



W H I T E P A P E R

Automating Business Process Management with BPEL and XML

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Introduction

This white paper looks at the business and technical drivers behind Business Process Management (BPM) and Business Activity Monitoring (BAM). It describes how the development of the Business Process Execution Language (BPEL) has made it easier for business to define, orchestrate and deploy business processes both within and between organizations.

At the same time we show that that orchestration is only part of the challenge, and that BPEL alone cannot handle all the complexities associated with translating between different information and data models. While BPEL provides a useful abstraction, its true power is only realized in conjunction with an integration solution that can manage validation, transformation, enrichment and delivery of business data within a secure, robust and efficient processing environment.

The business scenario

To explain some of the business and technical drivers behind BPEL, and to investigate some of the implications for business managers and system architects, this paper will refer throughout to an example business scenario.

Let's take the provision of treasury services as an example. These services are offered by financial service providers and used by the treasury functions of their corporate clients. These clients demand an ever richer set of services - such as foreign exchange trading and currency or interest rate swaps - to support their business as they try to increase their international trade and reduce the cost of managing their exposure to currency and trade risks. By providing these functions in real-time, through an internet-based service portal, the bank can retain and increase its business with existing clients as well as increasing market penetration by acquiring new customers and developing new services.

Of course, we could easily take examples from many other industries, for example:

- Dealing with the interfaces between local government and all its stakeholders – tax payers, residents, businesses, contracted out service providers, police forces as well as superior, inferior and neighboring branches of government.

- Managing supplier deliveries for a retail chain
- Processing and servicing requests from a self-service portal for new services for a mobile telecommunications service provider
- Handling fuelling and catering requests for an airline

In all cases, we would meet the same problems of integration and orchestration of data and processes, along the supply chain as well as within individual organizations.

Growing demand for integration

Over the last decade we have become accustomed to using specialized integration tools. Architects and project managers recognize that it is not cost-effective for integration projects and their individual components to be hand-built from the ground up; instead we use and re-use pre-defined “middleware” – to achieve physical connectivity, to automate common development and deployment tasks, and to ensure rapid and predictable project delivery.

Driving the business value chain

Integration has become more pervasive. The need to deliver real-time services to increasingly demanding customers requires the integration of increasingly complex systems. To do this, integration must reach ever deeper into the business, bringing together processes across many departments and functions within an organization. As processes are made more efficient, and as their cycle times are reduced from days or weeks to hours, minutes or even seconds, competitive stimulus – often combined with regulatory demands – ensures that there is still pressure to keep shaving away at inefficiencies in the system.

For our corporate treasury department, the process of managing currency exposures as goods are ordered, manufactured and shipped now involves real-time access to services from the bank. For the bank, changing currency requirements from one customer need to be balanced against other counterparties; net and gross exposures to different parties, countries and industries all need to be carefully managed to limit risk and meet regulatory demands.

Doing the process tango

Businesses – whatever industry they are in – rely on their suppliers, logistics partners, wholesalers and retailers to get their goods and services to market. Processes within the organization have to deal with third-party systems – typically across the Internet – while being resilient to interruptions, bottlenecks and other service exceptions.

When a couple take up a new dance step, they have to learn how to move their bodies in harmony to avoid stepping on each other’s toes. First they practice the basic movements, then they put it all together. Soon, experienced partners

will be whirling around the floor. Gaining confidence, as well as adding flourishes to their performance, they will be able to take instinctive avoiding action when one of them stumbles, or when another couple comes a little too close for comfort.

In the same way, organizations need to be able to handle the thousands of conflicting demands made by the never ceasing rhythm of twenty-first century life. They need to be able to define and construct the individual processes, then bring them together with their partners' and orchestrate them all into one apparently seamless collection.

Business Process Management

The requirement - a new architecture for business collaboration

In the past, the IT department could attempt to control all aspects of a business process, now it is a given that large parts will be outside the CIO's direct control. In the last five years, steps have been taken to standardize the way that processes can interact, and so make it possible for organizations to communicate more effectively and share not only data, but also applications.

Web services provide a foundation layer, supporting technology-neutral publication and use of system services within and between organizations. XML offers a common syntax for the exchange of complex messages and business documents. But Web services and XML are just low level building blocks when it comes to describing real-world business behavior.

