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Operational Intelligence:
Correct problems before they occur

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Introduction

The typical enterprise today views business performance through a 24-hour window. Executives may receive daily updates for sales and shipments, and review other core business KPIs on a weekly or even monthly basis. Yet for many companies, minutes or seconds can take on critical importance as customer expectations grow.

An OEM manufacturer promises to assemble and ship a custom configuration overnight. An online store promises to pick, pack, and ship the same day, or else the shipping is free. A retail call center has a two-minute window to answer customer questions before satisfaction levels begin to drop. A utility provider needs to manage demand closely during peak usage periods to avoid brownouts or other service interruptions.

To illustrate these challenges, let's look at one scenario from the mobile phone industry. Retailers know that fast service means more revenue and greater profit margins. A telecommunications service carrier provides a Service Level Agreement (SLA) to retail outlets (which are often independent agents), promising to activate new phones within three minutes.

If this service level is not met, waiting customers will become impatient and possibly leave the store. Failing to meet this and other kinds of Service Level Agreements will result in dissatisfied customers, customer defection, lost revenue, and risks to branding and reputation. To compensate, the carrier may have to offer discounts, give refunds, or even pay fines. Given the highly competitive nature of the industry, the company may even face defection by the retailers themselves, losing valuable shelf space to competitors.

Once the carrier realizes that it is missing its SLAs there are a number of ways to respond:

- Allocate more computing resources to handle the automated activities.
- Assign more work center staff to handle the manual activities.
- Change service activation processes to defer updates to billing systems until after activation.
- Prioritize activation requests based on customer or partner ranking so that high-value customers and partners are serviced within the SLA targets.

Meeting these SLAs is particularly critical during a product launch when demand can peak swiftly. Given the hype surrounding a new product, if customers have a pleasant experience from the start, they will develop the loyalty and goodwill that quickly becomes new revenue – through add-on purchases, and recommendations to friends and family.

For many companies, minutes or seconds can take on critical importance as customer expectations grow.

These problems are not exclusive to the mobile phone industry. Service Level Agreements are commonly used in many industries, and therefore so is the need to monitor, analyze, and act on them. In the express shipping industry, SLAs promise next-day delivery times. For Internet Service Providers, like cable companies, the SLAs are based around bandwidth usage. Energy companies provide SLAs for availability and peak demand. Although the details will vary from industry to industry, SLA compliance and management is important to almost all industries.

The earlier a company detects and responds to SLA violations, the lower the business impact. Even better, with sufficient visibility into critical business processes managers can prevent violations from happening in the first place.

The message here is that increasingly, companies need to manage business events in real-time. Simply producing reports on a predefined schedule is not enough. Decision-makers need real-time alerts and insight, so they may take meaningful action while it still matters. The moral: Proactive steps are better than post-mortem explanations.

In this white paper, we discuss the burgeoning concept of Operational Intelligence, a new approach for decision-making that allows the optimal response at the right time. It draws upon concepts and technologies currently in use, augmented with new analytical technologies and delivered as a unified solution.

The struggle to be responsive

Many companies face roadblocks when it comes to monitoring business processes and handling events and exceptions in a timely manner. The cold hard reality is that executives cannot keep pace with changing business conditions and satisfy high customer expectations at the same time.

- **Supply chain:** An automotive manufacturer only keeps four hours of inventory on hand. If parts are missing or delayed in the supply network, this can cause production lines to shut down, at a potential cost of $100,000 per hour or more.
- **Retail call center:** If customer call wait times exceed a certain threshold, a retailer knows that customers will start defecting. Without an early-detection method, managers can't respond proactively by taking such measures as reassigning workers in the call-center and prioritizing calls by customer level.
- **Logistics & shipping:** An express shipping company has only a few hours to receive all vehicles, unload the packages, sort them by destination, reload them into vehicles, and launch the vehicles toward their destinations. Any slight deviation in the schedule due to weather, equipment failures or traffic can wreak havoc on SLAs.
- **Energy & utility providers:** Utilities need to monitor supply, demand, and transmission conditions continuously to avoid brownouts and other service interruptions.
- **Web promotions:** The Web enables your company to run multiple promotions simultaneously. OI enables you to monitor the effectiveness of each promotion in real-time, thereby allowing you to react quickly to expand successful promotions and shut down lackluster promotions.
- **Web services:** IT departments need to monitor network traffic and server load times continuously to ensure that response times are within acceptable targets. Otherwise, customers visiting your site will easily click away if your pages and forms are not responsive.
- **Real-time clickstream analysis:** Many companies need this capability to not only monitor customer behavior, but to catch any suspicious activities such as identity impersonation or credit card fraud, and provide better customer service on their websites.

