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The business value of event processing: preparing the path

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Since organisations first began to utilise IT to support their business activities in the 1960s they have been capturing and storing representations of things that happen in the real world – in other words, **events**. The nature of event processing has changed fundamentally in the intervening period, of course. Growth in online commerce, increasing levels of "front office" IT automation, and increasing levels of integration between systems has created IT environments where real-world events are very often captured electronically as they occur. Today, organisations are taking advantage of the "real time" availability of electronic events, and using **event processing** technology to both improve operational business efficiency, and drive business optimisation – instrumenting and analysing business activity to drive decisions radically more transparently and efficiently.

This paper aims to dig beneath the surface of event processing technology, and show you how the technology creates business value – and what you need to think about (and do) to prepare for an investment and maximise that value. This paper doesn't provide detailed technology implementation advice, but it does provide a number of issues that you should consider as you start to explore the possibilities of event processing technology and plan your approach.

Macehiter Ward-Dutton is a specialist IT advisory firm which focuses exclusively on issues concerning **IT-business alignment**. We use our significant industry experience, acknowledged expertise, and a flexible approach to advise businesses on IT architecture, integration, management, organisation and culture.

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Summary

Event processing is coming of age, and organisations are using the technology to drive incremental business value

Organisations have been using event processing technology in isolated niches for decades, although it's often been hidden. However growth in e- commerce, increasing levels of front-office IT automation, and increasing levels of integration between systems have created IT environments where real-world events are very often captured electronically as they occur. At the same time, as SOA has become more popular, integration technology itself has become more open, making electronic event flows between systems much more visible.

Today, organisations are taking advantage of the "real time" availability of electronic events to both improve operational business efficiency, and drive business optimisation – instrumenting and analysing business activity to drive decisions radically more transparently and efficiently.

Engaging business domain experts is crucial for event processing success

As you plan your event processing technology investment, it's a good idea to think about the "people dimension" early.

Although event processing technology is not trivial to understand, you need to find ways to get IT specialists working with business domain experts in developing your own implementations. Domain experts have the most useful insights into significant events and patterns, decisioning rules and actions – the "content" for event processing systems – and they will need to work iteratively to give you the most value. With this in mind, it's vital to find tools that are easy for domain experts to engage with.

Examine use case factors like event complexity and speed of response required to find the right technology investment path

Although it's possible to generalise a blueprint for an event processing technology system, "on the ground" each different system available has its own capabilities, strengths and weaknesses. If you're looking to put a set of event processing capabilities in place that can be used in multiple scenarios within your organisation, you need to analyse the potential use cases that may arise – looking at factors like event complexity, the speed of response required, and the type of business value obtained – and use these to prioritise your technology requirements.

To maximise your ROI, make sure you drive event processing in the context of other strategic IT initiatives

To make event processing technology work for you, you need to make sure you take account of how other existing and potential IT initiatives – including Business Process Management (BPM), Business Activity Monitoring (BAM), Business Service Management (BSM), Business Rules Management (BRM), business intelligence and data warehousing – can add value to it.

Without a "big picture" IT strategy view influencing your investment and linking it to business capabilities and requirements, you risk creating event processing silos and missing broader opportunities to drive the unencumbered flow of valuable business event information.

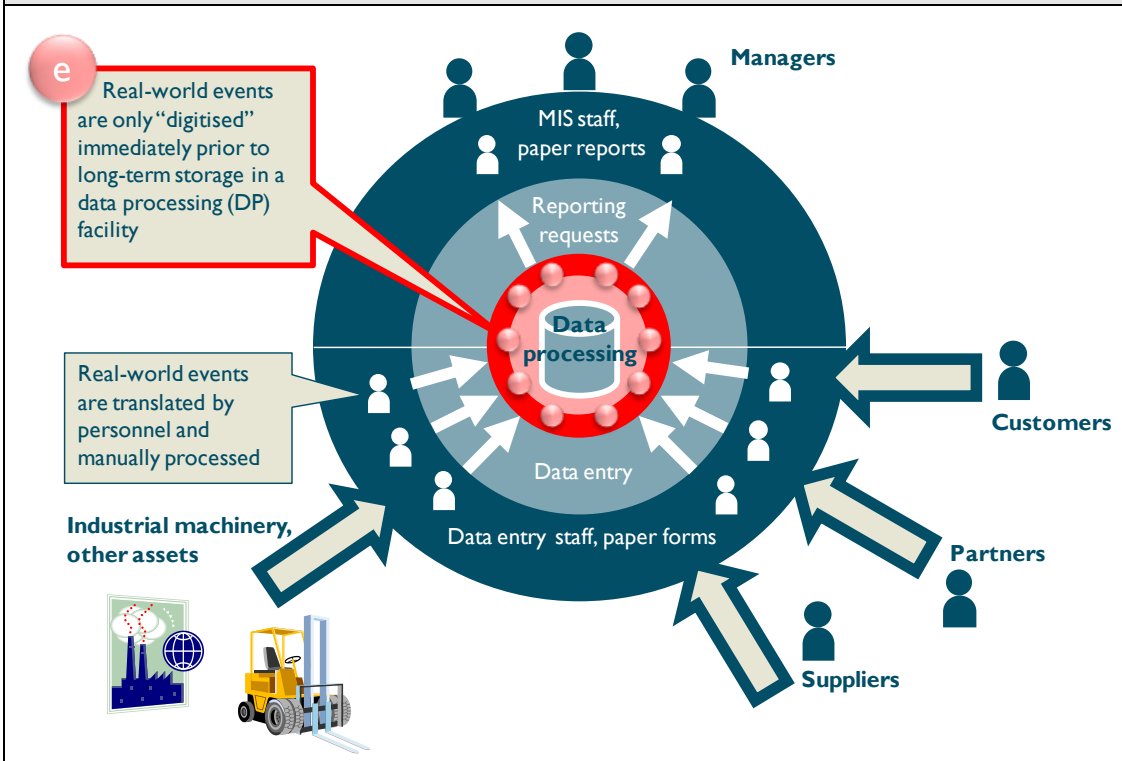
The case for event processing

Event processing – at the heart of IT in business

Since organisations first began to utilise IT to support their business activities they have been capturing and storing representations of things that happen in the real world – in other words, **events**.

Business events such as the placement of new order by a customer, or the receipt of a new asset, have long been recorded and processed for later analysis using IT systems. When you think of things this way, it becomes clear that from mainframe-based batch order processing to real time inventory tracking using RFID-enabled sensor networks, the processing of events has actually been the at the heart of IT since the 1960s.

