either sent to the desktop, or reside on a server as a set of desktop files, or even proprietary data formats. These methods can be categorized as providing no abstraction at all. For the BI tool to operate, everything must be staged in precisely the place and format that is required.

A slightly higher level of abstraction occurs when skilled developers construct queries, mostly in SQL, that are catalogued and invoked at runtime, skipping the intermediate storage layer of the tools described above. In this way, the BI server acts as an interpreter of the user's request, but only within the boundaries of the pre-built analyses.

The needed level of abstraction, whether or not an organization has deployed SOA, but critically needed if it has, is complete abstraction between the data sources and BI tools. This implies a host of capabilities, including:

- Robust, multilingual query generator (multilingual in the sense that it can issue requests optimized to the target data source, such as various versions and dialects and proprietary extensions of SQL, MDX and XQuery, to name a few)
- Load balancing to manage both the queues of requests and the issuance of queries to various sources
- Ability to leverage duplicate sources of data to improve query performance
- Abstraction gleaned from standards such as XML or even RDF, rather than dependence on strictly data warehouse schemas
- A single product so that the benefits of abstraction are not diluted from a mixture of products, user interfaces, disconnected processes

Proprietary approaches are hard to maintain, hard to upgrade, hard to integrate with other solutions and require specialized skills that are usually in short supply. Requirements are typically shaped to conform to the set of functions provided by the selected tools. Going forward, these proprietary approaches tend to shape the thinking of the people who use and maintain them, coloring their attitudes towards enhancement possibilities and business alignment, which impedes an organization's ability to be proactive, to react to changes and to maintain agility.

Abstraction also provides the ability for all of the stakeholders to play a role in defining the environment they work in. The Accounts Receivable process (people and programs) may define a "Customer" as anyone who has purchased something and owes the company money. A sales manager may define a customer as anyone who has purchased something in the past three years. These definitions, dimensioned by context and time, are an important element for improving the understanding of BI. The often-mentioned need for a "single version of the truth" stands in the way of more pervasive use of BI, mostly as a result of its dependence on a data warehouse and an imposed single schema of understanding. Real abstraction for BI must include the ability for stakeholders to work with information on their own terms, yet have all of the physical aspects of BI resolve correctly every time. For two groups to use the same name for different things is not always a problem of data quality, it can reflect the reality of business practices. Definitions, just like data, can vary across place and time. As long as the use of data is always consistent with its own context, this does not pose a problem.

### **Optimization**

A consequent requirement of abstraction is the need for highly optimized processes. A proprietary fetching mechanism dispatched against its tightly-coupled storage and/or caching scheme (such as a spreadsheet, or a multidimensional cube) will always outperform, head-to-head, a set of technologies operating through layers of abstraction. However, the flexibility and maintainability of abstracted schemes more than make up the difference, not only economically, in terms of maintenance and replacement costs, but also subjectively, as people who use the systems are able to understand their meaning and even participate in their definition and refinement.

Tools that require data in their own format, based on the assumption that someone else will move and transform the data, have too much latency to be useful. Your customers, suppliers, regulators – any third party who has become a part of your distributed business processes – moving their data to your repository is simply not an option. A BI platform must be opportunistic in its use of data spread across the virtual enterprise. For now, the bulk of that data is in relational databases, so the ability to optimize SQL for that target platform and to load balance the processing between native database manipulation and intelligent engines for processing is key.

### **Scale**

Put simply, a BI solution must be able to scale smoothly from a handful of concurrent connections to potentially millions. Being able to demonstrate linear scalability with additional hardware is an acceptable approach, but it has to be evaluated in concert with other factors, such as cost. If a product can scale to a thousand users by adding servers, but can only handle 10 users per server, that is a poor option. BI Servers that cannot perform function shifting to other services or operate with a thin trail of data are not likely to perform well in the new environment. For example, suppose a request is made to analyze warehouse conditions versus inbound stock, mitigated by temporary slack demand due to weather, but with a moderate lift for a period of time after it clears. A scalable tool will dispatch requests to one or more data sources, optimized for each platform, and have the data prepared as completely as possible before sending back a result. Many current BI tools cannot handle this type of request, or if they can, bring massive result sets across the network and sort through the problem locally. Some BI tools can't handle the problem at all unless the data is pre-loaded and calculated in their own formats.

