REAL-TIME OPERATIONS INTELLIGENCE

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ABSTRACT

This paper presents a new emerging class of applications that are called Real-time Operations Intelligence (RtOI) systems. RtOI is a management practice that measures performance in real-time. These measures are used to adjust targets to exploit current market conditions and improve business agility. RtOI provides a strategy for success with the very dynamic business conditions confronting today's manufacturers. The focus is on operational cost and profitability measures for resource allocation and decision making. Dynamic performance targets adapt to changing definitions of what is important and what is acceptable performance. The real-time monitoring of performance measures and external factors keep the corporation focused on the "right things"

INTRODUCTION

Rather than using dated operational measurements, RtOI solutions provide an executive the tools to manage their business based on current, real-time conditions. The disconnect between fixed historically-based operation measures and current operating conditions drives sub-optimal business performance.

RtOI focus is on operational cost and profitability measures for resource allocation and decision making. Dynamic performance targets adapt to changing definitions of what is important and what is acceptable performance. The real-time monitoring of performance measures and external factors keep the corporation focused on the "right things" – see Figure 1 [1].

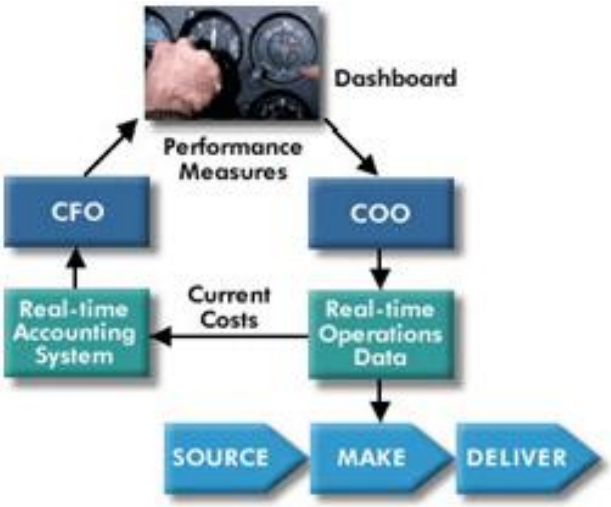

Figure 1 – *RtOI Continuous Improvement*

The definition of real-time varies depending on who you are. It could mean seconds if you are a production line operator. It could mean hourly or daily if you are a plant manager. A successful RtOI strategy also encompasses all aspects of the enterprise, from manufacturing and automation to the supply chain and accounting system – see Figure 2 [2].

Key performance measures, real-time accounting data, and real-time operations data are all necessary for achieving the level of operational excellence promised by RtOI.

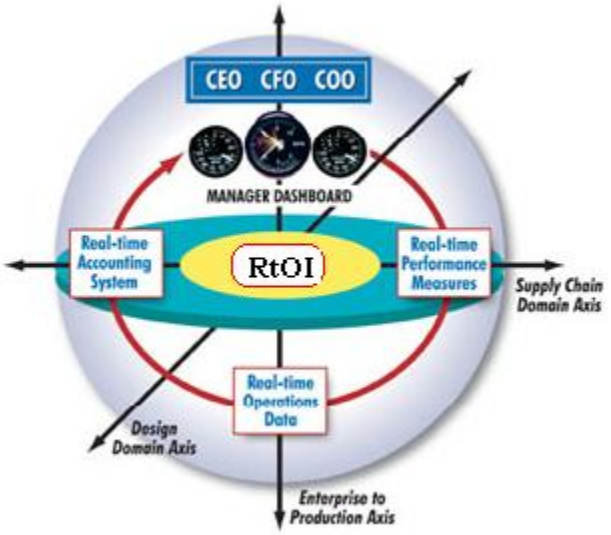

Figure 2 – *RtOI Strategy*

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RtOI Guiding Principles

- Monitor Performance in real-time
- Let customer needs drive collaboration
- Allocate resources as needed
- Empower local teams to continuously improve the action plan
- Structure rewards to encourage collaboration among internal teams
- Adjust targets to drive optimum perform

Internal bias often fogs our vision. Senior executives need to drive a cultural change while moving their organization to Real-time Performance Management. The concept of real-time measurements and dynamic performance targets involves much more than just technology. People need to be weaned from their traditional methods while learning and becoming comfortable with new business processes.