Operational Intelligence provides:

- Visibility (see and access information from a wide variety of sources using a rich and interactive user interface).
- Insight (the ability to analyze and draw conclusions from multiple real-time and historical data sources as the information changes).
- Action (the ability to respond in a meaningful way to positively impact business, processes, and customers).

Let's begin by discussing why current systems and methodologies have not been able to fully deliver this holistic set of capabilities.

The realities of real-time decision-making

The speed of business is accelerating. As this velocity increases, so does the operational cost of delays negatively impacting the bottom line, especially with many industries operating on razor-thin margins.

A manufacturing executive with a four-hour product assembly window knows that if he loses a few minutes at one point in the cycle, the result will be a cascade of slips affecting his product-build quota for the day. Without real-time information on any potential glitches, he can't adjust his production schedule quickly enough to prevent significant delays down the line. Ultimately, these operational delays will cost the business money through fines or lost revenue.

Most companies are unable to track business and operating conditions in real-time. Instead, they make decisions based on data that has been uploaded into data warehouses, or reports that are hours or even days old. Senior managers and executives are in effect driving their business by looking into the rearview mirror. They spend too much time fixing, or trying to fix, problems long after they've occurred and the damage is done.

When detected early, problems cost less to fix. As well, the early detection of trends—customer behavior, equipment malfunctions, or even industry events such as the bankruptcy of a major competitor—can help a business avoid problems and capitalize on new opportunities.

What's lacking in Business Intelligence

Many midsize and large companies have invested heavily in Business Intelligence (BI) technology solutions to aid decision-making and compliance. Yet those systems are not able to help companies effectively respond to the business conditions discussed above. Why not?

BI systems serve up Key Performance Indicators (KPIs) through reports and dashboards based on queries from data warehouses and other operational data systems. Some also provide the ability to drill down into source data for deeper analysis.

While BI tools are valuable for trending and predicting, they provide a historical perspective only. Even though many BI vendors tout real-time capabilities, BI reports can be 30-60 minutes old, and they are not viewing and analyzing the business process data or other sources of non-traditional data, thereby inhibiting sound decision-making.

At a glance: Why BI fails

- Limited access to relevant operational and event sources.
- Operational and event information not available in a timely fashion.
- Limited or no ability to update analytics, charts and trends on an incremental and continuous basis.
- Limited or no ability to correlate recent and historical data with real-time operational systems and event sources.
- Limited ability to respond by doing BPM analysis and invoking automated or workflow systems.

At a glance: Why BAM fails

- Typically tied to a single BPM system; cannot tap into data from operational systems.
- Narrow range of measurements and analytics.
- Cannot correlate data from a variety of sources.
- Limited ability to "drill down in context" into the system generating the underlying data.
- Limited user empowerment that easily allows users to define dashboards and KPIs.

BI tools can give clues about business processes, but no real insight into the business process itself. In BI, the insight depends entirely on the knowledge, skill, and intuition of the analyst. Change the analyst and the quality of the insight changes significantly. Additionally, tools developed for "data mining" can never truly provide insight into processes.

In contrast, Operational Intelligence relies on real-time feeds, also referred to as "event data." Event data represents in real-time any significant changes in data, processes, business transactions, or other business indicators.

