



FACE  
OF BPM

THE NEW

# **Business Activity Monitoring (BAM): The New Face of BPM**

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# CONTENTS

Executive Summary	4
2.0 Bam Basics	4
3.0 Second-generation Bam Strategies	7
4.0 Summary	9
Appendix	10
About The Author	21
About Software AG	21





## EXECUTIVE SUMMARY

Business Activity Monitoring (BAM) broke onto the scene three or four years ago, stimulated by the growing interest in Business Process Management (BPM), which made it possible to understand more clearly the relationship between real-time IT operations and business activities. Global 2000 companies, among others, have achieved significant return on investment (ROI) by using BAM as a real-time, intervention-focused tool for measuring and managing business processes. Using BAM, companies have been able to monitor their business processes, identify failures or exceptions, and address them in real-time. In addition, since BAM tracks process executions and knows when they succeed or fail, it builds up valuable records of behavior that can lead to overall process improvement, while also providing a useful tool to manage compliance, assure business transactions, and reduce risk.

Much of the focus of BAM through this period has been simply on process measurement. This has certainly proved fruitful, but now companies are starting to use their growing level of BAM expertise to target specific business problems, enabling them to deliver greatly increased returns. A range of second-generation strategies have emerged that extend BAM into a much closer participation in the business, generating value way beyond the first-generation process measurement approach. In particular, three new strategic areas have been developed:

- Business Assurance and Visibility
- Control Services
- Complex Pattern Recognition

There follows a high-level review of these new strategies and the associated techniques to implement them, followed by a detailed case study of ABC Co.'s experiences deploying these strategies in practice. But the key point is that compa-

nies across all industries should examine BAM closely, particularly in light of these new developments. BAM can deliver significant benefits and address a wide range of business solutions, and anyone either using or looking to use BAM should consider carefully the strategies and techniques discussed below in order to deliver maximum business value and returns.

## 2.0 BAM BASICS

Before looking at the new, second-generation strategies for using BAM to target business solutions, it is important to ensure a common understanding of what BAM actually is. Often in the IT industry, concepts emerge and are tagged with a definition that subsequently gets stretched and changed by the market as a whole. This can result in confusion when people end up with different understandings of the concept.

Fundamentally, BAM is all about monitoring and measuring business activity across operational systems and business processes. Terminology here can be confusing. To clarify: the business process describes the steps required to fulfill the specified business action, business transactions are actual execution instances of processes, and process events relate to occurrences within the transactions such as a transaction completing a step or an error occurring. BAM is focused on these transactions and events, concentrating on four key attributes:

- Volumes
- Velocities
- Errors
- Special conditions

### Volumes

As business processes execute, BAM tracks volumes – that is, values and counts of different aspects of the process and its associated transac-

tions. The important factor to bear in mind is that these relate to business events, rather than purely technical ones such as might be measured by an IT systems monitor. So, to illustrate, below are some examples of volumes that BAM might measure.

- Number of transactions
- Number of process events
- Transaction revenue
- Process revenue
- Line of business revenue
- Cost
- Margin
- Number of changes in a record
- Number of items consumed
- Number of calls
- Number of tickets closed
- Number of errors
- Number of days to scheduled ship date
- Number of compliance events for audit

The first use most companies make of BAM is to build on these basic measurements. Companies will usually define events related to these items, such as a pre-defined threshold being exceeded, or a statistical abnormality, and then use the BAM tool to generate an alert or take action when the event occurs. Also, companies often want to display the behavior of one or more of these measurements, either in real time or in historical performance records. This provides useful information on business transaction flow throughout the business – indeed, a common image portrayed by many BAM vendors is of a graphical executive dashboard display, where various business measures are tracked and displayed so that management can observe and react to this business performance information.

But some BAM technologies offer much more than this basic level of service. Analytical engines may be supplied by the BAM vendor that enable companies to learn about business activity patterns, forming the basis for improving process

execution and understanding better how different aspects of the business interact. This will be dealt with in the section on second-generation BAM strategies.

## **Velocities**

The other aspect of transactions relating to the general performance of the business is velocity – the time-related aspect of business operations. BAM tracks velocity measurements in a similar fashion to the volumetric ones already discussed, allowing them to be monitored and displayed and enabling events to be set up that have a time-related component. Once again, when an event occurs an alert can be sent and automated actions can be triggered. Examples of these types of velocity measurements might be:

- Process cycle-time
- Cycle-times of individual steps
- Wait-times between events
- Time remaining to completion
- Process throughput
- Life-time of ticket

The combination of these time-related measurements with the value-related ones discussed previously provides all the information needed to understand how the business is performing. The management information system aspect of this information, as already mentioned, is often used as the first sales line for buying BAM solutions.

But, valuable though this is, these time-related measurements in fact provide a far more powerful guide to business performance – instead of just showing what is happening, it becomes possible to start making predictions of what is going to happen in the future. Once time is factored in, analytical BAM tools can use real-time and historical data to detect changes in the operational behavior of the business transactions. For example, BAM can start detecting potential degrada-

tion scenarios - when business transaction execution behavior starts to deviate from the norm BAM may determine a familiar pattern leading up to a failure scenario where service-level agreements (SLAs) will not be met. Now BAM can raise an alert or take action to ensure the situation is addressed before service is impacted. And by measuring this SLA-ed process, the proof of and reporting of SLA compliance is automated.

Also, the addition of the time aspect makes it easier to identify and resolve process problems, ensuring that processes can be continually improved in terms of efficiency and performance. These problems may be due to a problem with an individual process structure, or perhaps with system bottlenecks created by the way the different processes and their related business transactions interact. These time-related statistical and analytical techniques form the cornerstone of second-generation BAM strategies.

## Errors

So, considering the value and time-related attributes of business transactions provides vital information about the overall operational health of the business systems. This is fine when everything is working reliably, but even in the best systems there will always be problems. These may be due to flaws in the processes, external problems such as hardware or software issues, or perhaps human errors. BAM tracks errors too, making it possible to identify where the problems are so they can be fixed. Counting and measuring errors statistically helps to improve understanding of the errors themselves, their frequencies, and any associated trends.

But once again, second-generation BAM strategies can go further than this. Because BAM un-

derstands the business process and its transactions end-to-end, it is ideally placed to understand process errors at the transaction level. These might include such occurrences as transactions executing out of sequence, duplicate transactions, and time-outs of steps or entire processes. Not only is this information valuable to improving business and process effectiveness, but it is also critical when it comes to the whole area of compliance. One of the key principles of compliance monitoring is that transactions have to be shown to be adhering to the required processes, procedures, and controls, and to be error-free. BAM ensures that any deviation from these requirements is reported and logged, so that it can be reviewed and the appropriate action can be taken.

Of course, process errors do not make up the whole story. They are certainly important, but business errors are just as important, if not more so. For example, in a situation where an item has been priced wrongly, the business process may function perfectly but the end result is still a problem for the business. In these situations, where there may be no obvious pointer to the source of the problem, BAM comes into its own. Because it understands the business activity in terms of both process AND content, it can identify this type of situation, report it, and flag it for resolution.

## Special Conditions

The final aspect of BAM measurement relates to special conditions. These are conditions that are defined by the user. Although not specifically errors, they represent events that are relevant from a user perspective to the execution of business transactions. As with all the other measurements, BAM will track these special conditions and provide statistical and analytical

information about them, raising alerts or taking actions when specified conditions are met. For example, a company might want to be alerted to any orders beyond a certain size or the presence of non-standard shipping instructions.