Real-time monitoring of internal performance enables the company to react rapidly to significant developments. Using real-time information to drive actions empowers decision-makers at the time of greatest impact (when they make a decision). Solutions are emerging that enable real-time monitoring across an extended enterprise.

Static objectives sub-optimize profits in today's dynamic environment. Unit managers often lose focus on the core drivers of corporate profitability. Two types of dynamic targets are critical:

- Financial targets for managers with profit and loss responsibility
- Performance targets for operational personnel that help to insure meeting the financial targets.

Dynamic performance targets can and must be applied to operations, supply chain, and logistics.

Running a refinery, a chemical plant or a pharmaceutical assembly operation is a complex business. Planning and scheduling, process control and maintenance require dedicated, multifaceted solutions necessitating highly trained and experienced users. The inevitable system and user specialization results in the proliferation of disparate data sources, incoherent information, inconsistent decisions and the failure to realize corporate objectives – until today.

Large organizations are managing their operations using two different application classes. Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Customer Relation Management and many other applications are one class of applications that support the business and administrative aspects of the corporate. On the other hand, corporate plant-floor is supported by totally different type of systems such as such as distributed control systems (DCS) and supervisory control and data acquisitions (SCADA), laboratory information management systems (LIMS), and data historians.

Although it is of critical importance for a plant manager to know what is happening throughout his plant or organization, the manager has neither the time nor the inclination to immerse him/her self in the many computer systems mentioned above that are used to manage plant activities. This is why managers are relying on subordinates to provide them with the information required to make decisions. This information is usually

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composed of both business-like data extracted from business applications and process-like data extracted from plant-floor applications. However, the process of extracting valuable information from data repositories and efficiently delivering it to the end-user is very complex. This is mainly because of the vast reservoirs of corporate data that was accumulated over the years, and the diversity of storage technologies, database management techniques, and data semantics. Furthermore, the two classes of systems are totally isolated and users have to jump from one application to another to get the required information.

This is why information takes such a long time to prepare and usually is late reaching the manager's office. This information traditionally flows to the plant manager through status reports, verbal updates, turnover meeting notes, phone calls, and e-mails. And often such information is out-of-date, filtered, and only partially complete. Worse yet, in the event that a problem requires further attention, he has no mechanism to quickly and conveniently find detailed supporting information. Tools are needed to package information in repositories and deliver it to the right people at the right time so they can make decisions worth millions of dollars. Tools that can blend data from multiple heterogeneous sources are needed, to support analytical reporting and decision making.

Real-time Operations Intelligence (RtOI) is emerging as a new class of applications which will resolve the above dilemma. These applications gather information pertinent to a particular job and present it graphically through a standard Internet browser (Figure 3 – RtOI Concept). On the main screen, summarized information automatically draws the user's attention through highlights of high activity and exceptions. These "actionable items" invite the user to click the mouse and drill down to sequentially unfold greater and greater detail in supporting information.