Other reasons why BI tools are poorly suited for real-time decision-making:

- **Limited access to relevant operational and event data.** Relying upon data from databases and data warehouses is not enough. Event oriented sources such as click information from a company's website, and novel data sources like RFID systems and RSS feeds, provide valuable information about business processes and customer behavior.
- **Operational data and event information is not available in a timely fashion.** Uploads to static data stores occur only periodically, thus you have a delay in actionable intelligence. And as we've already discussed, delays of even a few minutes can be problematic to your business because they reduce your ability to avoid a potential negative outcome. For example, the best time to correct a customer problem is before the customer detects it.
- **Limited ability to access continuously updated analytics, charts and trends.** While BI systems can run queries on data that comes from an operational system, this can only take place after the data has been loaded into a data warehouse or Operational Data Store (ODS). And BI systems only refresh analytical information or charts when someone asks the system to do so. Imagine if your car dashboard displayed the current water temperature only when requested: you would have no warning at the time your engine begins to overheat, only afterwards when the dashboard is refreshed. With access to continuous analytics, you can see problems as they occur, and trends that indicate upcoming problems, so you can take proactive action as conditions change.
- **Limited or no ability to correlate recent and historical data (as stored in databases) with real-time operational systems and new types of event sources.** Correlation is critical for analyzing and predicting the impact of events on outcomes and processes.
- **Limited ability to respond by doing BPM analysis and invoking automated or workflow systems.** For instance, the IT department may receive an alert that a web service is delayed, but they often don't have the information to prioritize it in business terms. If the glitch impacts a high-priority customer or opportunity, such as a promotional discount on a new product, that information should reach a business manager who can quickly address the problem.

"OI can help remediate issues by providing real-time notification and escalation as well as root-cause analysis of problems."

Ventana Research

What's lacking in other systems for monitoring and managing events and processes

Business Activity Monitoring (BAM) is another common tool set used in decision-making, yet it also fails to deliver a full analysis. BAM tools provide a real-time summary of business processes to operations managers and upper management. Originally BAM was built on top of Business Process Management (BPM) systems, and focused on the monitoring of formally modeled processes. While BAM can do simple analytics and KPI calculations, it cannot access a wide range of data sources, perform complex analysis (including historical, predictive, and multidimensional analysis), or provide a means for someone to take action.

If BI and BAM solutions fall short, what can a company do? In response to this long-delayed realization of real-time intelligence, a new technology segment called Operational Intelligence has evolved. Operational Intelligence brings together existing technologies and new analytical tools to help business managers and executives keep up with the speed of business.

Introducing Operational Intelligence

The modern enterprise needs the ability to visualize, analyze, and act in real-time on operational data originating from a wide variety of operational data sources, not just business transactional systems. Operational Intelligence enables decision-makers to respond to changing business conditions in order to decrease lag time, and increase operational efficiencies and overall responsiveness. This can help a business maintain customer satisfaction and retention, reduce operating costs, and protect and even grow revenue.

Ventana Research states that: "Operational Intelligence (OI) can make risk more visible and increase compliance with company policy across business units and fragmented financial systems. Furthermore, OI can help remediate issues by providing real-time notification and escalation as well as root-cause analysis of problems."[1]

While BI and BAM have existed for some time, Operational Intelligence is enabled by the emergence of Service Oriented Architecture (SOA) and Complex Event Processing (CEP). SOA is a standards-based approach for real-time access to new types of content, especially current data from operational systems such as ERP and CRM systems. CEP is able to perform complex analytics over real-time data (known as events) in an incremental and continuous fashion. With CEP running in the background, companies can not only see what is happening, but understand why it is happening, what it will impact, and how it has been previously handled. CEP technology allows you to make such correlations as: is a particular change in a web-promotion having an immediate impact on my best customers? Or, as my activation times continue to rise are my customer cancellation rates rising to the same extent?

[1] *"Operational Intelligence and Event Processing Research Agenda for 2008," Ventana Research.*

OI at a glance

Here's what OI delivers through a unified software package:

- Access to a wide variety of data sources in real-time, including business transactional systems, operational systems, and external sources such as Web feeds.
- Continuous monitoring and analysis of information in real-time.
- Ability to access and correlate related information, such as new incoming orders against customer ranking and recent buying trends.
- Rich visualization of the raw and analytical data organized easily from the business user's perspective.
- Ability to respond using a variety of automated and workflow systems.

OI Benefits

- Multiple SLA management and compliance across large data centers.
- Revenue boosts from responding to high-priority events.
- Improved governance toward regulatory compliance.
- Enhanced workflow productivity.
- Decreased delays with orders and services.
- Increased customer satisfaction.
- Improved marketing effectiveness in programs and promotions.
- Reduced costs incurred due to fraudulent behavior.