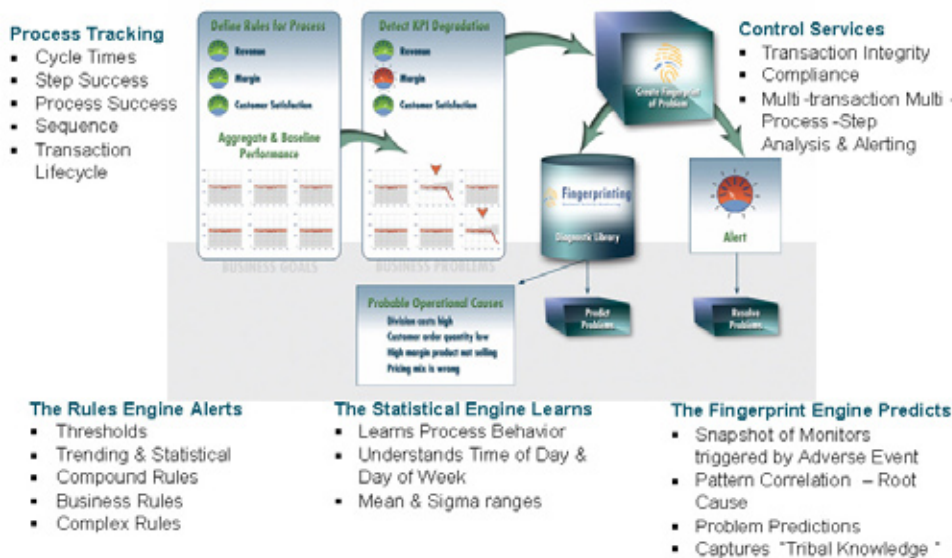
This special conditions category represents the key to developing comprehensive key performance indicator (KPI) based measurements, allowing the user to combine the volume, velocity, and error measurements with business-specific knowledge and understanding. Key process owners can decide what events they need to know about or monitor for maximum business benefit, which in turn provides a greater level of visibility into the functions of the business and a corresponding opportunity for productivity-based return on investment. In actual BAM implementations, use of special conditions measurement and tracking has produced productivity improvements of more than 40%, allowing key staff to be deployed to higher-value activities such as trending, looking at KPI patterns, and transaction profiling.

## Basic BAM Summary

BAM vendors differ in what they offer. Some carry out the necessary measuring and monitoring activities but do not extend beyond this primitive level of functionality. Others offer varying degrees of sophistication in the analytical engines that study, learn, and predict based on the information feeds.

The diagram on the next page summarizes the types of services and engines offered by a reasonably complete BAM solution.

One important point to bear in mind is that this diagram focuses purely on the BAM components. In fact, BAM effectiveness is dependent on having the right infrastructure in place to support



**Figure 1. Business Activity Monitoring Engines**

the BAM activities, such as EAI (Enterprise Application Integration) functionality to enable components and information to be integrated across the enterprise and beyond, and BPM (Business Process Management) support to provide a process-oriented view of IT assets. BAM provides the maximum business impact and benefit in working hand-in-hand with this infrastructure to achieve its aims.

### 3.0 SECOND-GENERATION BAM STRATEGIES

Having set the scene for BAM, we now focus on the latest development within the BAM space and the strategies leading companies are now adopting to substantially increase business returns from BAM usage. There are three strategies considered in this paper:

- Business Assurance and Visibility
- Control Services
- Complex Pattern Recognition

These will be dealt with in turn, with special attention being given to the techniques used to

address these strategies.

#### Business Assurance and Visibility

This strategy is really an extension of basic BAM usage. Some level of business assurance and visibility would be delivered through basic techniques, but this can be greatly increased using a combination of new techniques. Business Assurance and Visibility will be considered in two parts: Service-Level Agreement (SLA) assurance and Defect Detection.

##### SLA Assurance

SLA assurance needs to operate at the level of the business processes, the associated transactions, and even the business as a whole. In essence, SLA Assurance is all about ensuring that your core business is executing defect-free and within required criteria. Many companies have tried to do this in the past by focusing on point monitoring schemes that attempt to provide the required information, only to experience service failure or degradation even when everything is apparently operating in the green. Having

99.999% availability may be very laudable, but if a service is working incorrectly then this high availability measurement is not much help.

The key point in this particular area of BAM strategies is that whereas IT monitors and management mechanisms work with applications, files, networks, and other IT resources, BAM works with business processes, transactions, and services. This is of immense value when trying to understand whether business execution is achieving its goals. A critical business process might span a range of applications, running across multiple systems and databases. Without a process-knowledgeable view such as BAM gives, it would be necessary to understand the availability and performance characteristics of all these applications and their resources to try to assess whether the process is executing within desired limits. But BAM understands process and transaction-related attributes such as the process cycle-time and revenue contribution. With BAM, therefore, it is a simple matter to understand key performance factors at the business rather than the IT level.

The first thing for the BAM tool to do is to examine the various volumes and velocities of the process and its associated transactions, to gain a clear picture of its end-to-end execution in order to form a baseline representing normal operations. Once this is done, the BAM analysis component can start to understand historical behavior and trends related to this baseline and can watch for abnormal situations occurring in process execution and report on them. This can be particularly valuable in situations where there is no apparent failure in the normal sense of the word. For instance, the systems are all showing as running properly, no errors are being flagged, but a particular process has drifted outside of specification in terms of its business goals. This type of occurrence would be invisible to system-based IT tools, but BAM would spot this right away.



The other area in SLA assurance where BAM offers significant value is in change management. Because BAM operates at the business level, it is ideally placed to detect changes in process and transaction execution due to new changes. This makes it a valuable tool in assessing change impact on business operations, giving the opportunity for corrective action to be taken in a timely fashion.

### Defect Detection

The other key area within the business assurance and visibility BAM strategy is defect detection. This has already been touched upon in the analysis of SLA assurance, and it covers the ability of BAM to use its knowledge of business processes, transactions, and related metrics to identify error situations and defects. Again, it is important to understand that 'defect' is used here in the context of a business process or transaction as opposed to IT resource or application, and therefore a defect may occur even when systems operations appear normal.

One of the main techniques for defect detection is statistical profiling. Basically, the metrics that BAM gathers are assessed using historical data to understand what is "normal". Statistical measurements combined with historical records yield important measures such as mean and standard deviation values. It is now possible for the BAM tool to identify transactions that are moving outside of statistically normal operations and flag these transactions accordingly. In fact, there may be no defect in this situation – for example, an abnormally high value of sale might be due to a mistake in pricing, clearly an error, or perhaps to a more effective salesperson. But the important thing is that BAM will draw attention to the abnormality so appropriate action can be taken.

While statistical profiling may be at the business process level, maximum benefits are achieved when it is done at the transactional level. Both process and transactional profiling provide valuable information for the determination of the most relevant key performance indicators (KPIs). The transaction profile can be automatically matched against a range of 'profiles of interest' to determine whether it is some form of exception. The exception might be the potential infringement of corporate policy such as compliance, or a pointer to problems with the definition of a particular process or set of processes. BAM identifies the transaction and alerts the relevant people, avoiding the need for key staff to have to spend large amounts of time trawling through transaction logs and other online and historical data. This can be a real time-saver in the identification and resolution of potential impacts to the business.