Figure 1: "Offline" event processing

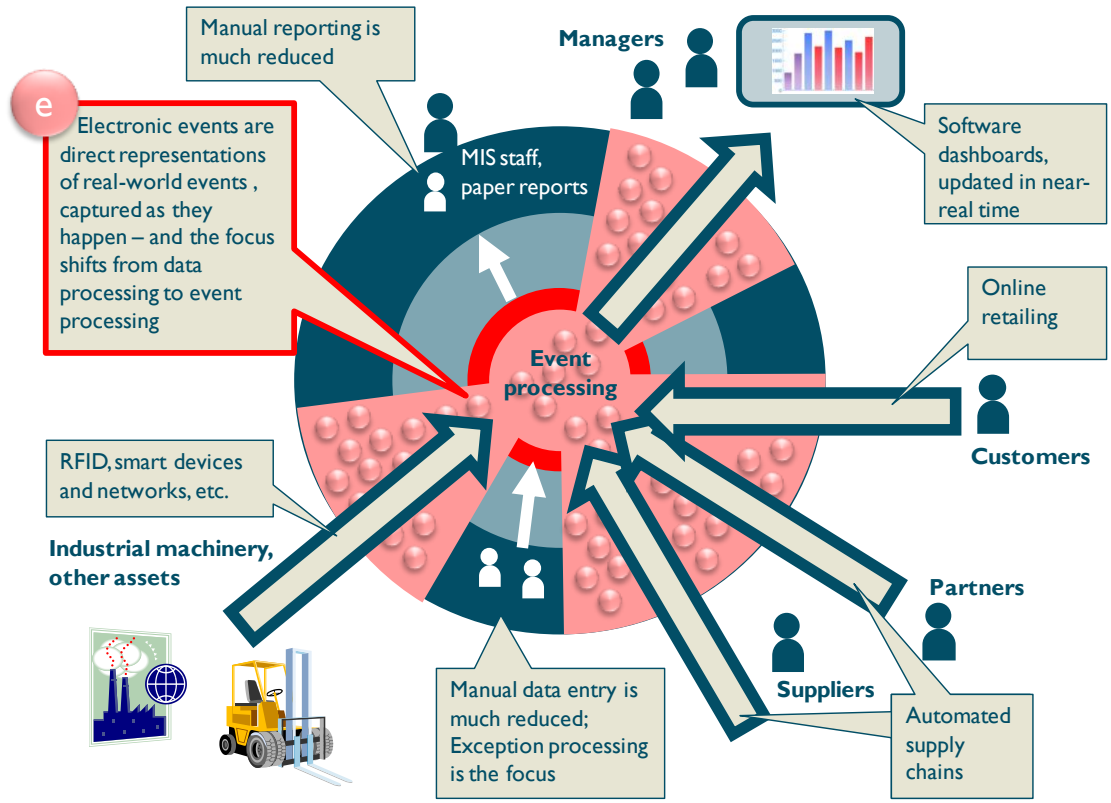


In the past, IT systems ("data processing" or "DP" systems) processed electronic events that were indirect historical records of real-world events. These event records were created by clerical staff, typically by entering data from paper forms into IT systems. These historical event records were used retrospectively for analysis and to support business decision making.

The nature of event processing has changed fundamentally in the intervening period, of course. We are moving beyond the world of "offline" event processing which dominated from the 1960s to the 1990s, shown in Figure 1, where information representing events was manually captured after the fact and retrospectively analysed; to the world now starting to dominate, shown in Figure 2, where that information is captured as the event occurs and is used to support up-to-the-minute analysis, decision making and actions.

Furthermore, as IT moves closer and closer to processing and analysing business events in real time, the ongoing operation and evolution of those business activities is becoming ever-more dependent on decisions taken on the basis of sophisticated combinations of electronic events.

Figure 2: "Real-time" event processing



Increasingly, organisations are working in a world of "real time" event processing where the manual data entry and report request steps of old are bypassed, and where electronic events, free to flow around IT systems and networks, are direct representations of real-world events. These events are used in "real time" to support analysis and to support decision making. Here, more and more, the focus of IT is shifting from Data Processing (DP) to Event Processing (EP).

The changing shape of business demands business-oriented event processing

It's worth bearing in mind that while "mainstream IT in business" remained firmly focused on offline event processing, there were areas of IT where real-time event processing was already being used actively. The introduction of specialised event processing technologies in business can be traced back to the event simulation and air-traffic control systems of the 1960s, through network and systems management products of the 1970s and active databases of the 1980s. Now, though, the potential application of event processing technologies is much broader in scope, thanks to some far-reaching industry shifts. Organisations of all shapes and sizes, across public and private sectors and differing geographies, are increasingly shaped by three large-scale socio-economic forces:

- **Globalisation**. Increasingly global customer bases, partner networks, supplier networks, and competition, are forcing companies to:
    - Become leaner and more flexible.
    - Focus on what makes them different.
    - Find new ways to deliver sustainable competitive advantage.

- **The drive for business transparency**. Regulation is sometimes forced on organisations by governments, but increasingly industry bodies and individual organisations are voluntarily moving to provide more information about their processes, the resources they use and the ways in which they interact with their ecosystems and environments.
- **The desire to engage effectively with smart, connected markets**. The rapidly evolving and maturing Worldwide Web is just one outcome of the explosion in always-on, global mass communication connections. Individuals and organisations are increasingly looking to the "online world" for solutions to problems and opportunities before looking to the "offline world". In this environment resources can feasibly be located anywhere: it is possible to consider that "the world is flat" (as New York Times columnist Thomas Friedman says). This connectedness and global availability of resources presents significant opportunities for disruption and organisational competitive advantage, particularly in light of the globalisation forces described above.

E-business is a strong driving force

Business and information networks are converging

The twin forces of globalisation and connectedness, as described briefly above, are driving business and information networks to converge. The result is that the effective operation of business networks is increasingly dependent on the electronic information that is flowing through them. In this environment, organisations need to be able to monitor, manage, predict and change their own operations and those of others in their ecosystem, based on potentially very high volumes and complex combinations of internal and external events originating from the IT systems that support their activities in the real world. In some cases, such as network management and fraud detection in the telecommunications industry, event processing is necessary to support the day-to-day operations of the business. In others, such as the generation of targeted marketing messages and promotions based on customer activity, it is to optimise those day-to-day activities for competitive differentiation.

Business networks are becoming more transparent

At the same time the transparency demanded by regulation (such as the Markets in Financial Instruments Directive (MiFID) in the EU investment services market) requires visibility into the operation of business networks, which again is dependent on electronic information flows. Furthermore, the stresses and strains these forces exert on organisations are changing all the time, and this means that organisations have to be able to sense and respond to internal and external changes with more and more quickly if they are to maximise their opportunities and deal effectively with competitive threats.