When you integrate a rich user interface with real-time analytics powered by Complex Event Processing, you gain the ability to drill down into the source (system) of the information, in context. Ultimately, you gain visibility and insight into the daily operations that matter most to business success.

Return on investment from OI

Companies that have made investments in an OI infrastructure can expect quantitative and qualitative benefits in a number of areas. One common benefit is the ability to manage multiple Service Level Agreements across large data centers, and achieve better compliance with those SLAs. The balancing of demand and demand fulfillment, such as re-targeting a web promotion when its success overloads a company's ability to fulfill the demand, is improved with OI. Companies have also reported increased customer satisfaction and retention through the ability to resolve issues in real-time and prevent additional delays with orders and services. Through OI, companies also gain increased process efficiency (to keep costs down) and improved effectiveness (to increase quality of interactions and deliverables).

Other benefits and ROI you can expect to gain with OI:

- Improved transparency of business activity.
- Revenue enhancements by giving attention to high-priority events.
- Improved governance by acting quickly when contracts or regulations are trending toward non-compliance.
- Faster responsiveness and decreased costs attributed to adverse events (e.g., shipment delayed due to bad weather at transportation hub).
- Improved utilization of resources through real-time monitoring of supply, demand and other related events.
- Improved marketing effectiveness, especially in web-based promotions.
- Decreased fraudulent activity by detection of suspicious behavior as it occurs, and quick action to reduce its impact.

What to look for in OI systems

An integrated OI system should deliver an intuitive interface for business users to define and view analytics against any of their information systems. An analyst should be able to ask questions at any level—from a fairly basic inquiry, such as the current on-time delivery metrics for all regions, to a more complex inquiry, such as revenue impact from missed shipments due to inclement weather conditions.

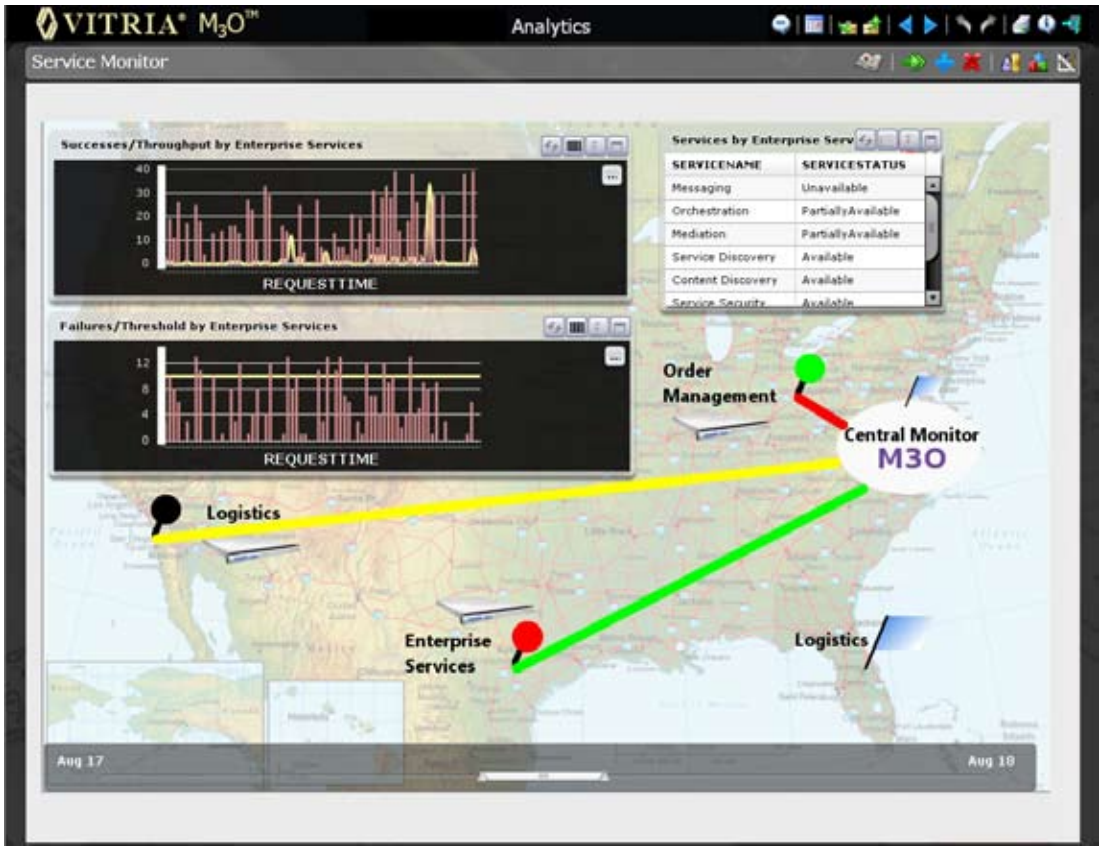
Once a query has been requested, the system should continuously evaluate the status of that query so that a user doesn't have to keep asking the same question. Business users should not need technical training to visualize the results – instead they should be able to click an indicator or graph on a dashboard to access deeper information and graphics. Finally, event management tools should monitor business processes in execution, and provide response mechanisms when adverse events or exceptions occur, either manually or through automated workflows.