Finally, since BAM collects data on all sorts of transaction-related attributes, it becomes the ideal source of information to use when trying to build higher quality operations. Various quality initiatives such as Six Sigma work on the principle of continuous improvement, but in order to achieve this it is necessary to have accurate and relevant statistical information with which to operate. In addition, in order to ensure that new changes such as process modifications do indeed improve quality, it is necessary to be able to carefully measure performance after the change and compare it to the before picture. BAM makes it possible to do this at the business process and transaction levels, providing a means for companies to strive for the highest quality processes. In addition, BAM enables transaction profiling based on the content of the transactions, another important means of detecting defects.

### Control Services

Control services provide the ability to manage business operations through the use of business policies and controls. The key differentiator here is that whereas other aspects of BAM usage have tended to focus on the process and its transaction from an internal perspective, control services bring these metrics together with other external inputs such as policies. BAM tools offering control services will generally offer some sort of discrete service where controls can be defined and then applied to the operational system.

As an example, consider a 'procure-to-pay' process. A payment authorization is requested for a specified amount, approved, and then paid. The process has executed effectively as far as basic BAM monitoring is concerned. But supposing a control has been defined that stipulates that the approver cannot be the same as the requestor, in order to preserve segregation of duties. BAM understands the metrics of the transaction, including the name of the requestor and the name of the approver, so when it consults its controls list it will be able to identify this transaction as an exception and flag it to the compliance officer for further investigation. Once again, a common theme emerges around these BAM strategies – the aim is to automatically flag situations that match predefined profiles, to avoid the need for staff to spend a lot of time searching and evaluating transaction records.

In fact, this area of compliance is one where control services are especially relevant. As an illustration of this point, possible control services for compliance might include transaction integrity, terms compliance, and multi-process step compliance.



But this control-based mechanism can do more than simply flag occurrences for future action and save staff time. It can be extended to provide additional business value, by addressing, for example, the area of deadline management. Deadline management is important across a wide range of businesses, although the scale of deadlines is likely to vary substantially, such as between manufacturing and financial services. However, BAM can help not only to understand whether deadlines are being achieved and when they are not met, but also to meet deadlines where possible. Since BAM understands such metrics as the time taken by particular process steps, and the overall deadline for the process, it can determine at each step how much time is left to the deadline. In some processes, alerting the relevant people to the danger of the deadline being missed allows action to be taken, such as prioritization activities, to ensure the deadline is met. Even if this is not possible, the recording of times taken by different process steps might provide the necessary input to identify weaknesses in the process and to streamline it to preserve deadlines in the future.

Also, control services provide yet another dimension to handling change management. Changes in an order might be relatively uneventful early in the cycle, but could cause major issues later. Because BAM understands the transaction metrics and can map the impact of the change against historical records, when this information is brought together with the controls the business has put in place it becomes possible to identify when a particular control is in danger of being transgressed, once again allowing corrective action to be taken in a timely manner.

### **Complex Pattern Recognition**

Because business can be complex, there are

times when a combination of circumstances may contribute to a particular business impact. A company may define KPIs that allow the company efficiency, effectiveness, and compliance to be assessed, but the signatures of some problems may involve a set of changes in a range of measures. Some processes might slow down, some values might start trending upwards while others are moving down and there might be sudden spikes in volumes. What complex pattern recognition is all about is getting the BAM engine to help to identify these situations so that corrective action can be taken quickly.

By definition, complex patterns are almost always beyond the scope of an individual process or transaction. So the BAM approach to providing support for complex pattern recognition is to have a 'snapshot' type of facility that can be executed whenever a particular condition is triggered. So, for example, if there is a sudden surge in help-desk calls, this may indicate major problems in some part of the business operation or perhaps some sudden competitive action that has destabilized the company's market. Therefore, the user can specify that if this occurs a snapshot should be taken of BAM information across the entire field of operations. This snapshot may also be across the range of a specific process execution too – not at a common time but based on a common process. BAM now records this information as a snapshot that identifies the particular set of circumstances.

Now, as BAM builds up its historical information, it becomes possible for BAM to watch for a similar combination of metrics across business operations and raise an alert. As it gathers more experience and intelligence, the BAM tool can start to refine its predictive capabilities to give more and more warning.

## **4.0 SUMMARY**

BAM is proving to be an extremely useful tool for many companies as they strive to get a better understanding of business performance and how to improve it. First-generation BAM usage was generally targeted at understanding business flow through the IT systems, by counting processes, transactions, and events and displaying that information either through an executive dashboard or in historical reports. But as BAM experience has grown, the focus has swung much more to moving from this relatively static view of the business to a much more dynamic, high-value one where business process interactions and trends are examined much more closely. The high level of statistical and analytical intelligence now delivered with the best BAM solutions provides the ability to understand much more accurately the business dynamics and therefore bring a tighter focus on addressing real business issues.

Second-level BAM strategies focused on Business Assurance and Visibility, Control Services, and Complex Pattern Recognition blend the core strengths of BAM with these powerful analysis capabilities to provide an effective approach for targeting business problems in areas like compliance, change management, quality improvement, and operational business health, delivering more business value and reducing risk.

For companies looking to realize the benefits promised by these new approaches to business effectiveness, the first step must be to ensure that its selected BAM technology has the functionality to support these initiatives. Then it is a question of deciding which strategies and techniques will offer the best returns for the company concerned, and getting started. The Appendix looks at some specific examples of these second generation strategies at work, based on ABC Co.'s experiences with the webMethods BAM solution.

## APPENDIX

### Case Study: Outsourced Manufacturing And Logistics

The following case study information was based on the experiences of a high-tech manufacturing customer (ABC Co.) as they adopted the second-level strategies discussed previously.

Confronted with supply chain complexity and global competition, ABC Co. realized that it could not do business in conventional ways; instead, ABC Co. chose to implement a new way of conducting business with its supply chain partners. Specifically, the company recognized a significant need to reduce transaction costs, greatly eliminate process and other order errors, speed the reconciliation of accounts, and generally improve its collaboration with third-party partners by enhancing the credibility of the data that it provides them.

Taking advantage of the emerging Rosetta Net standard for hi-tech manufacturing, ABC Co. was able to more easily integrate and synchronize third-party providers with its manufacturing and distribution requirements. As a result, orders can be placed with the most advantageous manufacturer or assembler with the final product shipped directly to the customer. In this manufacture-to-ship strategy, products never cross the threshold of an ABC Co. distribution facility, allowing the company to fully benefit from the cost-savings, time-to-market, and greater adaptability offered by these third-party resources.

While delivering a more direct route to market, this solution strategy has its own challenges. Specifically, ABC Co.'s dependence on third-party fulfillment made it potentially more difficult to meet on-time delivery commitments and to maintain service-process-and -business assurance, while this approach also reduced the work-in-progress visibility and control over

transactions, which is a common challenge inherent in all outsourcing relationships. To resolve these challenges, ABC Co. implemented webMethods' BAM technology across the integration infrastructure that it already deployed using webMethods technology.

Using BAM, ABC Co. is able to measure the lifecycle of every transaction occurring across the partner-service-boundary. Through this approach, they can automatically correlate ABC Co.'s processes and business requirements with the activities of their third-party partners, such as process events, work-in-progress statuses, management of deadlines, holds, and changes, in order to assure on-time, error-free delivery. The combination of BAM and Rosetta Net yields manufacturing, fulfillment and logistic flexibility, while providing visibility and control of the transaction's lifecycle. In the succeeding section we will illustrate many of the second-generation BAM techniques using specific business requirements.

#### SLA Assurance across Systems, Processes, and Business

The Business Challenge

Assuring that your core business is executing defect-free and as per your goals...