From supply-led to demand-led business operations

It's not just that business and information networks are converging. The nature of the information flows is changing, too. Organisations are now able to harness a broad range of specialised third-party business service providers to support innovation and help them deliver services to their customers, who in turn are able to connect directly to these increasingly sophisticated "value networks". It's no longer sufficient to analyse demand retrospectively in order to anticipate where supply needs to be in the future. The responsiveness required to changes in demand and supply is tending towards instantaneous, which in turn requires increasingly automated responses, be it dynamic resource scheduling in response to changing customer demand or changes to manufacturing processes in response to the delivery of new supplies. Demand-led business models are predicated on a better understanding of the customer or citizen: a single view of the customer depends on collecting and analysing information concerning their interactions with the organisation.

More events, and changes to the value of events

The changes in the business environment discussed above are in part driven by, and in part enabled by, technology enhancements. Technology is both driving and enabling organisations to process business events.

As figure 2 previously illustrated, increasing numbers of real-world events types can be represented in digital form, including:

- Orders, invoices, ATM transactions and so forth in the online transaction processing systems of old.
- IT system and network activity in management and monitoring technology.
- Operational events, such as telecommunication call data records and payment transactions.
- The movement of inventory through supply chains and baggage through airports captured and tracked using RFID sensors and barcode scanners.
- Vehicle movements through GPS and automatic number plate recognition.
- Manufacturing equipment activity and status information in SCADA (Supervisory Control and Data Acquisition) systems.
- Human health information through connected monitoring devices.
- Movements of crime suspects for intelligence-gathering purposes.
- Website navigation and online gaming activity.
- News and other web content through subscription-based notifications.
- Climate and other environmental changes through sensors.

It's not just the number of event types that is increasing. The volume of electronic events flowing around networks is growing exponentially, and their "value duration" (the period during which there is business value in making a decision based on an event) is changing too. In the financial services sector, for example, stock ticks have value both for historical market analysis – but also for algorithmic trading.

Furthermore, the number of event types that are relevant to a particular activity is increasing. In a financial services scenario, for example, the latest news about a particular company, provided through a subscription-based notification, may be just as important to a trading decision as changes in the value of its stock.

In parallel to the growth in the number and type of digitised events, advances in enterprise IT infrastructure enable events to be utilised more effectively. Standards-based distributed computing architectures – most closely associated with Service Oriented Architecture (SOA) – represent events in machine-readable XML formats that enable them to be captured as they flow around networks of software services.

Once events are captured, sophisticated rules-based processing facilities can be used to encapsulate event processing logic, ranging from the detection of events and patterns of events, through the filtering, aggregation and derivation of events, to initiating actions on the basis of those steps. Business process management and workflow technologies can then step in to model and automate responses to events. Finally, powerful user interface technology, be it browser-based AJAX and scripting languages or traditional desktop thick-clients, facilitates the development of sophisticated dashboards for event monitoring.

Stumbling towards the event-driven enterprise?

If the processing of events is nothing new, why have the past couple of years seen a growing interest in a new category of event processing technology? It's mainly because a number of active communities-of-interest, ranging from multi-disciplinary groups of vendors, enterprises, industry analysts and academics to bloggers, have realised that industries are stumbling towards event-driven behaviour, rather than making planned moves in that direction. This presents both opportunities and risks.

Much of the shift towards real-time event processing at the heart of business IT has been driven by industry desire to reduce latency and costs and improve accuracy, which has led to more front-office automation and greater levels of systems integration from the front office to the back office. The result is integrated chains of systems with fewer human links, able to act and react to events much more quickly than ever before.

As well as reducing latency and costs and improving accuracy, though, organisations doing this automation and integration work are building a foundation for becoming much more event-driven – and, with the right approach, this foundation can both improve the way that business services are supported operationally, in the face of stiff competition and increasingly complex environments; and improve business agility and flexible business optimisation.

But the truth is that the shift towards real-time event processing at the heart of business IT – the event-driven enterprise, if you like – has to be managed explicitly and carefully if organisations are going to extract the maximum value from their investments.

Organisations that are stumbling towards an event-driven future risk missing major opportunities. Without the right approach, it's easy to create event-processing application silos. As well as representing replicated investment, these silos will hinder information flow; add processing latency and the likelihood of errors; and compromise agility by requiring that rules and other event processing "content" have to be replicated manually across systems. In short, if you create and maintain event processing technology silos, you're destroying the very value that you're trying to create by applying the technology in the first place.

These risks present major opportunities for software companies, and so many of the leading software infrastructure vendors have announced ambitious event processing strategies, whilst event processing has spurred innovation from a variety of start-up vendors, too.

All this doesn't mean that you have to "boil the ocean" to get started with getting value from event processing technology investments – far from it. Individual projects can gain real value from event processing technology without you having to make a big enterprise-wide architectural commitment. But you do need to ensure that when you make these investments, you're being influenced by a "big picture" of IT strategy that will ensure that each new investment you make builds on previous investments rather than trashing them.

What technology capabilities do you need to embrace event processing?

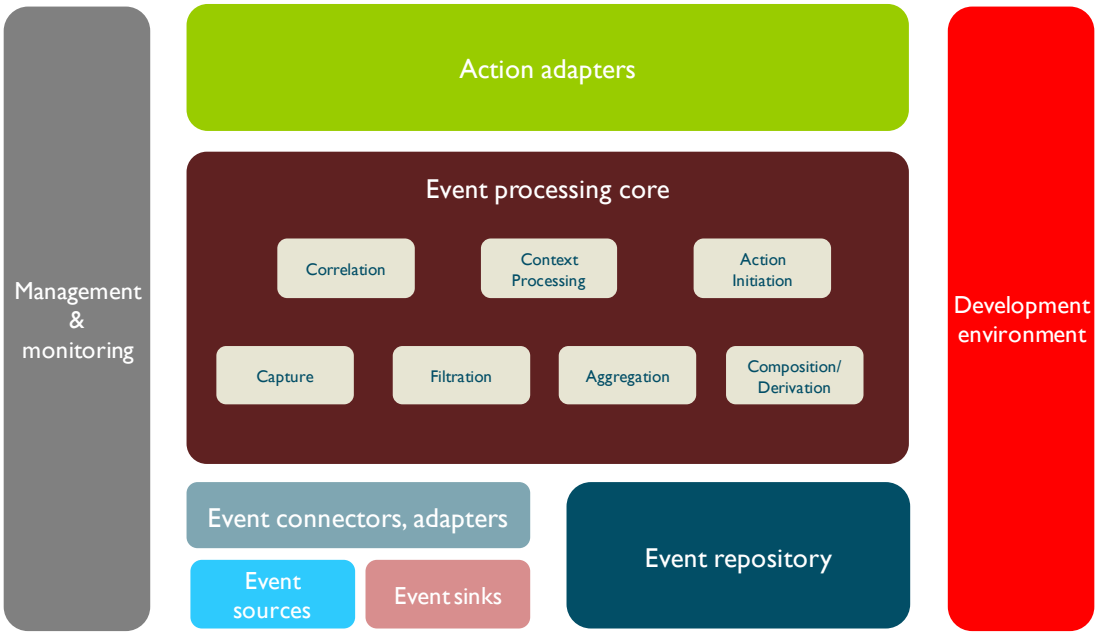
Although an in-depth discussion of event processing technology is beyond the scope of this report (we provide a pointer to some excellent resources in the Appendix), we do need to illustrate the high-level components of an event processing system – because it's only by understanding how these components fit together that you can understand your own potential technology requirements and also the opportunities for integration of event processing technology with other strategic IT initiatives.