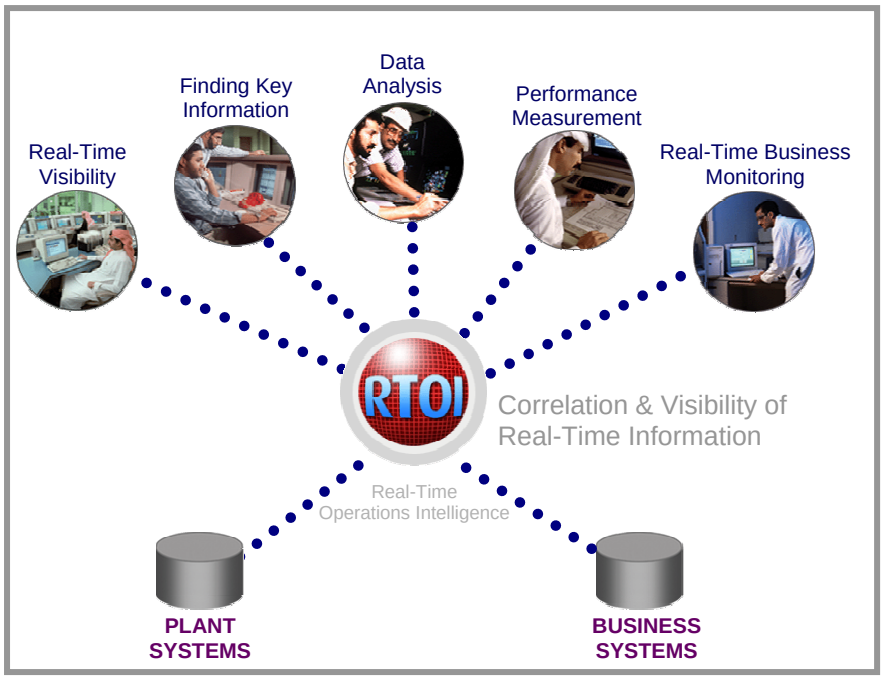

Figure 3 - *RtOI Concept*

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RtOI is deployed to deliver a coherent view of the current activity, future plans and production history to all plant desktops in near real-time. The RtOI solution is a plant-wide operations intelligence platform with visualization capabilities designed to aggregate and view information simultaneously from dozens of information systems and real-time plant applications – see Figure 4. RtOI is data source neutral. Data is maintained in existing back-end systems, collected and buffered in a virtual cache and presented to the clients/users in an Internet/Intranet browser or wireless devices, such as PDAs and handheld computers. Data sources accessed include: SAP, OSI PI, Oracle databases, various planning systems, LIM systems and document management systems. Information is served up to the clients from the RtOI virtual cache with minimized impact on network bandwidth and back-end systems.