The ABC co. Challenge:

- Is my supporting infrastructure up and transacting?
- Has the manufacturing partner acknowledged the order?
- Has the manufacturing partner committed to a Ship Date?
- Has Manufacturing started on-time?
- Has the order shipped on-time?
- Did all the requested changes occur?
- Did this order meet our On-Time Delivery Goal and KPI?
- If not, why not?

The conduct of business is often carried out upon an infrastructure and ecosystem of complexity spanning multiple systems, requiring actions by partners and human actors, and proceeding with virtual invisibility to those process owners and actors who depend on the successful lifecycle of these transactions. Business failures are often caused by issues arising within this complex environment and are left undiscovered until it is too late for business-saving intervention, leaving process owners and actors powerless to assure the success of their business.

Service-level agreements (SLAs) and commitments are made to address these requirements. Unfortunately, the red light-green light approach typically used to measure application availability seldom goes far enough as 99.999% up-time – as impressive as it is – does not ensure that the business process or transaction itself was successfully and appropriately executed. For example, we often still need to know whether a partner met his commitments. Did I meet my commitments? What do I do with the syndrome "Everything is up, but where is my order?"

The customer has requested a change, where is my order, and can we accept the change?

An infrastructure change has been made, what are the impacts? Is everything still working? Where are the bottlenecks? Did I improve my process or worsen it?

Exposing system, process, and business events within a high-value process, and key supporting sub-processes, provides opportunities to measure the lifecycle of a transaction, while providing data and events to trigger and populate controls, as well as time-based data for on-time measurement. By measuring the process with BAM, key process behaviors can be statistically learned and understood.

Through the use of BAM, the normal flow of the process can be identified and learned with transaction-level attributes, such as transaction cycle-times, or transaction volumes, or attributes contained within the transaction, automatically compared with historical means and standard deviations. Accurate evaluation of normal vs. abnormal can be performed in real time, and alerting actions and routing can be performed. Process and business events that should occur, but don't, order acknowledgements that are late, or fail to book into your ERP, are all events that put profitability and customer satisfaction at risk.

Understanding what is normal is the first step to understanding that something is wrong. The measurement of the process provides fact-based proof of process performance for business stakeholders because it assures these audiences that the business processes and their underlying infrastructures are transacting as designed. These KPIs can be dimensioned to reveal performance-based attributes specific to industries, customers, types of transactions, etc. Service and Process Assurance measurements greatly simplify SLA reporting for services in that they report specifically on the execution-health of a service. Instead of having to monitor every device and system in the process-supporting network and application infrastructure individually, and then constructing service maps out of these 'red light-green light' measurements to prove service up-time SLA compliance, measure the success of the service. A process assurance measurement of the service's transaction lifecycle demonstrates much more than the fact that your IT devices are up because it proves that your business was actually running as specified with transactions being processed in accordance with your commitments.

Further simplifying the application of SLA mea-

surements is achieved by combining velocity and process success monitors with error monitors (red light-green light) as this provides definitive SLA performance assurance as a fact-based finding, measurable down to the individual transaction level. These performance and SLA compliance KPIs can be aggregated, dimensioned, and fed to dashboards and portals for consumption by business users.

Measurement of the process lifecycle also supports assurance during change. Modifications to the underlying application infrastructure can impact the performance of the process. Adverse impacts can be detected in real time, providing the best opportunity for remediation prior to its impact on the concerned customers. Leading organizations like ABC Co. have defined, BAM-based assurance strategies as best practices during changes in their application services infrastructures. They have found many situations where upgrades, new application installs, and system modifications have caused the processes to stop transacting, despite the fact that all system diagnostic information indicates that all systems are healthy.

With BAM, you can immediately see the impact that any service change incurs. Often, by knowing the transaction characteristics and statuses as reported through BAM, a problem is identified and resolved significantly faster than is typically achieved using proprietary tools that fail to measure process – as oppose to application – performance.

This is important, as most critical processes cross multiple applications, business units, and even span entire businesses and trading partner networks. In the following case study, process assurance will be discussed in the context of critical business requirements for assurance that processes are running.

In the example, ABC Co. was able to realize system, process, and business assurance through the use of BAM for monitoring a series of processes. These monitors are used to correlate traffic across the partner boundary, measure sequence, cycle-time, success and failure, transaction by transaction in real time.

By subscribing to the Rosetta Net PiP-messages as they crossed the partner boundary, the processes supporting the order-manufacture-ship process can be measured and assured. In the example in Figures 5 and 6, this process measurement provides opportunity to measure and assure order acknowledgement, shipping commitments, and starts the on-time assurance 'clock' ticking toward key process way-points like release to the manufacturing floor, completion of manufacturing, and advance ship notification (ASN).



**Figure 5. Order Initiation Process Monitors, Controls and Associated Data Monitoring Order Acknowledgement Status**

## Defect Detection

### Statistical Profiling

The Business Challenge:  
Is this normal?

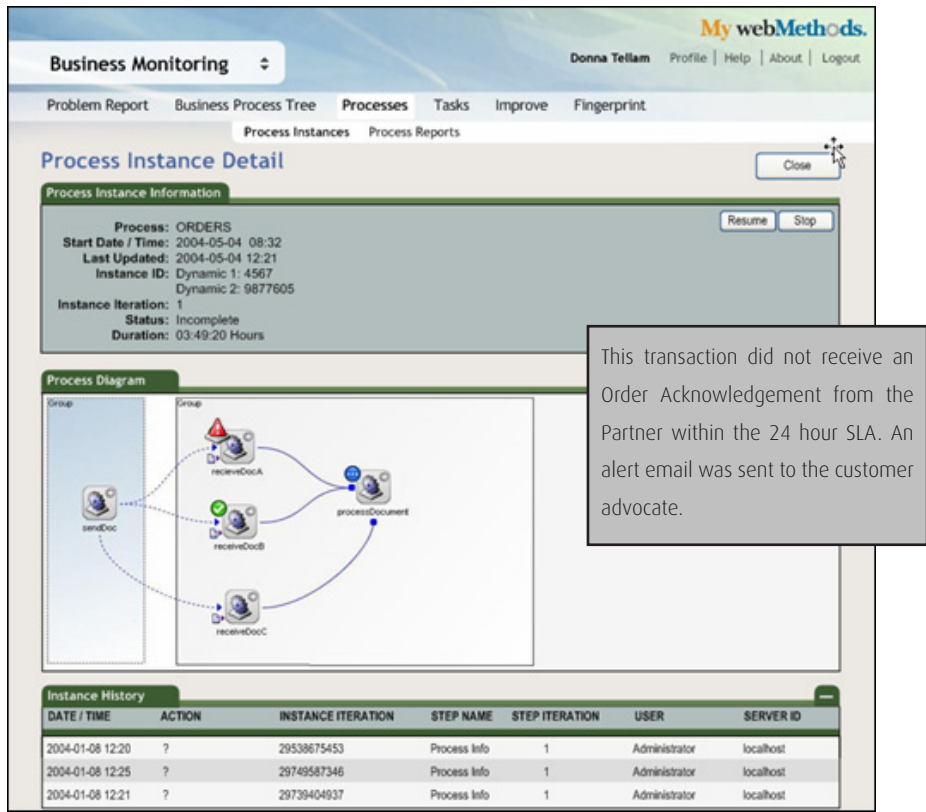
The ABC Co. Challenge:

- How do I detect defective or mispriced orders?
- Are my manufacturing partners reversing orders too often? Delaying delivery?
- Are defects trending up, receiving more returns?
- How close to the deadline is my partner starting manufacturing?
- Is that why my shipments have been late?
- What step is causing delays?
- Am I getting an abnormal number of returns? From a specific partner?

