Embracing Real-time Analytics for Proactive Business Management

Companies can achieve their strategic goals in any economic climate by combining 3-D visualization, intelligent agents and predictive analytics into a framework that recognizes underlying business issues and proactively offers solutions.

Executive Summary

In these times of economic uncertainty, companies must adapt quickly to changes in the revenue stream and find ways to stay competitive and profitable, even with substantially reduced staff due to lower revenues. To gain competitive advantage, most companies are digging deeper into their volumes of data and turning to real-time analytics.

Let’s consider some real scenarios that companies face today:

- A high-tech company wants to develop a microchip that would perform advanced analytics in real time, to be used by the retail industry in digital signage. This microchip would decrease the cost of advanced analytics by millions of dollars and allow retail companies to conduct real-time marketing analytics campaigns.
- A social media company wants to use real-time advanced analytics to improve its click-through rate by 20% by matching targeted advertisements to users.
- A healthcare payer is losing membership due to layoffs among its client base, and its revenues are decreasing. The company needs to develop a comprehensive cost containment methodology in pharmacy benefits, radiology and other high-cost medical categories. To do this, it wants a real-time analytics system that can identify and proactively provide solutions to these problems and potentially replace some of its labor-intensive operations in the claims processing area.
- A casualty and property insurance company faces declining revenues due to the inability of policy holders to pay their premiums because of job loss. With pricing optimization a key product differentiator in the marketplace, the company wants to use analytics to increase profitability by identifying and providing potential solutions in high-cost areas by deploying an early warning system.
- An international consumer packaged goods company is experiencing decreased sales and wants to gain back market share by utilizing...
analytics in the areas of foresight, blind spots, portfolio optimization and consumer insights. These challenges can be addressed through the use of agile and resilient computer systems that can detect underlying issues with revenues, expenditures and profitability and proactively provide insights to help companies adapt quickly to continuously changing conditions.

Such systems depend on the utilization of three scientific and technology techniques that have been in the making for years: intelligent agents, three-dimensional (3-D) visualization and data mining with predictive modeling techniques. These three technologies form the core of the Intelligent Agent Visualization Model (IAVM), a decision-support framework that allows companies to efficiently design, build, deploy and update an agile and robust enterprise analytics system that supports profitability under any economic climate by understanding business changes and providing proactive solutions to decision-makers.

An essential concept of IAVM is that business data, like our universe, is three-dimensional. IAVM seeks to improve users' ability to see patterns within business data by increasing their depth perception of traditional two-dimensional data analysis. This improved visualization is achieved through techniques such as self-populated maps that enable executives to quickly compare performance across different geographical regions. Such a 3-D dashboard would also include drill-down capabilities to allow further examination into issues detected by the IAVM.

To create agile systems using enterprise analytics, companies must focus on three main areas using IAVM design and implementation:

- Corporate goals
- The business model
- Metrics

Doing so will result in responsive and flexible systems that allow survival and prosperity even in harsh economic conditions. Companies that use proven science and technology in their decision-support systems will earn an advantage in the marketplace in good times and bad, since they will be able to quickly adapt to change without negatively impacting their core business.

**IAVM Foundational Components**

The IAVM framework is a culmination of 11 years of research and design of business analytics in large and complex data sets. To truly appreciate IAVM, we should first understand the components that create its foundation. These include the following:

- **Business Competency Model:** One of the issues that the IAVM strives to resolve has existed since the beginning of the 21st century: leaders have a specific vision, or mental image, of where they want to take their companies, but there is no visualization mechanism to describe that vision to the rest of the company. This became clear in 2000, in my work with a Fortune 100 company that was trying to determine how to change course in a fiscal quarter without negatively impacting profits. We developed a business model, which later became the business competency model (BCM), that could respond to recessionary times by bridging the gap between corporate strategy and operational decision-making. It accomplishes this by making sure the entire company mirrors the executive management committee and that the committee is organized according to the corporate goals and vision of its leaders.

- **Workforce Turnover Efficiency ratio:** The WTE is an asset management ratio that allows companies to design restructuring plans based on contributions to revenues. It was developed in 2001, when a Fortune 100 company realized it needed to lay off tens of thousands of employees in order to stay profitable but did not have a metric or KPI to measure how each individual and group contributed to revenues.

- **Weighted Outlier Variable:** The WOV is a way to separate clusters of data and understand the driving factors for any changes. It was developed in 2003, when I was designing fraud and abuse analytical detection models. To my surprise, probability theory and statistics had answered the dispersion (standard deviation) part of the equation, and Albert Einstein had shown mathematically how to clarify driving factors using an algebraic concept (quadratic equations) that had been around for over 2,000 years.