An event processing system blueprint

Figure 3 shows a conceptual blueprint for an event processing system, which defines the capabilities required to address a broad range of event processing scenarios. As we'll explain shortly, you may not initially need all these capabilities (or at least, your investment may not need to be equally deep in all areas) – that depends on the scenario(s) you're pursuing. However, it's important to keep the overall blueprint in mind when exploring the investment options you have.

This blueprint is based on a clear separation of event processing concerns: ideally, technology products and suites should realise this separation of concerns through modular offerings. In an ideal world, to promote interoperability and comprehensibility, the gaps between the individual technology capabilities shown in the figure should be bridged using open standard protocols and data formats. Use of standards will enable events to be exposed to external applications in context; and they'll also facilitate the eventual use of event processing technology as general-purpose business infrastructure.

Figure 3: Conceptual blueprint for an event processing system



This event processing technology blueprint highlights all the main technology capabilities that play a role in general-purpose event processing infrastructure.

Event processing infrastructure capabilities

In the sections below, we briefly explore the individual technology capabilities highlighted in figure 3.

Event sources and sinks

Event sources provide events for subsequent processing and range from general-purpose IT infrastructure, such as message-based middleware, through to specialised systems, including manufacturing equipment status monitors, telephony billing systems and financial market feeds. Event sinks, which are equally varied, receive events generated by the event processing system. Any technology resource can potentially act both as an event source and an event sink.

Although not strictly part of an event processing system, event sources and sinks are included in our blueprint for completeness.

Event connectors and adapters

Event connectors and adapters provide facilities to integrate with event sources and sinks. In order to deliver value across a range of scenarios and use cases you should look for pre-built connectors which can work across many common event types, such as those emitted by financial market stock feeds and RFID sensors, as well as message-based infrastructure, via technology specifications such as JMS, IBM WebSphere MQ and enterprise service buses (ESB). In addition, you will likely need technology which exposes APIs through enterprise programming languages such as Java and .NET. These will enable you or your technology partners to develop adapters to meet any custom requirements.

You may also require more sophisticated adapters that will ship with data transformation facilities, accessible from within the development environment, to enable events to be presented in an appropriate format to the event capture and aggregation layer and for external publication.

Event repository

Although events will be sourced through the event adapter layer, an event processing technology implementation needs to provide facilities to store events and their definitions. As well as in-memory storage of event data for event capture and aggregation and subsequent processing, persistent storage (potentially through integration with a RDBMS) is vital to help with testing and simulation. Furthermore, it's important to have facilities that help with accessing historical event data, for example from operational and business intelligence/data warehouse stores – both to provide additional context for event processing, and to assist in the identification of relevant event patterns.

Event processing core

The event processing core within our blueprint is a set of capabilities responsible for executing processing logic, typically in the form of rules, defined in the development environment to detect the occurrence of event instances and to eliminate those which are not of interest. Ideally, because the involvement of business domain experts is so important, the most suitable language for defining this logic is likely to be a high-level, domain-specific language – rather than a general-purpose programming language such as Java or C.

Event capture capabilities should be "active": that is, they avoid the need to poll for the occurrence of particular events, instead being automatically activated when an event occurs. It should be possible to filter events on the basis of their type, as well as according to context-specific factors such as the event source, and information specific to the event instance. You'll likely also need facilities to combine fine-grained events and to generate new events, either for subsequent processing or for publication to event sinks. Aggregation and filtering logic, as with event capturing and filtering, should be able to take account of event- and context-specific factors. It should also be possible to extend event capture and aggregation rules with custom logic, through familiar tools.

As well as providing a set of capabilities for gathering and combining events, the event processing core needs to provide capabilities to executes logic that can identify that a particular situation (represented by a pattern of events) has arisen – and initiate the relevant pre-defined action.

Sophisticated pattern matching capabilities are required to make this work, including the ability to:

- Identify sequences of events.
- Apply Boolean-like logic to combinations of events.
- Identify the non-occurrence of events.

A good event processing technology offering should also make it possible to apply additional logic to take account of the context, such as the time-of-day, in which pattern-matching is occurring.

In some cases, the required action will be the publication of an event for external consumption. In other cases, it may be the initiation of an automated business process or an update to a dashboard for human interaction.

Action adapters

Most event processing technology offerings enable you to specify a set of simple event-response actions "out of the box" – including sending notifications via email, delivering syndication-based data feeds, and so on.

You're likely to want to go further than this eventually, however, and in order for event processing infrastructure to truly play a general-purpose role, it's important that you don't have to "reinvent the wheel". You want to be able to have actions that are identified within the event processing core performed by existing enterprise IT infrastructure and applications, rather than having to implement them again implemented in a separate event processing technology silo.

So, for example, it's important to consider adapters for third party business activity monitoring (BAM) and analytical dashboards; and it's also important to consider how actions can initiate automated business processes and human-oriented workflow, for example through integration with business process management (BPM) and packaged application solutions, as well as the publication of events for consumption by external message-oriented middleware and enterprise service buses (ESBs).

Development environment

The development environment in an event processing technology offering needs to provide facilities to define event data transformation in adapter components, and to define logic for event processing, pattern detection and the initiation of actions in the relevant components.

The development environment, which should ideally integrate with common enterprise development environments (most notably Eclipse and/or Visual Studio), will need to be based around a specialised event processing language. As discussed previously however, the insight and expertise of business people is essential for the definition of relevant events, event patterns, correlation, context processing and action initiation. Therefore, it's vital that the development environment also facilitates business engagement through the use of visual interfaces into the event programming language.

In addition to providing facilities for the definition of event processing logic, it's ideal if the development environment can also support event processing testing and simulation by enabling you to use historical test data in the tools themselves. Also, ideally it should be possible to optimise event processing logic based on the results of simulation and to mine historical event data to identify potentially interesting event patterns.