What is normal? Is there a trend I should be aware of? Is this statistical outlier an error? Should I pay special attention to this high-value order? What does this data mean? Is this happening all of the time? Normally I have orders by this time, what is going on?

All of these questions represent a need to understand business process behavior. Behavior that is only decipherable if business behavior is measured.

The key concept behind statistical profiling is the transformation of data into information and information into knowledge so that this data – now recognized as knowledge – can be acted upon in a timely and informed manner. This is achieved by comparing a piece of data with the statistical history, including mean and standard deviation, so that it can be understood in its historical context and thus turned into information. It is the context that provides reference as to what is normal, through comparison with previous behavior.



**Figure 6. Order Initiation Process Tracking, Order, to Order Acknowledgement process events**

For example, a transaction that has revenue that is three standard deviations above normal often deserves special attention from multiple perspectives. If this order truly represents a customer buying significantly more product than is normal, it may indicate a rise in demand. By examining the factors that contributed to this change, such as a new account manager, you can more quickly and profitably replicate these changes elsewhere.

However, the statistical outlier might also represent a process defect – for example, is this order priced correctly? Can I even fulfill this order, which is beyond normal for my regular supply chain? Regardless of what question is being asked, a statistically abnormal transaction – even a positive one – often deserves immediate

attention.

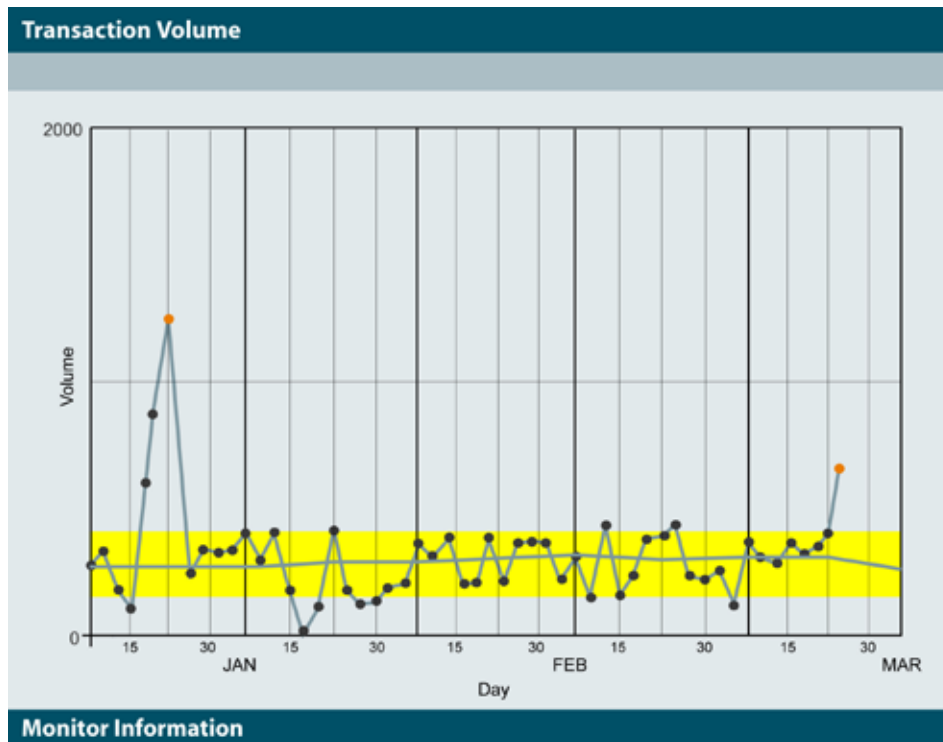
All statistically abnormal transactions should be reviewed by process owners and actors. This review should be for defects, as well as enhanced customer focus.

Having timely information, i.e. data that is presented in context, enables knowledge to be applied.

The choice of which aspects of transactions should be measured and statistically learned should be driven by the process owners and actors. Basic aspects like process cycle-times, transaction volumes, and error-counts are already measured by default by BAM. Best practices have highlighted the benefits of measuring basic business characteristics like revenue,

unit price, on-time performance, number of changes, or the number of defects, but the process owners and actors will know what KPIs are critical and measure success of their processes. A fundamental principle is that more is better. The more characteristics, for which normality is understood, can be expressed and measured, the better a process is understood and the better a process can be managed. A measured attribute that has a large standard deviation may indicate that the events that contribute to that attribute may be poorly behaved. For example, if a process step has wildly varying cycle-times, the process may need improvement. In a semi-manual process, on-time success variation may indicate an uneven skill set within the work group and that additional training in a certain set of skills is needed as a corrective action.

In the ABC Co. case study, KPIs that were selected for statistical measurement covered all aspects of relating to the timeliness of process events, all revenue and pricing aspects, returns, and other ‘order-type’ dimensions, as well as all KPIs that represent partner-performance service level metrics and commitments.



**Figure 7. Statistically outlying transactions may represent errors**

## Transaction Profiling

The Business Challenge:

What timely information do the process owners and actors require? How can productivity of key knowledge workers be improved?

The ABC Co. Challenge:

- How does my transportation department find out about special shipping instructions? Geographically-Specific INCO Terms?
- How do we automate the Advance Ship Notification process?
- How do I find out if a specific order-type has been placed?
- How do I detect large orders so that I can plan fulfillment?

With manufacturing outsourced to a partner, aspects and events that were readily available to

ABC Co. process actors are now embedded within partner systems to which ABC Co. has no direct access. Should ABC Co.'s ERP be modified to provide this information, unique for each partner, or can an external service provide this information, thus shielding the ERP and the end users from this often changing diversity? The answer to this problem is yes. By using transaction profiling at the process level, events like Advance Ship Notifications, Special Shipping Instructions, can be externally detected and process actors alerted. Often, these manufacturing and logistics events are reported at a more granular level than the ERP is capable of tracking. For example, orders are tracked by the PO Number and Line Number in ABC Co.'s ERP, but the manufacturing activity itself is tracked at a Discrete Job (DJ) level unique to each partner. Transaction profiles provide an external mechanism, automating alerts for required actions.

Many issues of importance for business or compliance are rooted in the content of transactions. Introspection of transactions against profiles that fit characteristics of interest can be monitored and measured using BAM and components of webMethods BPMS. Transactions can be flagged for review and action based on transaction content. For example, in the context of the Patriot Act in the US, importation and exportation activities require additional manifesting and documentation. Transaction profiles can be built that flag transactions that need special handling, triggering the supporting sub-processes that are required and reporting and measuring that these requirements were complied with.

Transaction profiling also provides the source data for the dimensioning of KPIs. For instance, if a revenue KPI is dimensioned by customer, the transaction profile will report the customer name and revenue amount to the KPI monitors. If a known error is detectable by specific combinations of transaction field content, profiles can detect and flag these transactions, with counts and other characteristics captured and measured.

During webMethods' experience of assessing business processes and their execution, a frequently observed activity, during time-and-motion studies, is 'ERP surfing' where valuable and knowledgeable process actors spend significant parts of their work day perusing applications and transaction logs looking for specific types of transactions that need special handling.