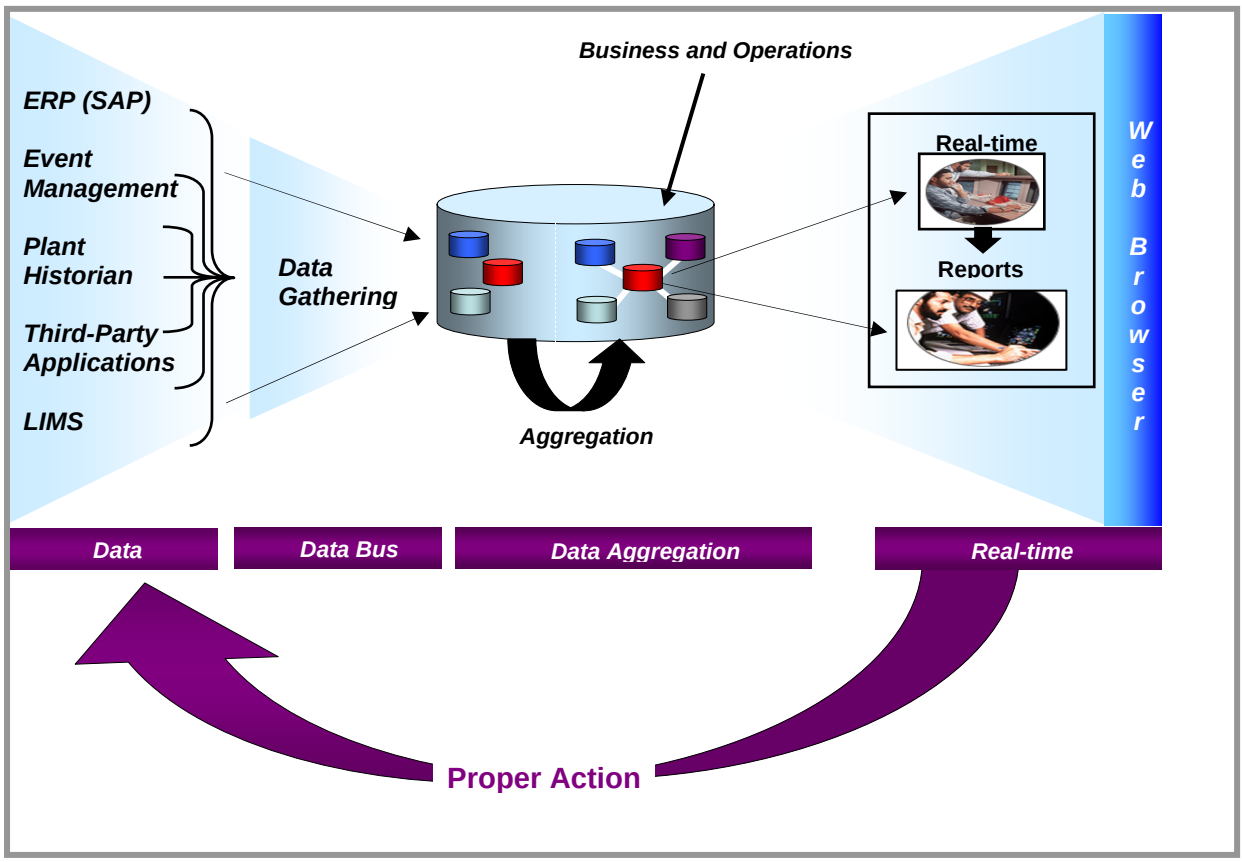

Figure 4 – *RtOI System Connectivity*

RtOI users are anyone in the business who needs tactical information to improve operational performance including management, planners, maintenance and operations personnel. RtOI is deployed to reduce expenditure, increase revenue and achieve corporate targets for net revenue.

This paper will describe the technology that supports the Real-time Operations Intelligence (RtOI), business drivers, major components, solution architecture. and benefits gained by implementing RtOI.

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OPERATIONS INTELLIGENCE

Operations Intelligence differs dramatically from Business Intelligence. The later provides market information to support strategic decisions. These products slice and dice transactional data from databases and data warehouses where the information is essentially of a single type [transactions held in a database], is static [not real-time] and the analysis is performed intermittently and on user demand,

Conversely, Operations Intelligence helps support tactical decision making by accessing dynamic data of different types from multiple distributed sources in near real-time. With the solution proposed in this paper the resulting information is pushed dynamically to a wide audience of subscribing users throughout the enterprise enabling them to make decisions that affect the outcome of current events and which has been shown to deliver dramatic improvements to the bottom line. Operations Intelligence seeks to bridge the gap between the technical plant information systems and the business environments providing a single point of access for the current status of the business and helping to deliver true operational excellence.

Today, few plant information systems across [the process] industry have been fully exploited to deliver real bottom line impact. For example:

- Application development is typically seen as an end user activity.
- There is no real change in the engineer's or manager's business process.
- There is very little stewardship of benefits capture… Essentially these are perceived as "soft" benefits.
- The data is consistent but there is inconsistent analysis by multiple end users.

Inconsistent analysis results in inconsistent information which leads to inconsistent decision-making. This is very different from what happens when advanced process control projects are implemented:

- Here the applications are an integral part of the project.
- Benefits are defined and the selected applications are rigorously justified.
- The applications development / implementation plan is clearly defined and the applications lock in and apply best practices in plant control.
- There is a real change in the way technicians work. Could the same approach be applied to plant information systems? Rather than Advanced Process Control this could be considered as Advanced Management Control (AMC), with the object of delivering Operational Excellence.
- AMC, supported by an Operations Intelligence solution would lock in and apply best practices in plant monitoring, asset management and compliance.
- AMC would support a real change in the way plant people work.