- **Depth perception studies:** Business analytics visualization borrows from analytics methodologies and algorithms used in diagnostic imaging. I realized the link in 2004, when I was researching the area of neuroscience to better understand diseases that both my parents were diagnosed with. Moreover, I realized that cognitive science and medicine had found that depth perception (binocular summation) involves the brain making predictions about...
size, movement and distance. The result of adding depth to our vision capabilities had been calculated to improve vision acuity by a minimum of 140%.

- **Commoditization of the statistics methodology:** In 2007, I learned that the Analysis Services team at Microsoft Research Laboratories had optimized regression and partition algorithms. From this, I realized that the statistics methodology had become a commodity and that the additional key ingredients were variable creation, visualization and domain knowledge.

- **Three-dimensional visualization:** In 2008, after seeing the work from the Visualization Group at the Lawrence Berkeley National Laboratory (see page 8), it became clear to me that 3-D visualization could be adapted to business analytics to share strategic vision across the enterprise.

- **Optimized delivery model:** In 2009, I found that Cognizant’s business model is an optimal delivery model for the IAVM. There are three aspects of our model that are tailor-made for the IAVM: our on-site/offshore ratio for solution delivery; our depth of analytics experience; and our domain expertise in multiple industries.

- **Intelligent agents:** An intelligent agent is software that is autonomous; interacts with other agents (is sociable); reacts to its environment; and proactively tries to reach its goals by producing solutions. This technology allows for software to detect and suggest solutions to business problems. Basically, advances in technology (more data processed more quickly using smaller form factors) allow us to perform multiple calculations in a very short time. Intelligent agents are currently used in a number of industries, such as in electrical grids to ensure a continuous flow of electricity to hundreds of millions of consumers, as well as in large, distributed commercial systems to detect and control intrusion.

**Methodology**

In business, it sometimes seems easier to live with a familiar problem than implement an unfamiliar solution. This is particularly true in corporate decision support systems; however, the 3-D visualization of analytics clarifies underlying issues in a way that anyone can understand.

Current decision support systems are difficult and expensive to manipulate and seldom proactively provide solutions to issues. On the contrary,

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**IAVM High-Level Framework**

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Goal Assessment</th>
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<tr>
<td>Clear definition of vision, goals and stakeholder responsibilities.</td>
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<tr>
<th>Stage 2</th>
<th>Organizational Realignment (BCM Process)</th>
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<td>BCM ensures that the organization supports the corporate goals and vision.</td>
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<th>Stage 3</th>
<th>Metrics Definition</th>
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<tr>
<td>The WTE ratio ensures accurate measurement of how individuals and sub-organizations contribute to revenues and profitability.</td>
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<th>Stage 4</th>
<th>KPI Updates</th>
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<tr>
<td>WOV separates clusters of data and clarifies driving factors in large and complex data sets.</td>
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<th>Stage 5</th>
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<tr>
<td>Interface, tasks and information agents.</td>
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Figure 1
IAVM is a decision-support framework that allows companies to efficiently design, build, deploy and update an agile and robust enterprise analytics system by understanding business changes and providing proactive solutions to decision-makers.

The high-level process of IAVM involves six different steps that constitute a continuous improvement method, or kaizen analytics (see figures 1 and 2).

Instead of great technological breakthroughs, the kaizen approach aims to involve the entire workforce in a continuous improvement process. Hence, most of the improvements are small and process oriented (like making shelves easier to reach), but they involve the entire workforce rather than a selected few, inspiring the enterprise as a whole to be vibrant and innovative. A good example of how this works is at Toyota, whose employees provide management with 100 times more suggestions for improvement than other auto manufacturers.

Businesses that want to improve their analytics capabilities should follow the kaizen approach and make business analytics available throughout the entire organization. In some companies, analytics is limited to the purview of the few – statisticians, physicians, molecular engineers and actuaries – often because it is seen as expensive and difficult to interpret. This premise is no longer applicable, as costs have declined and ease-of-use has improved to the point that anyone in the organization can use these tools.

**Step 1: Assess corporate goals and business rules**

The first step in IAVM is to assess corporate goals and business rules. Before designing any decision support system, the company needs a clear understanding of the corporate goals and how those goals flow through the organization. General statements of increased profitability and decreased costs must be translated into specific metrics that can be reported, measured and predicted. Discovering business rules is essential during the assessment since these rules tend to mirror corporate compliance and workflow.