As a result, this valuable knowledge worker may spend more than half the day hunting for a needle in a haystack, finding just one or two transactions that require intervention. Examples of special conditions include the search for large orders. Large orders represent value and risk, may require manual fulfillment within a distri-

bution center, or prompt special care and handling. Detecting a large order may prompt additional relationship-building contacts to the customer, thanking them for their business. In reviewing process histories with process and business owners, a useful technique in the Assessment phase of webMethods' BAM Methodology<sup>5</sup> is to ask what were the top-ten bad things that happened over the past year in this process. Many aspects and opportunities for transaction profiles develop out of these discussions as adverse events and their causes are discussed and translated into business monitoring strategies and transaction profiles. The goal of this is, "If a bad thing has happened, let's detect it and make sure that it never happens again!"

Profiled transactions and events within the process can trigger the execution of controls, where risks for specific signatures of fraud can be executed in real time. Exposing these events makes the attributes of that event available for consumption by multiple process-focused systems, including data-warehousing, dashboarding, or for automation of audit workflows.

In the ABC Co. case, specific transaction profiles were implemented for the detection of Special Shipping Instructions, Geographically-Specific INCO Terms, and Advance Ship Notifications for the ABC Co. Transportation Group. Sister profiles on the Order Change process also alerted on changes to these fields of Transportation Group interest, as well as other changes that would impact the manifesting of orders.

### **Process Improvement (Six Sigma Error Tracking)**

Business process improvement is a science based upon the acquisition and validation of facts surrounding the lifecycle of transactions.

One of the most proven methodologies for process improvement is Six Sigma, which strives to achieve a negligible number of defects, i.e. a process must not produce more than 3.4 defects per million opportunities to produce such defects (where a 'defect' is defined as any kind of unacceptable outcome produced by the process under scrutiny).

The power of Six Sigma lies in its 'empirical,' data-driven approach (and its focus on using quantitative measures of how the system is performing) to achieve the goal of the process improvement and variation reduction. That is done through the application of a Six Sigma improvement methodology which follows the Six Sigma DMAIC sequence of steps (Define, Measure, Analyze, Improve, and Control).

- Define - The Define phase is concerned with the definition of project goals and boundaries and the identification of issues that need to be addressed to achieve the higher (better) sigma level.
- Measure - The goal of the Measure phase of the Six Sigma strategy is to gather information about the current situation, to obtain baseline data on current process performance, and to identify problem areas.
- Analyze - The goal of the Analyze phase of the Six Sigma quality effort is to identify the root cause(s) of quality problems and to confirm those causes using the appropriate data analysis tools.
- Improve - The goal of the Improve phase is to implement solutions that address the problems (root causes) identified during the previous (Analyze) phase.
- Control - The goal of the Control phase is to evaluate and monitor the results of the previous phase (Improve).

BAM automates the collection of event and de-

fect data for the DMAIC process. BAM provides correlation as to the most frequently occurring defect, time of day, and day of week profiling, and also provides validation of improvements.

Care must be taken when mixing Six Sigma-focused monitors with business monitors. In many cases business monitors trigger on events that do not represent defects, skewing data. With webMethods BAM 6.5, monitors and rules can be grouped, aggregated, and displayed in a role-based manner, allowing for multi-purpose implementations. Following DMAIC, contributing monitors and rules are defined, and assigned a Six-Sigma role for measurement.

For the Analyze and Improve phases, BAM monitors provide history and measurement of trends. When analysis points to a change for improvement, BAM provides the baseline for comparison of the new state. BAM's contribution to controlling processes will be discussed in the next Chapter.





Figure 8. Manufacture to Ship Process, Monitors, Controls, and Associated Data

## Control Services

The Business Challenge:

Am I in compliance? Are employees bypassing authorities? Has the required process event occurred on time? Do I have a three-way match? Is this change a problem?

The ABC Co. Challenge:

- Is this order change too late?
- Has the partner started to manufacture the order in time to meet the ship date?
- Have my credit and other hold processes released in time to meet the ship date?
- Is it too late to make this order change?

*"Internal controls monitoring confirms adherence to policy, either in real time or near-real time, and directs remediation of material gaps in control."*

- John Hagerty, analyst and vice president at AMR Research

*"Companies that consistently demonstrate good governance are, on average, valued 20% higher than other equivalent companies."*

- Deloitte CEO/CFO Symposium, Vancouver, 2005

Responding to a process event triggered through measurements of strategic or financial processes, or supporting processes, webMethods Control Services provides an agile platform for the rapid and flexible applications of controls. The basic concept behind Control Services is to measure, compare, or evaluate a transaction's attribute with respect to attributes external to the transaction or process and report the results to a BAM monitor.

Many adverse event-signatures are only detectable when real-time transaction data is compared against other data sources. For example, to detect a separation of duties violation in a 'procure-to-pay' process requires comparison of the approver to the requester in order to determine compliance. Control Services has as its strategy the use of EAI (Enterprise Application Integration) capabilities to allow the real-time comparison of transaction characteristics against data that is held from the process, from multiple

transactions, from tables holding authorities, terms, reference information, or other control-type content. Examples of Control Services for Compliance would include:

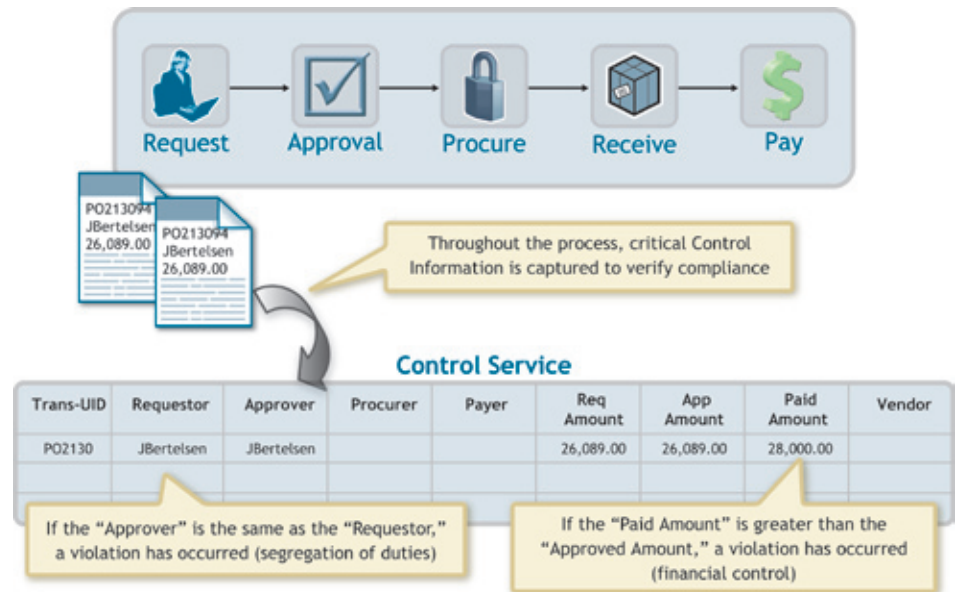
- Transaction Integrity, e.g. approved amounts compared to paid amounts?
- Terms Compliance
- Authorities Compliance
- Multi-transaction, measurements against deliberate bypassing of authorities
- Multi-Process-Step Compliance, e.g. SOD Violations
- Deadline Management
- Fraud-Pattern Detection
- Three-Way Matches

An example of a Fraud Control to detect an inappropriately filed or fraudulent tax return is illustrated by a control designed to catch the fraudulent misdirection of a return to a bank account through manipulation of financial institutions in the Tax registry:

The Triggering Events are defined within the flow of the Tax Return Process. This trigger could be for every transaction, triggered when a transaction enters a certain process step, or be triggered based on thresholds, statistical abnormality, attributes, or even from a previously executed, separate control.