CEP is powerful in analyzing multiple events over a specific period of time, detecting complex patterns, and making correlations.

Four critical OI capabilities:
The four areas of technology below are complementary: a system with only three of these capabilities is like a table missing a leg – it will be off balance and not fully useful.

1. User empowerment and rich visualization
A common scenario in many enterprises is that costly BI applications are used by few people, and have minimal impact on the business. To gain real value from these applications you need tools that look, act, and feel like today's newer productivity devices (PDAs and smartphones), that empower employees to better manage their lives. The goal is to support a level of ease-of-use that allows C-level officers and other executives to ask their own questions of the system for immediate analysis. Look for these features in an OI solution:

- **Interactive dashboards:** Users can define KPIs and click icons to hyperlink to other dashboards, or to drill down in context (e.g., drill down to the average customer revenue in a particular city featured on a sales map). Users can organize the information in any way that makes sense to them and that supports their specific questions.



- **A range of visual tools:** Such tools enable users to organize and customize the dashboard to monitor and analyze events, KPIs, SLAs, and other metrics. Web 2.0 technologies work behind the scenes to provide this flexibility. Users can drag and drop charts, merge lists and other data sets to create new views and correlations, use overlaying charts to compare current versus historical trends, or access 3D navigation tools for a richer experience.
- **Mash-up data from many sources:** Web 2.0 technology enables users to create dashboards combining data from many sources, including traditional and non-traditional sources such as Google maps with internet traffic information and current vehicle routings from the ERP system. This all-encompassing view of information enables better decision-making.

2. Access to operational data from a wide variety of sources

Operational Intelligence goes beyond traditional databases and data warehouses to provide access to a vast array of information – both structured and unstructured. You can fully leverage all of the structured data generated in transactional systems and business processes. Yet increasingly, given the volume of information being created daily from individuals within your company and stakeholders externally, you need unstructured data from e-mail, workspaces, and wikis. Even RSS feeds about weather patterns, geopolitical events, or financial markets have an important role to play in daily business decisions.

An express shipping company has only a few hours to sort packages and launch them toward their destinations. Any slight deviation in the schedule can wreak havoc on SLAs.

Without these other non-traditional data sources, it's not always possible to have a complete picture of operational performance and business projections. An OI system can draw upon this non-traditional data, filter and correlate it with structured transactional data to create multilayered charts and dashboards, and deliver the results to event management tools.

3. Real-time continuous analytics

As mentioned earlier, CEP is a key OI technology that allows an individual to request an inquiry or analysis once, and continuously evaluate it in a highly efficient manner.

Perhaps you want to know the average wait time of customers broken out by region, product requested, and customer type. With a traditional BI application, the application recalculates the query from the start each time it delivers a new customer request. The CEP engine instead stores the results from the initial analysis, and only processes the incremental change as each new request arrives. Thus, with each new customer request, only the incremental change in the result is calculated. The resulting ROI: you receive analysis much faster compared with bulk database processing found in most BI systems.