Management and monitoring

Whilst it's crucial that every event processing technology offering provides dedicated facilities to enable administrators to manage and monitor event processing technology components, it should be possible for these to be integrated with the broader enterprise IT systems and service management infrastructure. In addition to bi-directional integration with IT management and monitoring frameworks from the likes of CA, HP and IBM, we expect that the most advanced event processing technology offerings should extend this openness to include use of external enterprise authentication, authorisation and security infrastructure for access control and compliance purposes.

Finally, it should be possible to distribute and cluster event processing technology components to address performance and reliability constraints, for example through the deployment of an event processing network described above.

Standards

Open standards data formats and protocols, as outlined in *An event processing system blueprint,* are key enablers of general-purpose event processing infrastructure. Standards facilitate technology and vendor interoperability of course; but they also help organisations with access to skills in the market and make knowledge transfer easier. A variety of event processing technology standards initiatives, at various stages of maturity, are underway, which address various requirements, including:

- Event processing languages – StreamSQL
- Event processing rules – OMG Production Rules Representation (PRR); W3C Rule Interchange Format (RIF); OMG Semantics of Business Vocabulary and Business Rules (SBVR) and Rule Markup Language (RuleML)
- Event metadata – Mitre Common Event Expression (CEE)
- Messaging – W3C SOAP, REST, ATOM and RSS
- Event distribution and notification – W3C WS-Eventing; OASIS WS-Notification.

Although there is a lack of mature event processing technology standards, and those standards that are under development provide incomplete coverage of our event processing technology blueprint, we don't believe that this state of affairs should delay your event processing initiatives. However, you should monitor their development and adoption by vendors for two reasons:

- First, standards support will ease the deployment of event processing infrastructure if you considering adopting components from different providers.
- Second, standards support will facilitate integration into your existing IT environment, along the lines we discuss below.

Understanding the requirements of different event processing use cases

If, as we have already discussed, IT support of business activities has always depended on the processing of events, how do you assess the ways in which your event processing technology investment will deliver business value? In addition, how do you determine whether or not you need infrastructure that is optimised for "real-time", as opposed to "offline", event processing? How do you ensure that your investment is focused on the appropriate set of capabilities?

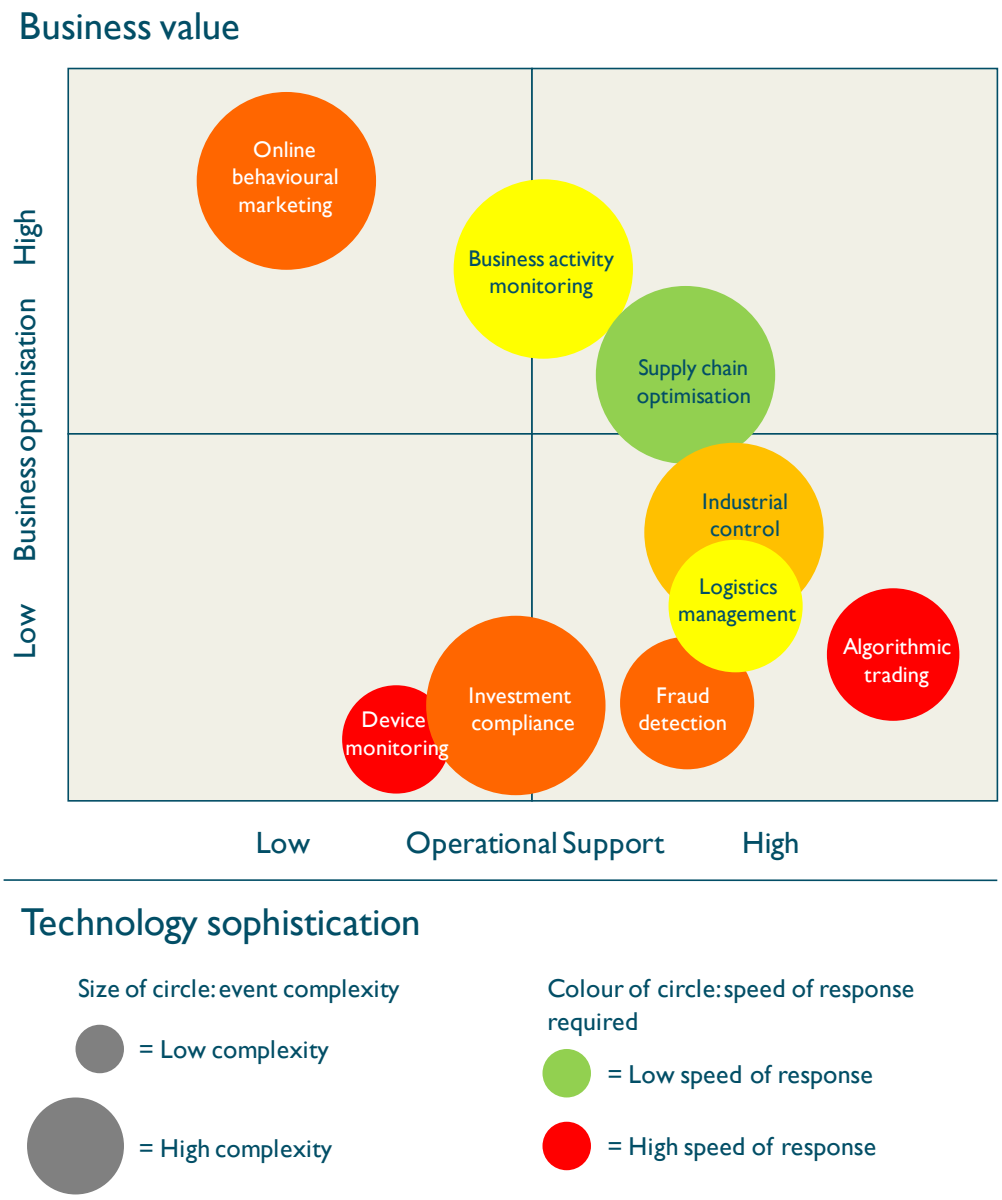
These key questions can be answered by understanding the kinds of event processing use cases that you expect to be exploiting.

As we discussed earlier in this report, there are two high-level ways in which you can gain business value from applying event processing technology: firstly, by improving operational support in the face of broadening competition and in complex environments; and secondly, by maximising business agility, and enabling flexible business optimisation. Concentrating on business value is one key way of exploring use cases. Another important way of analysing use cases is in terms of the technical complexity of the scenario – that is, the volume of events, and the number of event types that will be involved; the extent to which decisions will depend on derived or composite events; and the speed of response required.

Figure 4 summarises examples of specific event processing technology use cases – and shows how they might differ both in terms of the business value they deliver, and in terms of their technical complexity. The examples we show below are just for illustration: what's more important is the axes that we use to illustrate how use cases differ.