When two or more organizations are automating their business interactions, or a single organization is doing the same, they must catalog and unambiguously describe all significant cross-enterprise behavior, not forgetting that:

- Business protocols invariably include data-dependent behavior; in our treasury example, selection of the best currency transaction – whether spot or forward, fixed or floating, FX or swap - depends on data such as amount required, periods of exposure, and the availability of matching counterparties. Defining business intent in these cases requires the use of conditional and time-out constructs.
- The ability to specify exceptional conditions and their consequences, including recovery sequences, is at least as important for business protocols as the ability to define the behavior of the vanilla, "no problem" case.
- Long-running interactions include multiple, often nested units of work, each with its own data requirements. Business protocols frequently require cross-department or cross-partner coordination of the outcome (success or failure) of units of work at various levels of granularity. To take one example: the currency transaction cannot be allowed to proceed if cumulative exposure

breaches risk management limits. By juggling with the many possible options there may be an alternative business proposition which can achieve a more satisfactory outcome for the bank and its clients within organizational or regulatory parameters.

Only when all these aspects are defined can each participant plan and build systems that conform to the business protocol. To achieve this requires the development and deployment of standards for process design, deployment, execution, maintenance, and optimization.

BPEL – the Business Process Execution Language

One such standard is BPEL – also known as BPEL4WS - an XML language used to describe business processes and how they fit together. IBM and Microsoft submitted BPEL4WS to OASIS (the Organization for the Advancement of Structured Information Standards) in April 2003 to become an open standard.

BPEL defines a model and a grammar for describing the behavior and sequencing of a business process based on interactions between the process and its partners. The interaction with each partner typically occurs through Web Service interfaces, although products such as PolarLake can obviate this requirement. BPEL defines how multiple service interactions with these partners are co-ordinated to achieve a business goal, as well as describing the state and the logic necessary for this co-ordination. BPEL also introduces mechanisms for dealing with business exceptions and processing faults, and defines how individual or composite activities within a process are to be compensated in cases where exceptions occur or a partner requests reversal.

Orchestration – co-ordinating business processes

Continuing the earlier musical metaphor, the high level management of interactions between processes is often known as orchestration or choreography. Managing the complex interrelated processes within an organization's supply chain is more complex than simply calling web services or sending messages. When there are several partners in a transaction, each party has to build robust systems that can handle the necessary control flow.

Most importantly, these systems have to handle:

- A range of counterparties – trading relationships are not exclusive, so each partner will deal with many other organizations, and the protocol used may vary in each case;
- Asynchronous conversations – correlating the original requests with responses received seconds or days later;
- Handling of failure conditions, and the application where required of compensating transactions.

Just as a composer takes a simple melody and orchestrates it to add harmony, structure and tone, so BPEL takes relatively simple constituent Web service elements and assembles them to create fully-formed business flows.

In our example BPEL can be used – by agreement between the client’s treasury department and the bank itself - to define the business process activated by the client connections to the bank’s portal. Furthermore it can be used within the bank to define how the detailed business processes that complete the foreign exchange trade are to fit together. An (greatly simplified) example of such a process is illustrated in figure 1.