A significant difference between APC and AMC is that APC is a closed loop solution while AMC relies on the abilities of the users to react to emerging situations and events (leveraging what is often referred to as the intellectual capital of the business) – see Figure 5 [3]. In the context of Operations Intelligence "Management" refers to anyone in the enterprise including corporate senior management, maintenance engineers, plant operators, planners and traders. Indeed an Operations Intelligence solution provides essential information to support tactical decision making, in [near] real-time and confers

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the greatest benefit when deployed enterprise-wide. On-demand processing only works for a limited number of users owing to the unpredictable loading imposed on the network infrastructure and back-end data sources. Deploying a solution enterprise-wide demands a more robust and controlled architecture and platform technology. The solution described in this paper has been proven with hundreds of users accessing information simultaneously and repeatedly with access periods in the order of a few seconds per view.

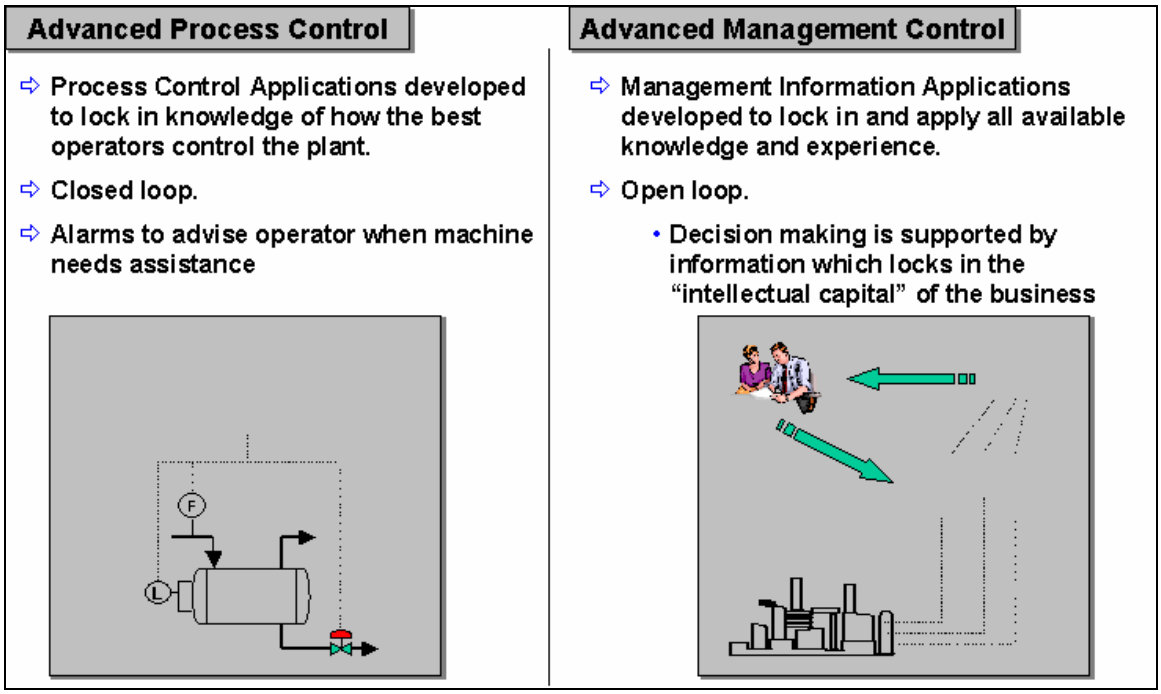

Figure 5 – *Contrasting APC and AMC*

Business Drivers

Ensuring compliance with corporate objectives assumes that targets are established. Setting these corporate objectives frequently involves the determination of key performance metrics (KPI) in order to ensure that the business is on target.

However, simply the setting and reporting of these key metrics is meaningless and certainly insufficient to ensure success unless the means to drill down (to understand the underlying causes of any deviations) and to manipulate control points is available. Furthermore these targets have to be disseminated across the business to ensure that the entire workforce is focused on achieving the corporate objectives so an enterprise-wide capability is essential.

A simple weekly or monthly report is barely adequate for monitoring the progress towards the targets: By the time that deviations are observed the deficiencies are already locked into place and the report merely serves to record the historical facts.