You can use these axes to help you analyse your potential event processing use cases and explore the technology requirements that will arise. For example, the higher the technology sophistication associated with your use cases, the more likely it is that you'll need to employ specialist event processing technology rather than relying on traditional "offline" event processing technologies such as RDBMSs and business intelligence tools.

Figure 4: Analysing use cases in the context of the type of business value they deliver



Event processing use cases deliver different types of business value: some boost support for day-to-day business operations; some focus on boosting business optimisation; and others do both.

Exploring business value

Use cases appearing in the top half of Figure 4 (our examples are online behavioural marketing, business activity monitoring, and supply chain optimisation) primarily add value by boosting **business optimisation** efforts – helping businesses differentiate on the basis of how well they respond to changing business conditions and take appropriate action. These use cases place increased emphasis on the uppermost layers of our event processing technology blueprint. For example, in an online behavioural marketing scenario, it's the ability to understand the implications of individuals' interactions and to respond with appropriate propositions that is crucial. It's the sophistication of the decision-making and action initiation capabilities available that will really determine how well the event processing system is able to address that scenario.

By contrast, those use cases on the right-hand side of Figure 4 (our examples include logistics management, algorithmic trading and fraud detection) are strongly associated with boosting **operational support** in business – even though at one level they might seem very different, their value typically comes from helping organisations deliver services of one kind or another (goods distribution, financial trading, retail revenue assurance, financial risk management) to demanding quality standards. These use cases are most likely to require advanced features from the capabilities in the lower layers of our event processing technology blueprint. In these use cases, the ability to work with large volumes of events, received through multiple channels and widely-distributed sources, is typically crucial.

The role of domain experts

The other thing that's worth noting about the use cases that are primarily concerned with boosting operational support, is that the domain experts who need to be involved in your implementation work are likely to be technical specialists of one kind or another. In our example operational support use cases, the relevant domain experts might be equity trading specialists; fraud analysts; logistical operations experts; and so on. All these roles are "business" roles rather than IT roles, but the people within them are technical specialists who have probably had significant exposure to software programming in some sense. By contrast, the use cases that are primarily concerned with boosting business optimisation are more likely to require domain experts who have much less direct experience of working in technical disciplines. This has significant implications for the type of development and modelling tools that you'll need in your event processing technology solution.

Exploring required technology sophistication

Those scenarios which are represented by large circles in Figure 4 (our examples include online behavioural marketing, business activity monitoring, industrial control, supply chain optimisation, investment compliance) are all associated with relatively **high event complexity** – they typically need process a wide range of events emanating from various operational systems for subsequent analysis via "real-time" dashboards. In order to get the most out of event processing technology in these scenarios, you'll typically need to access a comprehensive set of event adapters and sophisticated event capture and aggregation capabilities.

Those scenarios represented with large red or orange circles in Figure 4 (our examples include investment compliance, online behavioural marketing and algorithmic trading) exhibit high event complexity and also demand a **high speed of response**. To serve these use cases effectively, as well as a rich set of event adapters and capture/aggregation capabilities, you'll also need powerful decision-making and action facilities and a broad range of action adapters to enable high-speed responses. Those scenarios in Figure 4 represented by small circles, in contrast, have low event complexity associated with them – and are unlikely to require specialised "real-time" event processing systems. In most cases they can be adequately supported using existing "offline" event processing systems.

Placing event processing in your IT strategy landscape

Recent event processing technology market developments mean that it's now possible to consider implementing a set of event processing technology capabilities as "general purpose" IT infrastructure, rather than using highly specialised technology that's tied to serving one particular application area. Organisations across industries are now making these investments.

As you consider making your event processing technology investment, you need to think about how you can set yourself up to maximise potential reuse of the capabilities that you implement across a variety of scenarios and use cases over time. To do this, you really need to take a broad IT strategy perspective and understand the relationships between these event processing technologies and the components of other key technology initiatives that conceptually overlap – that is, initiatives that play a role in enabling improvements in operational support, or in business agility and business optimisation.

The first issue it's vital to explore is what a holistic perspective of event processing technology looks like. Only then can you understand how event processing should fit with other key IT initiatives and capabilities – including IT systems and network management; business intelligence (BI), data warehousing (DW) and data mining; business process management (BPM) and business activity monitoring (BAM); and business rules management (BRM). We explore all these questions below.

An architectural approach to event processing

Earlier in this report we explored a logical blueprint of an event-processing system; but there's more to an architectural perspective that will drive the effective, broad use of event processing technology.

This architectural perspective is all about the implications of an event processing "orientation" on the way that systems interconnect and integrate. An event-based architectural approach to IT systems integration automates work and moves electronic information between systems and resources not by directly orchestrating and coordinating resources from some central point or "master application" ("ask X to do A, then ask Y to do B, then ask Z to do C"): but instead, by decentralising intelligence and encouraging individual systems and resources to be (re)designed to take on the burden of working out what to do when an event of interest occurs. From a middleware design perspective, this "event orientation" fits naturally with the publish-subscribe model of communication, which fosters very loose coupling between technology systems and resources.

This extreme loose coupling is very important for two reasons. Firstly, in operational support scenarios, loose coupling helps with the scalability necessary to deal with large numbers of widely distributed resources that may emit large volumes of information. Secondly, in business optimisation scenarios, loose coupling helps because it provides a good foundation for improving agility and flexible processing.

Making event processing real: how should event processing relate to other IT initiatives?

With this architectural picture of event-oriented groups of IT systems in mind, getting the maximum value out of an event processing technology investment requires you to get to grips with how other technology initiatives that conceptually overlap with event processing can be best integrated into that picture. In the sections below, we explore several of these initiatives, showing how each conceptually overlaps with event processing technology; and then explaining a little about the value you can get from combining the ingredients in question together.

Business process management, business activity monitoring

Clearly, the central value of BPM and BAM technologies is to help organisations maximise business agility and provide a platform for flexible business optimisation. These technologies differ from general-purpose event processing technologies, though, in the way they typically implement automated work.

The processes that are typically automated (or semi-automated) and monitored through implementation of BPM and BAM technologies are fairly predictable. They're strongly structured at design time, and centrally coordinated by a "process engine" at runtime. That's the nature of the business processes that BPM and BAM technologies are best suited to.