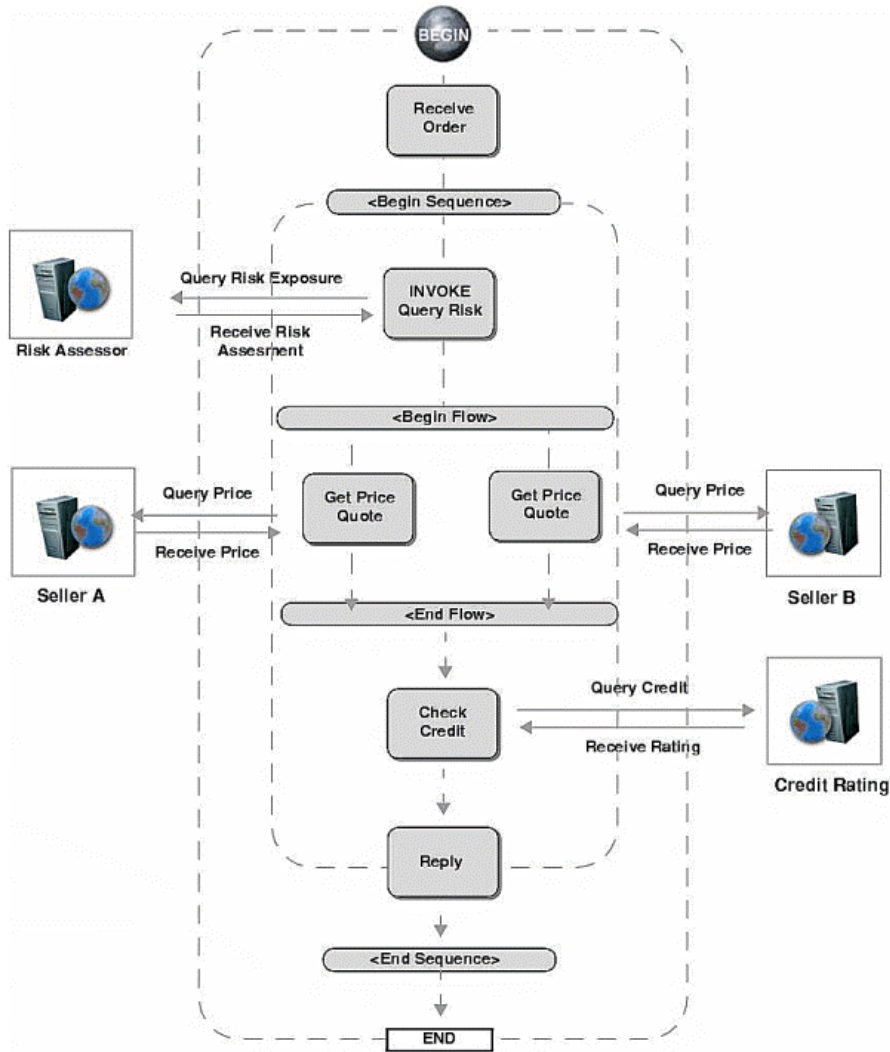


Figure 1 Foreign exchange trade business process

The limits of BPEL - bridging the gaps between process and data

However, BPEL can fall short when integration is being attempted between multiple diverse systems. At the macro level, BPEL does not in itself address common quality of service requirements – such as security, authentication and access control. These ‘non-functional’ requirements are left to the system designers and the specific tools they use to implement the business processes.

More importantly, in the real world, the message formats used to exchange data between the bank and different customers will not all be the same. Even the largest bank cannot always enforce its will on major corporate clients; there may be substantial differences between industry verticals as well as idiosyncratic variations between customers in the same industry, or even within a single organization.

It can be reasonably straightforward to define a BPEL model to handle the message format agreed with a single client. However, when the second and subsequent clients use different formats, defining a new BPEL for each client would soon become unmanageable. BPEL alone does not go far enough.

For this reason, BPELJ, a language which combines BPEL with Java 'snippets' in order to address some of these issues, has been suggested as an extension to BPEL. Unfortunately there are significant weaknesses with this approach. Although it may assist developers in creating integrated business processes that function at both macro and micro levels, it simply re-introduces all the difficulties associated with code-based integration. Most architects will thus be reluctant to adopt BPELJ, knowing the difficulties this may cause when integration solutions must be migrated or extended to include diverse platforms and technologies.

An alternative approach is required to handle the intricacies of transformation, validation, routing, processing and exception handling of XML data in a standards-based manner.

PolarLake, and specifically XML Data Circuits, make it possible to handle different formats in a controlled way. Client specific variations can be pushed down to the data integration layer rather than having to be exposed at the BPEL level. This also avoids the alternative of diving down too far into coding solutions (like BPELJ), which can eliminate the benefits gained from the higher level orchestration by coupling it too closely with detailed application code. In addition, PolarLake adds the ability to call services that aren't – as BPEL expects – defined as web services. In fact any kind of service – whether XML, database or legacy – can be included in the process orchestration.

Looking at the micro level within our example, BPEL defines the process orchestration required to support the service request within the bank. However once again it is not designed to bridge between the formats of the incoming service request and the various formats required by the internal systems included in the orchestration (such as client records, settlement, trading systems, risk management and so on). In each case, there will usually be a need to validate incoming messages, as well as transforming and enriching them with additional data.