The Control would retrieve, from the appropriate source, the date of the last changes to the Taxpayer Business Registry for the fields Financial Institute and Tax Agent within the refund-requesting business's profile. If these event-date-time-stamps are within a configurable period (e.g. 7 days), it would then publish a Control Event and spawn appropriate follow-on activities.

Another key concept behind Control Services is the ability to layer, or super-position, controls as a strategy. This capability allows for the rela-



**Figure 9. An Example Set of Control Services for a Procure-to-Pay process**

tively simple expression of a control, while allowing for complex control profiles to be constructed. Central to the goals of agility and flexibility, the ability to incrementally reduce the pool of transactions being evaluated, through the super-position of relatively simple controls, allows for fact-based reduction of false-positive transactions being flagged for manual review.

Constructing Control Profiles though assembling relatively simple and rapidly executable controls becomes the executable strategy for responding to newly perceived threats. These profiles can be used to branch and orchestrate the process or can be run in parallel to the process. A Control Profile approach also allows for the construction of a scorecard, where the response to a set of controls can yield weights for the evaluation of risk, and source for event reporting.

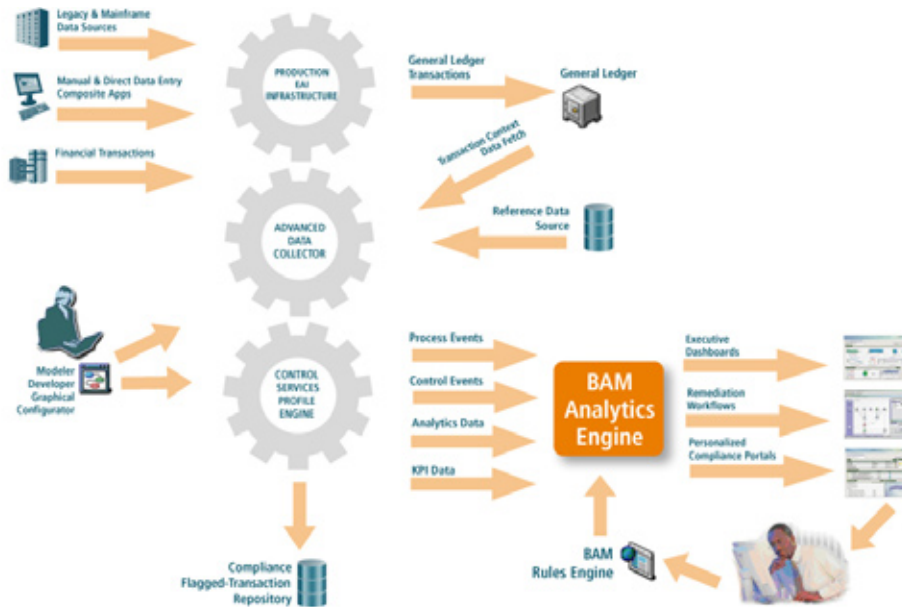
Two examples of Control Services Solutions will be illustrated as follows in Deadline Management, and Status-Sensitive Change Management Solutions from the ABC Co. Case Study.

Deadline Management Techniques

When ABC Co. outsourced manufacturing to a partner, ABC Co. became dependant upon the on-time performance of the partner for fulfilling its primary goal of on-time delivery. On-time performance in a manufacturing process can only be managed and improved by measuring and understanding where time is being consumed and if key process starts begin on time. In other business scenarios, as in a bank loan process, the goal is reducing the end-to-end process time. Even if a process has significant numbers of manual steps and events, durations, and key gaiting events can be measured, and in context of gaiting events, deadlines imposed. By imposing deadlines on sequential tasks, and their completions, wasted time can be driven out of a process.

Within either scenario, or any time-sensitive process, the measurement, management, and enforcement of deadlines provide significant business benefit and a practical opportunity for process improvement.

webMethods' Deadline Management technique



**Figure 10, Control Architecture for a high-volume General Ledger environment**

is based on a two-part strategy. The first part focuses on the measurement and statistical profiling of key contributing process events with respect to on-time performance. The technique is simple in its execution, but powerful in its impact on improving deadline performance. The technique involves the subtraction of a date-time-stamp of each of the transaction's process events from the date-time-stamp of the deadline and publishing the remaining time to a BAM monitor.

The measurement of time-remaining to the deadline for each contributing-process-event allows for understanding of where time is consumed in the process, what is normal with respect to an event's timeliness to the deadline, and to understand standard deviations with respect to that process event's on-time performance. Thresholds of minimum time-remaining or standard deviations can be set into rules applied to the BAM monitors, allowing for targeted expediting of a task and for on-time performance improvement.

The second part of the Deadline Management technique focuses on the impact to on-time performance of the absence of events and is based on Control Services. Through the construction of a Deadline Control Service, expectations are set that certain critical events should occur within certain proximity of a deadline. This allows for targeted expediting and ranking of priorities at a transaction level.

Architecturally future process-branching and special handling automation can be added to direct 'late' transactions to expediting sub-processes. Events in the process can be identified as having broad standard deviations, or significant 'late-transaction' events, and the supporting tasks and application infrastructure can be targeted for improvement. And finally, fact-based KPIs surrounding on-time performance of the process can be gathered, aggregated, and reported to stakeholders.

webMethods Deadline Management also works

with manual activities if the conclusion of manual tasks can be published for measurement. Deadlines can be set for the conclusions of these manual activities; and if these events have not occurred within specified deadlines, alerts will be triggered. Measurement of concluding events in a manual step of a process exposes how much time is being consumed in that step and show if time consumption is trending out of norm.

The guiding goals have been identified:

- Business Process Control

Better control over the execution of the business processes (tracking, performance, etc.) in order to take action where appropriate.

- Business Process Optimization

Identify easily the problematic areas of the business processes in term of performance in order to solve them.

- Business Process Efficiency

Make the business processes more efficient in order to increase the customer satisfaction as well to reach or to exceed the competition.

In the ABC Co. Case Study, each step of the Manufacturing to Ship Process was measured with respect to its on-time performance. For example, when the Released to the Manufacturing Floor status is transmitted through the Rosetta Net Boundary, the value derived from subtracting the status date from the scheduled ship date (SSD), is published to a BAM Monitor. Rules are assigned to each step's deadline monitors, providing alerts that are appropriate for that step's deadline context.

To facilitate this measurement, the SSD is stored in a Control Table for each order and accessed for each manufacturing process status received. Each manufacturing process status is also cached to the same table. By polling this Control Table on a daily basis, and measuring the



**Figure 11. Three days of margin erosion caused by an undetected competitor move**

aging of a status, alerting can also be performed in the absence of a status message. For instance, if an order is still in the Ordered Status and only four days remain until the ship date, an alert is triggered.

This Control Table Polling technique is also used to detect issues within the Hold and Release Processes. In a manufacturing partnership, both parties may place an order on hold. A hold can be for credit validation purposes, i.e. a Credit Hold, or for a manufacturing quality issue, i.e. a Quality Hold. It is often the case that a given order may have multiple holds placed on it. For an order to progress appropriately through a process and ship on-time, these holds must be released in time.

In this case study, the Hold/Release status of an order is also cached into a Control Table, and this table is polled. Based on the Hold-type, specific release deadlines can be alerted on, promoting the appropriate process actors to Re-

lease the order, allowing it to move forward. For example for a Credit Hold, with less than six days to ship, an alert is sent to the Credit Department and the Customer Advocate, notifying them of a time-sensitive issue that may impact the successful delivery of a customer's order.