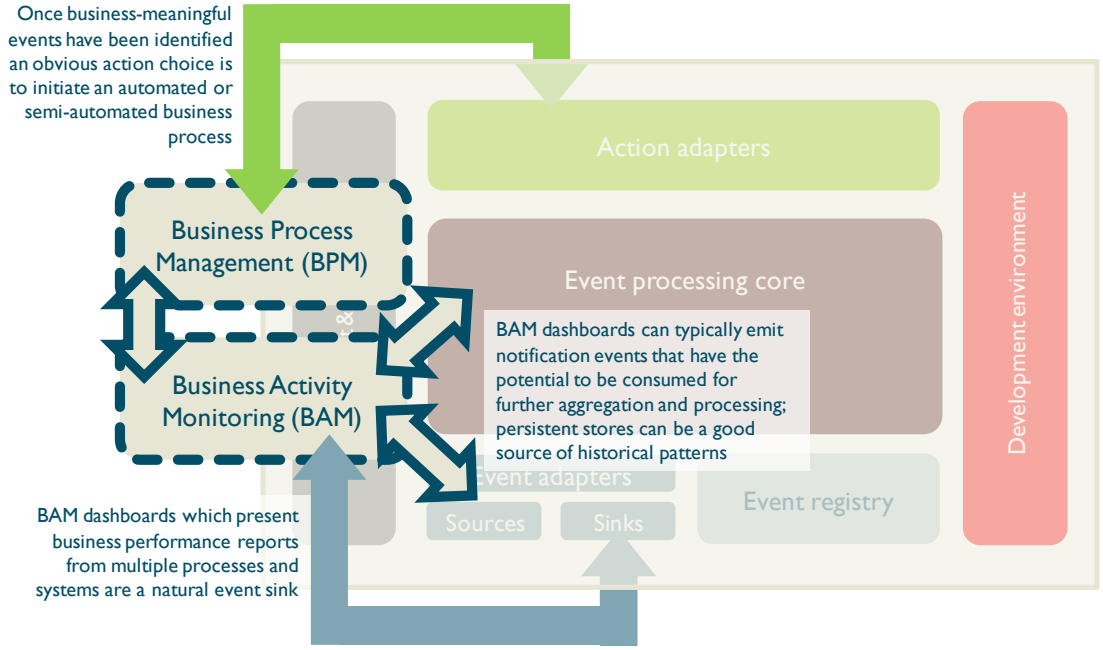
By contrast event processing technologies, as described above, are best suited to automating and capturing unpredictable behaviour that is more suited to distributed, federated control. In fact BPM, BAM and event processing are well-suited to being combined, as shown in figure 6.

Firstly, automated business processes are well-suited to being initiated in response to the receipt of a business event. In some cases, where BPM technology is being used, human operators will manually invoke new process instances; but increasingly, organisations' efficiency and e-business agendas mean that they want to maximise efficiency and responsiveness through direct integration between external-facing systems and BPM implementations. Here, the marriage of event processing technology and BPM can be really valuable – it can reduce process latency and improve business responsiveness and agility.

Secondly, although BAM dashboards are often positioned purely as monitoring environments that "sit on top of" BPM technology implementations, the truth is that to be truly valuable, they should be much more inclusive in nature – being able to collect and aggregate business performance metrics not only from BPM implementations, but also from networks of applications and services, and – of course – event processing technology implementations. In reality, it's very unlikely that any one BPM implementation will give a complete picture of the kinds of business health and performance metrics that senior business people will be interested in.

Lastly, BAM technologies can act as useful sources for event processing initiatives in two respects – they themselves can emit notification events that can be consumed by event processing implementations for wider dissemination or further processing; and in addition, their historical data stores can provide very useful stores of performance and event patterns that can be used to refine decision-making and action rules in your event processing technology implementation.

Figure 6: The role of BPM and BAM



BPM and BAM tools are obvious candidates for integration with event processing initiatives because their focus on automated (or semi-automated) business processes that integrate data and functionality from multiple IT systems is a natural fit; BPM and BAM are both used to drive efficiency in business operations and increased business agility and optimisation.

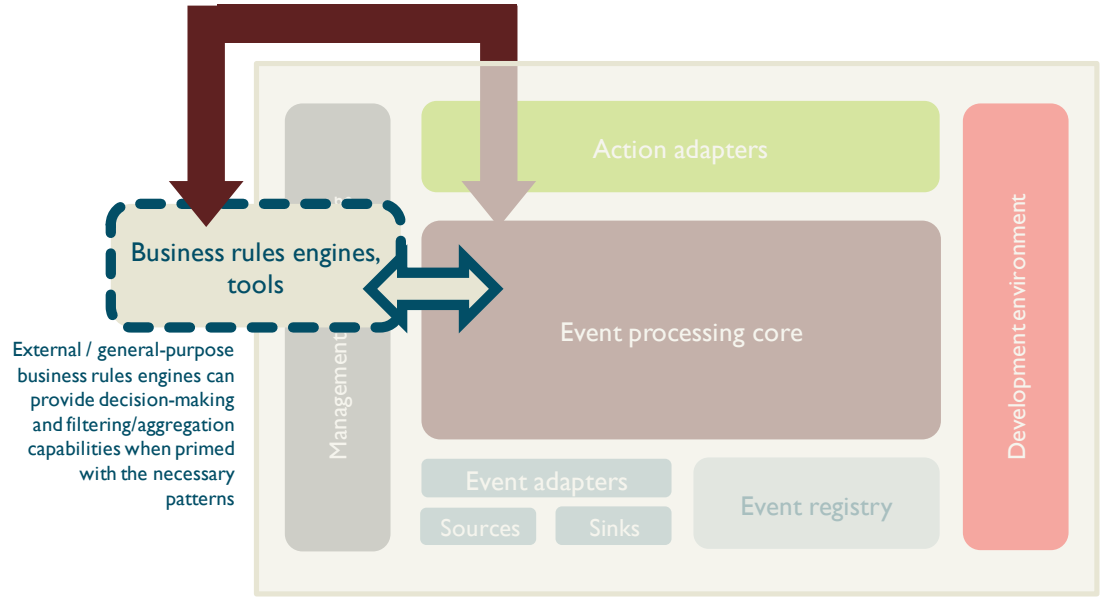
Business rules management

Business Rules Management (BRM) technology (such as that provided by vendors like ILOG/IBM, Corticon, Fair Isaac, Sapiens and Pegasystems) shares a couple of historic attributes with event processing technology. First, although its use is far from new (inference rules engines have been in production in businesses for well over 20 years), it's becoming much more high-profile. Second, the technology is becoming more high-profile largely because it's becoming more affordable, easier to use and less specialised for very particular applications and more general-purpose in nature.

Also, like event processing technology, business rules management technology is squarely aimed at helping organisations with business agility and optimisation challenges. However, although it's capable of simple event processing, BRM technology typically doesn't support advanced event processing requirements: it responds to simple requests to evaluate rules based on some provided data, and returns a result. In truth the two technologies are complementary: event processing technology implementations can leverage external BRM capabilities to help determine how best to respond to detected business events requiring action.