SOA will eventually force BI vendors to rationalize the architecture of their tools. In the meantime, many of them are too expensive and too inefficient to scale to the volumes of data and number of people that are now positioned to use BI effectively.

### **Performance**

One thing that BI has never had to deal with was "mission critical" service level requirements. Because BI was typically conducted offline from operational systems, the only two performance criteria that were measured were cycle time to refresh the data warehouses, data marts and other downstream data containers, and query time. Cycle times had to fit into an update window, typically overnight, even for weekly or monthly data, and numerous approaches were adopted, from hardware upgrades to staged rollouts of various levels of aggregated and partitioned data, indexes, etc. Query response times were usually benchmarked against what was possible before, therefore the constraints were loose. In time, however, query response greater than a few minutes became an issue, but the more complicated analyses still can run longer.

To the extent that analysis can be conducted in the somewhat leisurely manner it always has, performance requirements for next generation BI will not change. But for all of the new applications of BI, such as process measurement and management, unattended decisioning and analytical and data services in an enterprise architecture, the excuses of old ("this was not even possible before") no longer hold up. BI engines have to provide blistering performance.

If a BI engine invokes another service, such as a relational database, to perform some functions, it must be able to request those services in the most efficient manner and it must handle the queues and the results in a way that adds as little overhead as possible. BI as part of tactical, operational processes does not have the protection and lower performance expectations of classic BI. Next generation BI technology will require a great deal more attention to this performance issue and most BI tool vendors will need to add this competency to their development teams.

### **Semantic Technology**

Semantic technology is a broad field that incorporates techniques from Artificial Intelligence, Knowledge Management and Linguistic Programming, but the major driver lately is the Semantic Web, a bold initiative started by Tim Berners-Lee to, essentially, turn the Web into a searchable database, but at a level that exceeds current search technologies (some of which are already using some semantics). At the heart of the Semantic Web is a way to represent information in "triples," with a subject, predicate and object, and a series of standardized dialects, based on XML, to capture semantic data and describe the collections, referred to as ontologies. These latter two developments, RDF and OWL, are standards that are controlled by the W3C, which controls web services as well. The languages used for ontologies are standardized, but ways to

build, discover and use ontologies are wide open and dozens of companies are pursuing this field.

Semantic technologies will have an impact on BI in the next 2-3 years. While other areas of enterprise computing are already finding applications for semantic technology, especially content management, knowledge management and infrastructure management, data warehousing and BI industry activity is still at a low level.

Some areas in BI that will be affected by semantics are:

**Relevance and Understanding:** Relational databases, and the data modeling disciplines used to design them, have evolved over time into excellent mechanisms to gather and safeguard information, but they cannot communicate meaning to non-technical people directly without some intermediate layer that provides meaning to the structure. Data warehousing sought to create the "single version of the truth," a concept that was the best possible result with the definitional approach to metadata. But the definitional approach is too cumbersome and rigid for multiple versions or contexts. A major cause for the slow acceptance of BI in organizations is a lack of understanding of the data caused by these fairly rigid and inflexible definitions. Semantic technologies, on the other hand, place emphasis on domain expertise, allowing non technical people to add their knowledge to the definitional layers. With semantics, it is possible to have many contexts, each with its own integrity but all participating in a mutually consistent framework. Consider the two diagrams below:

Complete this Sequence: 14, 23, 34, 42, 50, 59, 72, 81,

Arrange in Order: Ar, Xe, Rn, He, Kr, Ne

The power of context is dramatic. Unless the reader is familiar with the New York City subway system, it might take all day to work out the first sequence, because the answer is 86, the next stop on the northbound Eighth Avenue A-Train. While the urge to arrange the second series in alphabetical order may be powerful, a little knowledge of the Periodic Table would reveal the six noble gases which are, in order, Helium, Neon, Argon, Krypton, Xenon and Radon. Anyone who has struggled with formatting a report that arranged the days of the week or the months of the year in alphabetical order can understand the value of even a little contextual knowledge.

**Data Integration:** Some semantic tools already available outperform more traditional data profiling and data integration methods. This could be especially useful for capturing data "in-flight," in message queues or even pure network traffic and performing real cleansing and transformation without the need for persistent repositories, such as data warehouses or Operational Data Stores (ODS). Semantic integration is capable of understanding the context of data, not just its structure or syntax.