Any key metrics have to be presented in a timeframe that enables the causes to be identified and beneficial action to be effected before the event becomes history: The so

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called “Real-time Enterprise” is required. Inherent in the Real-time Enterprise should be the ability to present information in [near] real-time, to provide the user with intuitive mechanisms for navigating and with the capability to explore (drill-down) for greater detail (Figure 6: KPI hierarchy and control points) [4].

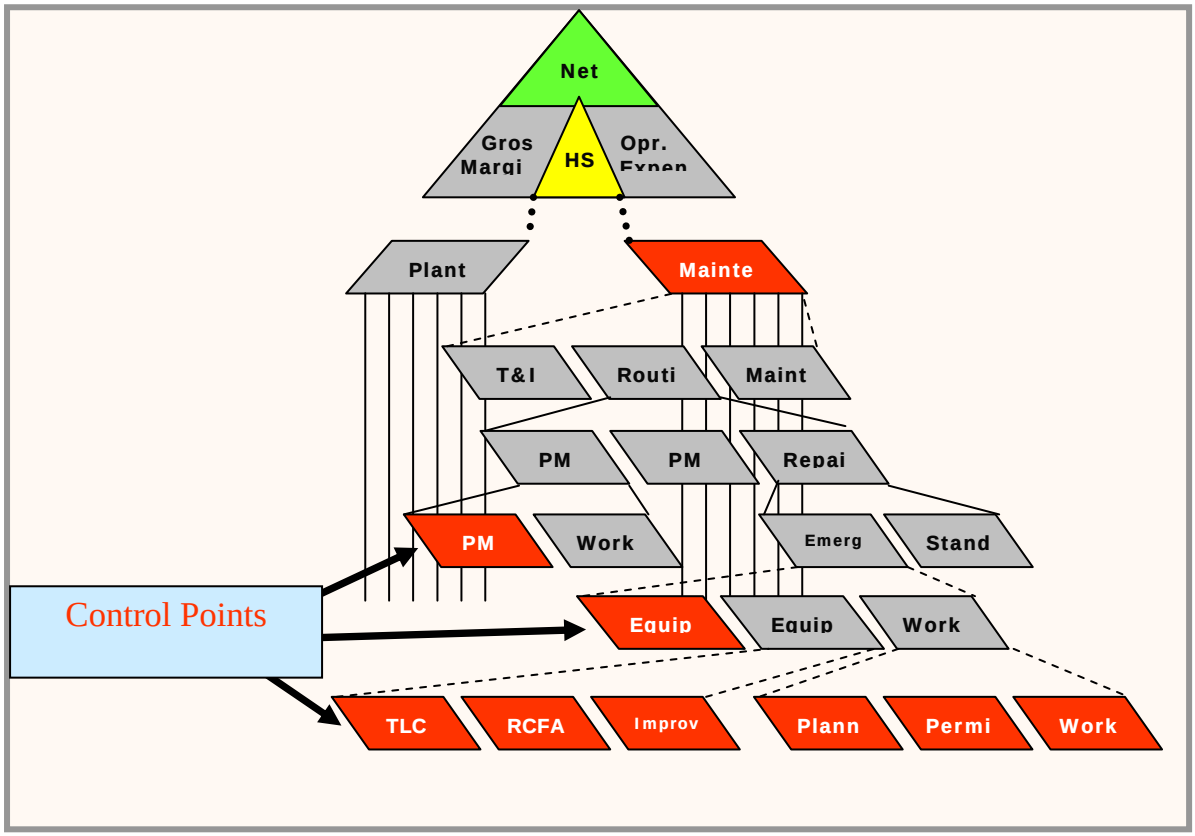

Figure 6 - *KPI hierarchy and control point*

Figure 6, explores the Operating Expenditure hierarchy of key performance metrics and control points. It illustrates the complexity of the business control process that is hidden when an “Opex” report arrives on a manager’s desk. The Real-time Enterprise should provide a mechanism for exploring the reasons for any deviations from plan, drilling down to the “control points” and causing a beneficial change to limit, or eliminate, the cause of the deviation. Disparate sources provide this information. For example, a typical process plant will include, at least, the following:

- A strategic planning application.
- Process modeling application
- Linear planning/optimizing tool (LP)
- Document management system
- Enterprise Resource Planning system (ERP) ERP – handling HR, Finance, Inventory, etc.
- Supervisory Control and Data Acquisition system (SCADA)
- Distributed Control System (DCS)
- Plant historian.