Vital quality of services issues - such as transaction integrity, integration with management systems, security, performance and availability – are not directly addressed within the BPEL specification, but they are required for any integration platform whether it uses BPEL or not. The bank will need to track the flow of messages and documents through the process and to monitor system events so that the process can be completed in a controlled, audited and reliable manner.

Business Activity Monitoring and Management

Orchestrating automated business processes is hard enough, but today's business also has to provide a way for human beings to manage them in real time.

Traditionally businesses logged financial and process information as business events took place – recording shipments, invoices, payments, and so on – and then collected and analysed that information at the end of each trading period. Closing the books each month was a major activity taking several days. Finally, well into the following month, management would be able to see a picture of the financial health of the business.

Clearly, inherent latency in information delivery makes the business difficult to manage. Information can be up to five weeks out of date; that makes it as hard to steer the organization as a supertanker. So a series of mechanisms have been deployed to manage the business in near real time. We have seen decision support and executive information systems (DSS and EIS); data warehouses, data marts and business information (BI); and a slew of other (sometimes industry specific) techniques to make sense of the mass of detailed information that the modern business collects and stores.

Now, rather than collecting billions of pieces of data and then (at great expense) mining them to create the significant business information we need, it is possible to identify significant events straight from the business processes in real time. The need for real-time visibility and immediate response has given rise to what Gartner has called "Business Activity Monitoring" (BAM), a process by which key operational business events are monitored for changes or trends indicating opportunities or problems, and enabling business managers to take corrective action.

Business Activity Monitoring - Putting events in context

BAM works by capturing events as they occur and then immediately correlating them with relevant contextual data – such as a record of a customer's previous sales activity. For example, a BAM system in our bank's foreign exchange trading environment might quickly alert a senior trader to a top customer's new requirements. Such fast action makes it possible to quickly resolve any issues – and keep the customer's business. By contrast, a non-BAM (or batch) system requires extra, time-consuming steps to perform the correlation, and the manager might not be alerted to the issue until minutes or hours later, when the customer has already been lost.

Key metrics vary from business to business, and industry to industry, but typical examples include:

- Mismatched control counts and totals
- Failure to service requests within a defined response time
- Responses to escalations and exceptions

Organizations can use BAM tools to configure, track and analyze their key performance metrics and quickly spot business problems, opportunities and trends. In a bank, those key metrics are not just executive toys or organizational window dressing; they drive the business and are directly (and very rapidly) exposed to regulators in all the various markets in which the bank is involved.

BAM differs from traditional business intelligence and data warehouse environments, which target business analyst users and tend to take on aggregate tasks such as sales forecasting or financial consolidation. Instead, BAM targets line-of-business managers and watches for operational events as they unfold.

In order to do this, of course, BAM relies on real-time data capture concerning the state of the automated business processes within an organization, or across multiple organizations. PolarLake provides the ability to select points within each business process – 'milestones' – at which relevant data can be gathered and used as input into BAM tools.

Because BAM relies on rule-based monitoring of real-time business events, and doesn't rely on a complex and heavyweight data warehouse model, it is much easier to change behavior over time. The business can react to changing business conditions and structures far more quickly than before. BAM can be used to help identify and report on unusual trades or trading patterns, to spot delays in execution or reporting of trades, and to alert managers to critical external market events.

PolarLake and BAM

PolarLake allows the developer to enhance integration processes so that they can recognize significant business events as they occur. The milestone event handler is dragged and dropped onto the diagrammatic representation of a data or process circuit; it offers very simple configuration of common tasks like timestamping of data, monitoring of running totals, and conditional alerting.

On the fly correlation of business events with deeper contextual information can be effected – in parallel with core business processes - using PolarLake's integration and adapter components as part of the overall XML circuit.

Conclusion

Taken together, Business Process Management and Business Activity Management are intended to give enterprises "instant insight" into their business processes and systems through real time process orchestration and business event notification. Because key metrics are presented in a timely manner to line of business managers, companies can make rapid and well informed decisions.