CEP is also powerful in analyzing multiple events over a specific period of time, detecting complex patterns, and making correlations. For example, it can detect suspicious credit usage by monitoring credit card activity, as it occurs. It can perform time-series analysis and trending over streams of events, and it can correlate a stream of real-time information with stored and historical data, such as new credit card activity with customer information from a CRM system and historical usage patterns.

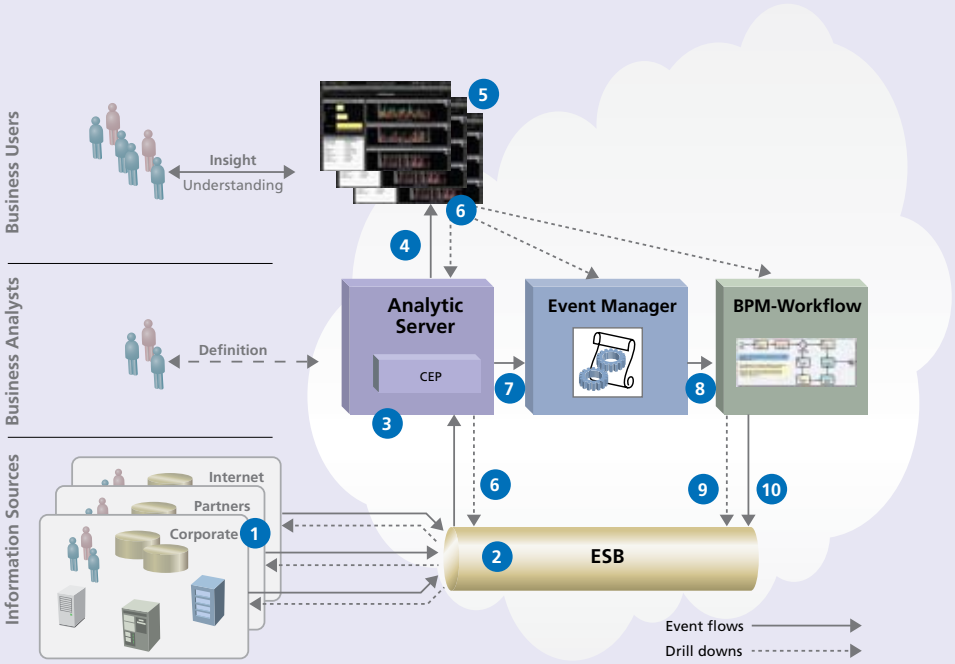
4. Root cause analysis to facilitate corrective action

When an event occurs, it sets off a chain reaction that has consequences for processes throughout the operational systems. Analysts need to know which event triggered what exception or corrective action, and what impact that will have in the future. To get to the root cause, you have to be able to drill down in context to discover why certain events occurred. Drilling down into the process shows you the history of the event execution to find out what went wrong, and where. And then you can initiate corrective action. For example, a popular new mobile phone is released and selling in record numbers, but the activations are failing because automated credit checks can not keep up with the high traffic rates. A corrective action might be to change the activation process by temporarily reallocating resources to handle the spike in demand.

With the four OI capabilities outlined above, employees now have one toolset to define business rules, align them with policies and corporate objectives, and then directly initiate corrective action as needed.

The Importance of Events and Event Feeds

At the root of Operational Intelligence lies the data, or event feeds (sometimes called "event streams"). An event feed is a sequence of changes to a data item or business condition. The simplest example is the familiar stock market ticker, which shows the fluctuating prices for stocks traded on the stock exchange. Most databases and many applications provide a notification or a trigger when a data value changes. An Enterprise Service Bus (ESB) together with integration tools can turn these notifications into an event feed which then can be transmitted to multiple applications, and filtered and correlated with real-time sources or data from data warehouses, CRM and ERP applications. The data is made available to Business and IT users via rich Web 2.0 dashboards which can easily display information from multiple sources and visually compare real-time and historical data. Users can drill down into the context of the data, and send feeds back to an event manager to trigger an automated response. Events are evaluated against relevant policies which can then automatically initiate a new business process or workflow, empowering users to take action in context.