The conceptual design of the 3-D visualization begins within this phase because the visualization needs to mirror the corporate vision and goals. For example, a soda manufacturer and distributor may want to see the aggregate visualization as a series of 3-D soda cans, or a retailer may want to see the aggregate visualization as a category of consumer goods. These visualizations can be self-populated maps like the ones used by the Lawrence Berkeley National Laboratory Visualization Group, with underlying geographical information system (GIS) and dashboard technologies. A 3-D visualization of the enterprise's analytic
and predictive capabilities will allow executives and field staff to use the power of the human brain to its fullest potential.

Step 2: Realign corporate structure
The second step in IAVM is to evaluate the company’s organizational structure and make recommendations for how to better align the company with its corporate goals. This is where the BCM comes in. The BCM is a three-pronged structure that aligns the company’s financial goals and organizational model with strategic planning, assessment tools and knowledge management (see Figure 3). Its leading feature is its efficiency, allowing a company to turn around in a short time period, even one financial quarter. This type of agility is a necessary characteristic for any decision support system that involves human-computer interaction (HCI).

Step 3: Define metrics
The third step is to define metrics and determine how they aggregate through the company in order to predict and meet corporate goals. An organization must measure what it expects to manage and accomplish; otherwise, it has no reference with which to work. The IAVM uses a company’s current metrics and enhances them by using the WTE ratio, which measures the relationship between the cost per employee and the timely management of project staffing. This ratio can be used in M&A, due diligence and financial analytics.

In today’s economy, companies like to say that human capital is their most important asset. Indeed, the last 10 years have seen the development of a service economy and increased reliance on the knowledge worker. As a result, the measurement of management efficiency in utilizing human capital has moved to the forefront of this benchmarking exercise; hence, it is essential to develop a financial performance tool that determines how an organization is managing its workforce.

Asset management ratios measure the ability of assets to generate revenues or earnings. As such, they complement liquidity ratios when analyzing financial performance. There are six other asset management ratios: accounts receivable turnover, days in receivables, inventory turnover, operating cycle and capital turnover.

WTE is calculated by multiplying average daily salary (ADS) with the actual number of days to fill an open position (TTF), dividing that sum by the average number of days to fill a position (ATF) and then dividing again by 10 (see Figure 4).

WTE is useful for companies with a large number of employees (over 10,000). These companies can be in different industries such as healthcare, manufacturing, financial services, telecommunications and other services. Also, it can be used to measure performance efficiencies within any organization, including but not limited to IT and business processes.

Step 4: KPI updates using the weighted outlier
The IAVM also uses the weighted outlier methodology to improve visibility into data patterns. An outlier is an observation that lies outside the overall pattern of a distribution in the data. Usually, the presence of an outlier indicates

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\text{WTE} = \frac{\text{ADS} \times \text{TTF}}{\text{ATF}} / 10
\]

 BCM Framework

![BCM Framework Diagram](image_url)
some sort of problem. The weighted outlier variable (WOV) separates clusters of data while simultaneously clarifying the driving factors in large and complex data sets (see Figure 5). A weighted outlier creates variables that maximize the differences in the data, while simultaneously minimizing the similarities in the data to detect potential fraud. This effect could be described as “squeezing and pulling out” the potential fraud from the data set. A significant WOV should also substantially increase the efficiency of a data model for fraud detection.

**Step 5: Designing intelligent agents**

The design of the IAVM framework takes into consideration three different types of intelligent agents:

- **Interface agent**: Collects information from users and delivers requested information.
- **Task agent**: Performs most of the autonomous functions. For example, task agents calculate in real-time the mean and standard deviation of a specified value and then decide the outlier limits for an alarm script. Also, these agents may decide whether the solution is a potential data error, fraud issue, new pattern or risk management issue.
- **Information agent**: Used for one-time retrieval of information that has reusable capabilities.

**Step 6: IAVM implementation/visualization**

The conceptual framework of the IAVM is depicted in Figure 6 (next page).

The visualization architecture consists of three main layers: 3-D interactive visualization, a geographical information system and a dashboard with drill-down capabilities. The 3-D interactive visualization uses the medical concept of binocular vision, which adds an additional predictive variable to two-dimensional data.

Business data is three-dimensional; however, business analytics tend to be flat, or two-dimensional, like an Excel table or chart. The difference between a 2-D analysis and a 3-D analysis is depth. Depth perception allows an individual to accurately determine the distance to an object.