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- Laboratory Information System (LIMS).
- Plant Information System
- Asset/Maintenance management application

Many of these systems handle fundamentally different, and mutually incompatible, data that is distributed throughout the enterprise making the task of integrating and blending information a difficult technical proposition.

In summary the problems faced by the process industry include:

- Disparate data. Process industry data is held in lots of different systems.
- How to scale the solution to accommodate lots of users and multiple sites or plants – essentially, how to deploy the solution enterprise-wide?
- The [near] real-time enterprise: How to deliver data in a timely way so that users can effect a beneficial change to events.
- How to enable the user to explore and discover the cause of problems?
- Rendering KPIs in [near] real-time that truly reflect the current, underlying activity in the business and monitoring progress towards these targets.
- In addition the solution should deliver these capabilities without necessitating the replacement of any existing enterprise applications. It should be source agnostic.

RTOI SOLUTION AND ARCHITECTURE

Enterprise Monitoring (EM) can be thought of as an additional element of the information structure. A visibility layer, geared for operations but not an application itself. EM uses live data from other systems to create an environment for users to perform their jobs more effectively and the transactional systems are left unchanged. EM Solutions are web-centric applications. However, by itself, the Web cannot create or distribute the information securely and efficiently within your enterprise. It does not give you the tools you need to mange information, keep it current, or keep it organized. Furthermore, web servers are not designed to handle processing-intensive business applications on the Internet and they do not have the required features to support such applications.

EM solutions require a business-processing or application server to handle the processing and interfaces requirements - a processing server that delivers the high performance and scalability required to meet future growing demands of an enterprise. EM solutions operate in n-tier architectural environments with four major logical components: business servers, application connectors, web servers, and browsed based clients.

A business user utilizes a web browser to send HTML requests through HTTP protocol to a web server. The web server then forwards these requests to the business server. The business server utilize the application configured connectors to fetch the required data from the external systems, perform any pre-processing requirements on the data before routing the result back to the web server which in turn delivers the result to the user's web browser. The web server component acts as a presentation server or conduit for receiving requests from delivering views and data to web browsers while the business

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servers which are the integral component of the solution handles the majority of the remaining activities.

This solution content is held in components which are easily developed and stored on the application server. Instances of components are assembled into a model that naturally reflect the organizational, physical asset base, process, logical, activity or workflow structures present in the business. Each component manages its associated data and renders this data in any of many possible appropriate views. Views render data as graphics, forms, tables or time-series charts. The model appears as a tree structure with branches and nodes. Data from nodes lower in the tree can be aggregated and presented at any higher node. This feature enables RtOI to easily summarize and present data from multiple data sources. When the data changes in the lower (child) node the aggregated data in the summarizing node is updated to reflect the change.

Data is delivered to the solution components via connectors. Unlike technology simply based on web servers and active server pages, which can generate multiple, asynchronous requests for the same information, RtOI connectors aggregate these multiple requests for data into a single request. The performance of the resulting architecture can be tuned to optimize both the consumption of network bandwidth and the impact on the data sources. Connectors are highly configurable in the way they acquire data. The update frequency and data acquisition mechanism is dictated by the needs of the user community and the capabilities of the backend data source. These connectors plug into a framework making it easy to add (or delete) connections to data sources.

Unlike conventional browser based applications RtOI data is automatically propagated to subscribing users whenever the data change is perceived by the model: The updates require no user intervention and users are supplied with the freshest information.

Also unlike conventional web based applications (for example, portals, html or ASP pages) that present the data from each data source to the user into unique “tiles” of data the RtOI application seamlessly integrates data from disparate data sources and types. This seamless blending of data makes it easier for the user to assimilate information and understand what is occurring than with other solutions. For example a component view could consist of production target data from the ERP system blended with the current production level from the process control system – see Figure 8. In this example the RtOI view would be dynamic, animated and display the current production status.