Architecture of an Operational Intelligence Solution

1. Data is accessed from a variety of sources and grouped into "event feeds" based on logical topics.
2. Event feeds are conveyed via an Enterprise Service Bus, based on SOA standards, to other components.
3. The analytic server with its embedded CEP engine filters and analyzes the different event feeds, correlates with related historical data, and calculates results on a continuous basis.
4. The results are organized into "result feeds" and forwarded to other components, including dashboards and an Event Manager.
5. Dashboards and reports are generated for user consumption and displayed in a standard browser.
6. Users can drill down into the originating system to see data details or related contextual data.
7. Selected event feeds and result feeds are also sent to an "event manager" for automated responses.
8. The event manager evaluates each event against relevant policies, each policy being a set of rules expressing a business objective. When a policy is matched, an associate action is triggered, which could be as simple as sending a notification or invoking a web service, or as sophisticated as initiating a new business process or workflow in a BPM system.
9. During the execution of a business process the BPMS can request additional contextual data from the original data sources.
10. The BPMS forwards process status as an event feed that can be analyzed, displayed, and drilled into as described above.

Bringing it all together: realizing quantifiable benefits from OI

Let's return to the company example that we discussed at the beginning of this paper: the telecommunications service carrier. This company had an ongoing issue with SLA management. Missed SLAs were threatening customer service and satisfaction levels, revenues, and even market share. However, with an Operational Intelligence solution in place, the situation is much different.

Now the company can:

- Monitor and measure the service activation process, enable business users to create interactive dashboards with a wide range of visual tools, and help the carrier to see the potential Service Level Agreement violations – before potential customers start walking out the door. With this enhanced visibility, decision-makers from the very top of the organization all the way down to the point of decision can ask their own questions of the system.
- Correlate activation requests with customer ratings (from CRM), retail channel (from partner database), ongoing marketing promotions, and geographical location to gain greater insight into activation request traffic.
- Analyze the activation traffic against multiple dimensions, such as customer ranking, promotion type, partner ranking, and geography; thereby providing insight into delays experienced by the best customers, best partners, or best locations.
- Add time-series and trend analysis to the activation traffic analysis to discover undesirable trends in progress, before they cause an adverse impact. For example, if the company discovers that its best retailer is experiencing increasing delays in activation time, they can proactively re-prioritize that retailer's requests.
- Finally, by linking this insight back to the business rules and policies, the company can perform root cause analysis and take action that will prevent costly problems before they occur. Such action does not always involve solving a problem – it can also implement a highly-profitable best practice.

Conclusion

As we have shown, given the highly competitive nature of the current marketplace, not meeting Service Level Agreements results in customer dissatisfaction, contractual non-compliance, and of course loss of revenue. Thus, it's important to detect potential SLA violations early and be able to respond, to prevent negative outcomes. To do that, companies need to manage business events in real-time, using Operational Intelligence. Other technologies like BI and BAM don't offer the scope of OI and cannot perform deep analysis in real-time, or allow you the ability to proactively take action.

In a world where Operational Intelligence is prevalent throughout the enterprise, you can achieve SLA Management and improve customer satisfaction in ways that were not possible before. Retail call centers experiencing increasingly long wait times can dynamically select and transfer high-value

customers to the front of the line. Airlines can automatically rebook passengers on a different flight if connections were missed. Logistics and shipping companies can dynamically reroute trucks and packages based on unexpected delays to optimize their on-time shipment rates. Energy and utility providers can match external events with upcoming weather predictions to proactively monitor demand and better manage the supply.

Keeping up with the speed of business is a never-ending challenge. Fluctuations in global supply and demand, customer needs, regulatory changes, and other variables are difficult to predict. Operational Intelligence provides a way to navigate the changing business environment and keep your business viable and competitive. Real-time visibility into your enterprise operations, insight into the current climate and situation, and the ability to take action immediately are the cornerstones of true Operational Intelligence.

About Vitria

Vitria Technology, Inc. is the industry's leading privately-held BPMS and integration technology company. The company has a rich heritage as a pioneer of BPM that spans more than a decade. Vitria's award winning process integration solutions provide the backbone for many Global 2000 companies' mission-critical business processes. Vitria has customers in North America, South America, Europe, Asia, and Australia.

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