In analytics, depth is referred to as dimensional analysis. Dimensional analysis is used in engineering, physics and chemistry to understand the characteristics of multi-dimensional data and formulate hypotheses about the data that are later tested in more detail. In business analytics, we can create a 3-D variable that allows the end-user to “see the depth” of the data. This variable is called a 3-D vector analysis. This variable, when combined with cluster analysis and a visualization tool, answers the recurring business question: How deep can I go into my data and see patterns in which sound business decisions can be made?

The main goal is to increase the user’s understanding of the data by adding depth perception (i.e., predictive modeling) to traditional 2-D data analysis. This method, binocular summation, increases visual perception by a minimum of 140% in clinical studies.

**Weighted Outlier Effect**

![Figure 5](image-url)
The IAVM uses this increased visual perception to its advantage. An example is a self-populated map that allows executives to determine potential issues and solutions to achieve corporate goals (see Figure 7, next page). The geographical information system gives the user a spatial dimension among different geographical regions for comparative analysis. The dashboard view should have drill-down capabilities that allow users to examine the root causes of the issues detected by the IAVM.

Real-Time IAVM Applications

To fully understand the potential for IAVM, we must recognize how intelligent agents are currently used in the following industries:

- **Healthcare**: As patient care becomes more data intensive, intelligent agents are used in intensive care settings to administer medication by proactively reacting to constant monitoring of vital signs.

- **Air traffic control**: The volume and complexity of managing air traffic control systems requires the utilization of intelligent agents to avoid collisions and manage departures and landings.

- **Manufacturing**: Robotics has become one of the main applications in the manufacturing industry, and intelligent agents are used to react and proactively make decisions regarding quality control processes.

Other potential applications for real-time IAVM include but are not limited to:

- **Retail**: As a consumer browses through a store (brick and mortar or Internet), intelligent agents react to browsing and purchasing patterns to recommend additional articles to purchase. This output then can integrate with a marketing campaign to send coupons that target the consumer’s preferences.

- **Financial services**: Early warning systems react to diverse credit card purchases, and investment mechanisms proactively detect fraud and abuse.

- **Healthcare**: Systems detect and proactively recommend diagnoses and treatment based on real-time clinical and claims data in a digital hospital setting or in a claims processing clearinghouse.

- **Internet gaming companies**: An inflation control tool acts as a central bank regulating the supply of money to control inflation in virtual economies.

- **Internet advertisement**: Mobile agents detect patterns in user behavior and proactively communicate with other agents to determine what advertisements to display.

- **Communications**: Intelligent-agent technology efficiently transfers calls and detects potential outages.
Self-Populated 3-D Visualizations

Source: Lawrence Berkeley National Laboratory
Figure 7

Conclusion
The IAVM has multiple applications in analytics around big data for the high-tech, healthcare, retail, pharmaceutical, life sciences, CPG, banking and financial industries. It can be used for M&A, risk management, financial analysis, corporate asset management, restructuring, fraud detection and best practices identification. This framework incorporates proven business, scientific and technological methods and processes to provide companies with a flexible and robust decision support system that will allow them to rapidly adapt during difficult economic conditions and flourish during strong economic times.

As an added benefit, the IAVM proactively brings potential solutions to issues based on sound and proven mathematical and scientific methods like standard deviation, risk detection, outlier analysis and visualization. It allows decision-makers to gain confidence in their understanding of why a goal-related issue has surfaced (or been detected), and why a specific solution has been recommended.

Footnotes
4 Inventory turnover is similar to accounts receivable turnover. It measures how many times a company turned its inventory over during the year. Higher turnover rates are desirable, as they imply that management does not hold onto excess inventories and that its inventories are highly marketable. Inventory turnover is calculated as follows: Cost of sales/average inventory.
5 Days in inventory is the average number of days a company holds its inventory before a sale. A low number of inventory days is desirable. A high number of days implies that management is unable to sell existing inventory stocks. Days in inventory is calculated as follows: 365 or 360 or 300/inventory turnover.
6 Operating cycle = number of days in receivables + number of days in inventory.
About Cognizant

Cognizant (NASDAQ: CTSH) is a leading provider of information technology, consulting, and business process outsourcing services, dedicated to helping the world’s leading companies build stronger businesses. Headquartered in Teaneck, New Jersey (U.S.), Cognizant combines a passion for client satisfaction, technology innovation, deep industry and business process expertise, and a global, collaborative workforce that embodies the future of work. With over 50 delivery centers worldwide and approximately 137,700 employees as of December 31, 2011, Cognizant is a member of the NASDAQ-100, the S&P 500, the Forbes Global 2000, and the Fortune 500 and is ranked among the top performing and fastest growing companies in the world. Visit us online at www.cognizant.com or follow us on Twitter: Cognizant.

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