Process Aware Change Management

Another complexity in an outsourced manufacturing relationship is Order-Change Management. Changes are generated from numerous sources and impact multiple facets of both partners' processes. While some changes occurring early in a process present little issue, some changes occurring at specific points of a process require immediate intervention. In this case study, a set of Control Profiles were defined evaluating the sensitivity of the requested change in the context of the order's manufacturing status.

The simplest example of a status-sensitive change control is the Control Profile defined for

the Ship To Address order attribute. If a change to this Ship To Address order attribute is requested early in the process, the change has no impact; but if the order has already reached an ASN, or Advance Ship Notice status, immediate action is required by the Transportation Group in order to assure that the order is shipped to the correct destination. Shipping to an incorrect destination is a costly mistake, which is ramified by international taxes and fees.

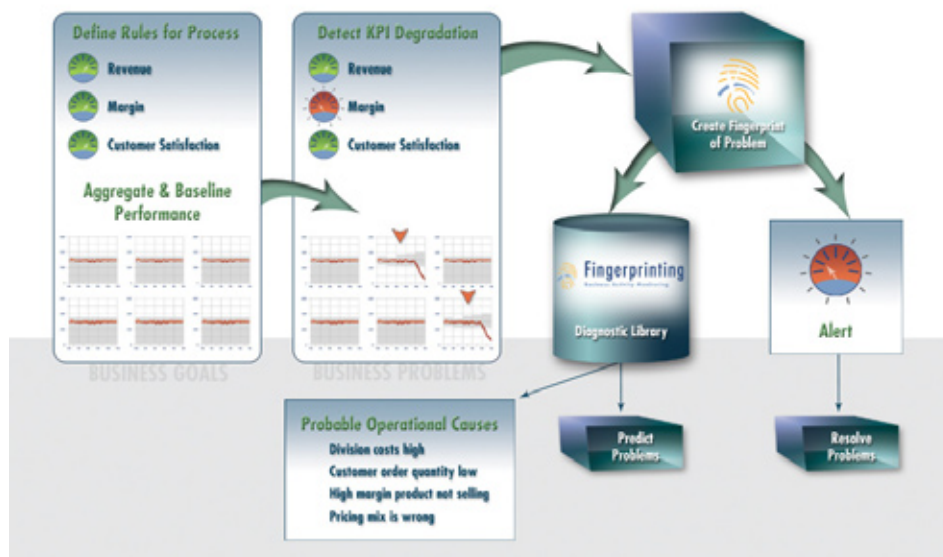
The BAM Change Management Control Service evaluates the status-sensitivity of a change, when the change is requested, against the same Control Table used for Deadline Management, and triggers BAM alerts based upon the Control Profiles defined for each managed order attribute.

## Complex Pattern Recognition

In today's high-availability and high-performance process environments, problems occur and disappear so fast that often, by the time somebody takes a look, the adverse conditions are gone. Root cause analysis of defects is incredibly difficult when the causes are transitory. Many adverse business events demonstrate a complex confluence of KPIs. These KPI patterns could be formed when a competitor is undercutting one of your barometer products in the marketplace, stealing your market share and your margin. In a grossly simplified example, the state of the following KPIs could indicate this market situation:

- Revenue is trending down
- Margin is trending up
- Product X volume is trending down
- Product Group Y volume is trending down
- Product Group Z is trending normal

In this situation, this pattern could indicate that



**Figure 12. webMethods BAM Predictive Analytics Engine**

a competitor had undercut the product (X) that you sell at a loss in order to attract customers to your business. Your margin is trending up because you are not selling your ‘loss-leader’ product. Opportunities to sell your high-margin products are decreasing through the lost sales event. This example is from the Office Supply business, with computer paper being the loss leader.

If this market condition occurs, and you do not find out about it until your weekly reports come in, you risk significant loss of profit.

### Predictive Analytics

webMethods predictive analytics was created to respond to these complex situations. Based on an option in a BAM Rule configuration, if a tagged-rule triggers, BAM takes a snapshot of all monitors that are reporting an abnormal state. This snapshot freezes the event’s ‘moment in time’ for analysis of contributing factors and for patterns that represent this business situation.

This snapshot can be annotated with information around the event like cause, resolution, etc. and then committed into a Library. webMethods’ BAM Neural Engine performs continuous pattern matching, looking for the re-confluence of a historical KPI and learns the contributory weights of each monitor. If a similar pattern comes within a matching threshold, a prediction alert is issued stating, “There is a 90% probability of a repeat occurrence of the Loss Leader Issue.” And, “This was caused last time by X competitor undercutting our price for paper.”

This Complex Pattern Recognition capability provides early notification and an opportunity to impact an adverse business situation prior to it impacting profitability.

### Coordinated Event Publishing

Similar to the Control Services concept, where data is sourced for comparison to a transaction keyed to a process event, data pertaining to related events can be cached until, or sourced when, the last pattern event occurs, and then all this data can be submitted as a single event. All the monitors surrounding a specific event of interest are reported together, regardless of where or when they occurred. With contributing events reporting simultaneously to BAM, they would populate into BAM’s Snapshot engine for measurement of their contribution and for neural-net-detection and monitor weighting within the Library.

These cached KPI events will also be published in real time for traditional use. This builds a snapshot with all of the events that could have contributed to a complex condition, regardless of timing. Having all contributing events show up in the snapshot greatly enhances the ability to do complex pattern matching in the context of fraud or in situations where cause and effect occur separately.

In the coordinated event profile, key predefined monitors (monitors that could contribute to the pattern, e.g. monitors that occur earlier, or asymmetrically, and are of potential interest in the context of the pattern) have their values cached or sourced. Only when the key defining concluding-event of the profile, tied at a transaction level, occurs would these contributing monitors be published to BAM, simultaneously to the defining event. This facilitates the inclusion of all non-simultaneous events, so that they can be recognized for their potential contribution to the pattern.



## ABOUT THE AUTHOR

James Crump, Senior Director, Strategic Solutions Architectures for Software AG, has spent the last 5 years defining the science of Business Activity Monitoring (BAM) and Business Process Management (BPM) through customer engagements, implementations, innovations and industry defining reusable solutions. With innovative solutions ranging from Partner-Performance Measurement in B2B, to Controls Services for Sarbanes-Oxley and other compliancy solutions, James has pioneered the use of BAM across industry verticals including Government, Financials, Hi-Tech Manufacturing, Distribution, and Retail. His transaction-profiling approach to BAM is yielding significant benefits and ROI for customers, allowing for the real-time detection and remediation of transaction defects, and a 6-sigma, intervention-based approach to the execution of business.

Prior to joining webMethods, James was Director of Technology Innovation for Time2Market, leading engagements in such broad areas as application services for Korea Telecomm, video-on-demand, and metropolitan surveillance architectures for Cisco Systems. He was Director of Development for Qwest's Apptimum offering which won ITIL Certification, ASP Gold Certification, and Global Hosting Partner of the Year awards. He spent 12 years as an IT Architect in the Petro-Chemical industry, including 5 years with Electronic Data Systems as Chief Technologist for Huntsman, where he was responsible for the global IT architecture for, at the time, the world's largest privately held chemical company.

James has a BS in Physics, with additional graduate studies in Quantum Chemistry from the University of Texas, and over 20 years experience in IT problem-solving. In his youth, James was a professional rock climber and guide with over 200 first ascents, and five published guidebooks to his credit. His recent whitepapers and articles include BAM the New Face of BPM and Active vs Passive Compliance which appeared in the February '07 issue of Bank Accounting and Finance magazine. He currently resides in Colorado, while traveling internationally engaging with Global 2000 customers.

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