Meanwhile, the automation of business processes can deliver significant benefit in terms of reduced operational cost and improved customer service. However, as with all integration projects, success will depend on implementing these solutions in a way that enables them to evolve with the business and adapt to meet rapidly changing requirements.

Appendix: The PolarLake Integration Suite

The PolarLake Integration Suite is an example of a successful integration tool set aimed particularly at business processes involving XML formatted messages and documents. It is made up of the following products:

- PolarLake JIntegrator – the Universal ESB;
- PolarLake Messaging Integrator – which includes a rich set of content-based routing, transformation and validation capabilities for XML documents, sent and received over tried and trusted messaging systems, and also adds complete integration of XML and Web Services with relational databases;
- PolarLake Adapters – which support bi-directional synchronous and asynchronous communication with a wide range of business applications (including Oracle E-Business, PeopleSoft, SAP and Siebel) and mainframe technologies (including IMS and CICS).
- PolarLake Process Integrator

Integration capabilities

PolarLake applications are assemblies of business logic components defined using **XML Circuits**. Incoming XML documents are broken down and delivered to the appropriate components based on rule matches. This simple but powerful architecture provides a complete integration layer focused on the key goals:

- Fine grained manipulation of XML documents
- Transformation, validation, and enrichment
- Operating at the right level of granularity – either a single XML branch, or the entire document, depending on the business requirement
- Supporting de-coupled and distributed operations across a globally dispersed organization.

High-performance processing is achieved by handling complex XML messages in parallel tasks. Through user-defined XPath expressions, incoming XML documents are split into "segments," which are then handed off to processing components (typically Java components or XSLT scripts) and eventually recombined.

The Dynamic XML Runtime adds support for integration of these XML applications into RDBMS, EJB, non-XML formats and legacy infrastructure, and the PolarLake Adapters enable connectivity to enterprise applications.

PolarLake Process Integrator

As we have seen BPEL provides a standard way to define this sequencing and composition of automated business processes. Reinforcing PolarLake's commitment to standards-based integration, the Process Integrator directly supports BPEL. Built on the same industry-proven high-performance XML Dynamic Runtime™ server as the rest of the product suite, the PolarLake Process Integrator enables PolarLake users to orchestrate complex business processes within the standards-based integration platform provided by the existing product suite.

Using the Process Integrator, system developers are able to import and export BPEL definitions, and allow non-SOAP messages (even non-XML) to be included within the orchestration as **Process Circuits**.

In deployment, XML Data Circuits and Process Circuits can:

- Be deployed over multiple PolarLake servers, allowing scalability both of throughput and of scope
- Call other Data and Process circuits – both local and remote – supporting geographic spread and business partitioning
- Call other BPEL engines or Web Services – either within or outside the organization

The Milestone Event Processor

The PolarLake Integration Suite v4.0 includes greatly enhanced business activity monitoring (BAM) capabilities. PolarLake BAM delivers basic activity metrics, such as the number of transactions being processed, and business metrics such as the total worth of those transactions. This information can then

be stored in any relational database and queried via the PolarLake activity monitor or third party BAM or BI tools.



PolarLake provides a complete suite of products for implementing integration solutions based on the Enterprise Service Bus. Our full-strength, productive solutions deliver code-free orchestration and mediation of software services, enabling integration solutions to be extended and re-used without extensive re-engineering. The result: real return on investment.

PolarLake has a proven track record in delivering the benefits of incremental integration with a technology that leverages existing IT investments in standards, skills and systems to reduce both initial investment and total cost of ownership. Deployed customers include leading corporations in financial services such as JP Morgan Chase, Pioneer Investments* (Ireland), Man Financial Ltd (UK), and Nissay Dowa (Japan), in Government, such as CJIT (Criminal Justice IT, UK), and in telecommunications such as Midwest Wireless (USA) and KDDI (Japan).

PolarLake's solutions are provided by partners such as Hitachi Systems and Services and Sun Microsystems. PolarLake is a private company, headquartered in Dublin, Ireland, with offices in London, New York and Tokyo.

Leveraging its unique Dynamic XML Runtime™ technology and XML Circuits™ application assembly framework, PolarLake's products allow customers to deliver integration solutions at a fraction of the normal time and cost.

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