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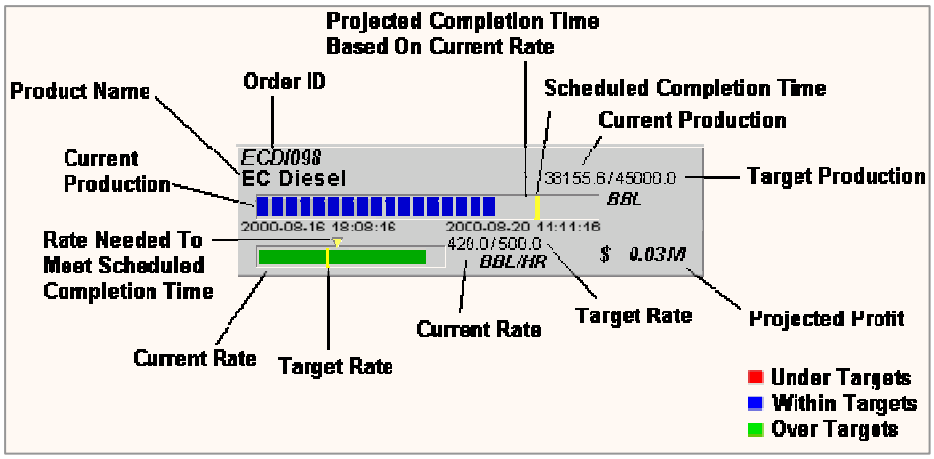

Figure 7 – *Blended View*

BENEFITS

Deploying an Operations Intelligence solution delivers benefits in several key areas. The principle benefits derive from improving the Net Revenue for an enterprise. Benefits can be summarized as follows:

- Enables management and employees to focus on the metrics used to run their enterprise (KPIs)
- Better align employee actions with corporate objectives
- Efficiency and agility in business decision making
- Enhances troubleshooting, communication, and operations training
- Empowers users throughout the enterprise with the information they need to make rapid and informed decisions
- Provides users with a broad understanding of the business optimization opportunities
- Improves overall performance and directly impacts plant profitability

SUMMARY

It is widely recognized that people, not systems, are the best way to deal with problems or exceptions. As a result, decision support, analytical applications, and business intelligence systems are increasingly common additions to augment core transaction software.

Most decision support software helps plan the future, while analytical or business intelligence software analyzes the past. However, this leaves out a critical element in running a business – the present.

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Real-time Operations Intelligence is a new category of software focused on that missing element: decision support for the present. Unlike decision support for the past or future, Real-time Operations Intelligence presents live data, thus addressing the need to respond to operational conditions as they change. Through a web-browser, Real-time Operations Intelligence delivers alerts, alarms, and visual graphics to represent information based on live data from existing systems. To ensure sound decision-making, Real-time Operations Intelligence also allows drill down into supporting data and a view of the context of exceptions.

Responding to changing conditions speaks directly to a companies' need for speed. Making the right decision at the moment an exception occurs or a trend appears can be the difference between outstanding and poor operational performance. Real-time Operations Intelligence provides immediate insight for anyone in the enterprise concerned with any operation.

While most employees will continue to use existing applications as their primary task systems, Real-time Operations Intelligence can and should be added to their primary task systems.

When fully deployed, it has the capability of empowering every employee to make good decisions even as the business demands more complex decisions in shorter times.

Having immediate insight consistently across the enterprise allows for fast, accurate, and coordinated responses that market leaders need.

References

[1] Figure 1 is copied from ARC Web site. http://www.arcweb.com/Consulting/issues/rpm.htm.

[2] Figure 2 is copied from ARC Web site. http://www.arcweb.com/Consulting/issues/rpm.htm

[3] IndX Corporation, "Operations Intelligence and Enterprise Monitoring", IndX web site http://www.indx.com.

[4] Figure 6 is copied from IndX web site. http://www.indx.com.

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