**Metadata:** Metadata in relational databases cannot provide, without massive overhead and scanning, the raw power of an ontology that can be queried conceptually and quickly with query optimization based on graph theory<sup>5</sup>, which finds the most efficient path to solving the problem.

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<sup>5</sup> For more information, see <http://www.geog.umontreal.ca/Geotrans/eng/ch2en/meth2en/ch2m1en.html> Graph Theory is the mathematics of networks. The relational model is based on Set Theory and its manipulations are applications of Matrix Algebra. With ontology, information is represented as graphs, because of its relationships and interconnections, and

Ontologies allow computers to draw inferences<sup>6</sup> from the metadata itself, instead of relying on the query constructor (man or machine) to add knowledge embedded in the query.

**Real-time and unattended decisions:** Because ontologies can be used for inference without explicit rules engines, it is possible to deploy BI applications that can perform at a certain level of intelligence and make decisions and take actions in real-time. This is a controversial topic, but there are many applications in organizations where these technologies can be applied. They will not replace human experts, or even non-experts, but it will facilitate the automation of some work that is driven now by averages, assumptions and rules-of-thumb and can clearly tolerate room for improvement.

**Modeling:** Semantic technology is not only useful for metadata, but also for describing relationships, models, rules and constraints. Ontology builders can add information inferred from information already present, such as existing databases. A major weakness with BI tools today is the inability to support analysts creating, modifying and communicating business models – most models are defined and built by technologists.

## ***Real-Time***

One final concern for next generation BI is latency or the potential of more time sensitive technology. Real-time BI can be construed in at least two very different ways. First, real-time can be performance-related, meaning, requests are handled instantly. This can occur whether or not the data is real-time, such as a credit application, where the decision to grant credit or not is the result of some real-time analysis, but the data for the analysis may be a day or a week or even a month old

Because BI is still largely defined within the confines of a data warehouse, real-time BI more often refers to real-time data from operations, message queues or web clicks, for example, being extracted, transformed and loaded into a data warehouse or other structure within a very small time slice of its creation, perhaps seconds or even less. Applications for this low-latency data are not yet widespread, and for that reason, the BI community has not been energized with enabling these capabilities. The reason for this lapse is that it is difficult to understand why BI needs real-time capabilities when arguing from the point of view of current BI practices, which are disconnected from the flow of business. In the very near future, this reasoning will not hold up. The convergence of BI and operational processes will provide more than enough real-time opportunities to energize the BI providers.

## **CONCLUSION**

BI is a wonderfully rich and complex field that has not yet delivered on its potential to positively impact business processes and outcomes. While BI design and implementation in the past was

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queries are formulated as graphs, an approach that allows for quickly finding complex relationships without having to sort and merge all the possibilities first.

<sup>6</sup> The Oracle Spatial 10g supports RDF processing

driven from scarcity, not enough CPU, not enough memory, not enough storage, not enough bandwidth, the abundance of computational resources available now makes it possible for BI to deliver new dimensions of value to organizations and to everyone in (or attached to) them . New SOA based BI platforms that are based on unified metadata are poised to lead in the next generation of technology because of their thoughtful design, their potential for growth and refinement and what they offer to the enterprise.

BI is also hampered by its legacy. What comprises BI today is a collection of technologies that spans a spectrum from deep down in the bits and bytes of data to the flashiest of executive dashboards, to the most exotic algorithms of data mining and predictive modeling. The ability to expose pieces of these offerings as reusable services in the short term while re-architecting them for better performance later will go a long way towards getting BI to fit in the SOA world and provide the new and flexible capabilities that are needed.

But without question, it is time to abandon, once and for all, the outdated usage models that have hampered the advance of BI and perpetuated the stereotypes of “power-user,” “go-to guy,” “casual user, and ” report viewer”. This obsolete pyramid usage model cast everyone in an organization in overly simplistic roles, that did not capture the complexity of the real world and relegated most BI to a binary report-creation, report-viewing design. Dynamic, evolving organizations today need much more than that from BI and are looking at next generation BI to realize its potential by creating a working environment when information and insight are an ambient part of the very atmosphere.