As we explained in the *Event processing infrastructure capabilities* section above, event processing technologies invariably embed some form of rules definition language and runtime engine in order to specify and drive event filtering, aggregation and correlation logic. In many cases, though, organisations will already have made investments in stand-alone BRM implementations, and will have spent significant time and money defining, centralising and standardising business rules within these BRM systems. In these situations, it's impractical to suggest that rules be migrated into new event processing technology systems. As figure 7 suggests, here the link between an event processing technology implementation and an external rules engine makes a lot of sense.

Figure 7: The role of business rules management



Business Rules Management initiatives are a good fit with event processing initiatives because in many cases, their ability to externalise and centrally-manage business rules can broaden the utility of event processing technologies.

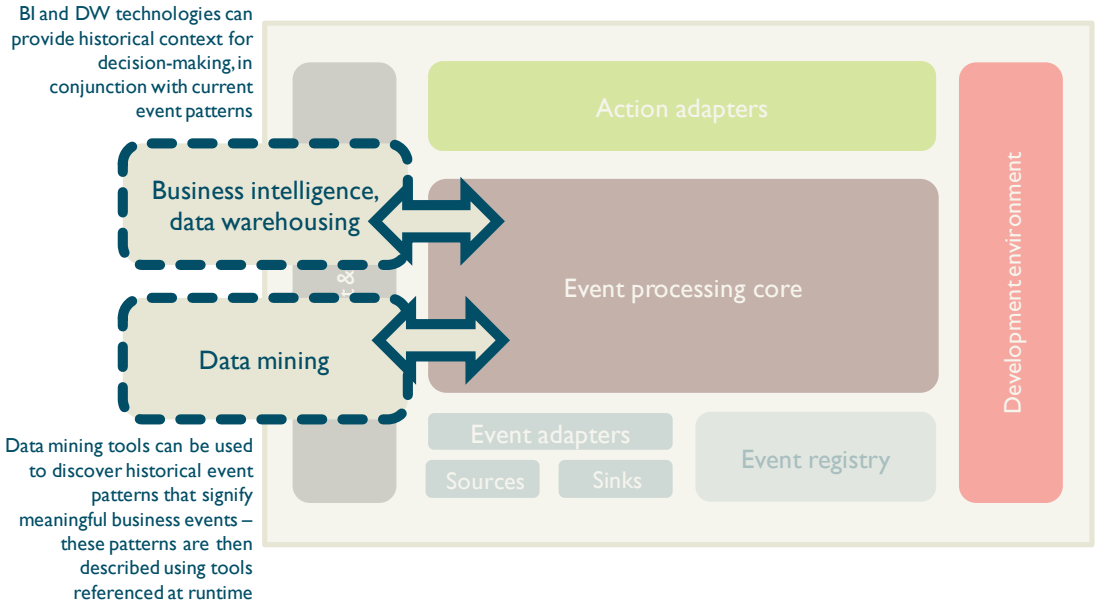
Business intelligence, data mining, data warehousing

Business intelligence, data mining and data warehousing technologies have long heritages as tools to aid business optimisation – though they're clearly distinguished from event processing technologies because all of these technologies work retrospectively on historical representations of events, rather than working in near real-time on current events.

As figure 8 shows, all three of these technologies have clear value to add to general-purpose event process technology implementations. Data warehousing and business intelligence implementations can provide important historical context; in practice, this means that extracts from data warehouses and BI stores can provide reference data for decision-making components of your event processing technology stack.

Data mining's role in business optimisation is in the discovery of important patterns in historical data. Event processing technologies rely on understanding of significant event patterns to drive complex event processing and stream processing/filtering; data mining implementations are ideal sources of this "pattern intelligence". For example, data mining initiatives might discover buying patterns that typically indicate up-selling opportunities; these patterns can be used to configure event capture and aggregation layer technology to drive detection of those patterns in real-time – to initiate highly relevant sales promotions as users browse e-commerce websites.

Figure 8: The role of business intelligence, data warehousing and data mining



Business intelligence, data warehousing and data mining tools can all add value to event processing initiatives by providing sources of event patterns, rules and other contextual data.

IT systems and network management

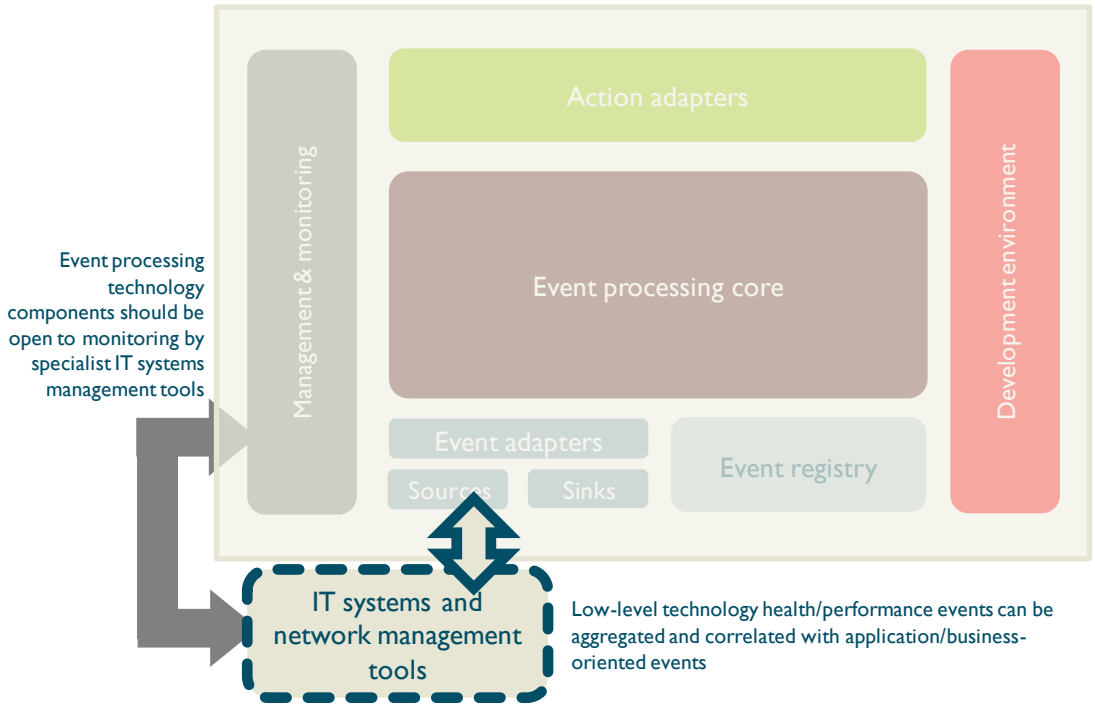
IT systems management suites and network management products (such as those provided by IBM, HP, BMC and Microsoft) use event processing techniques to monitor detailed changes in conditions in network equipment, servers, software environments and so on, filter out unimportant events, correlate events to formulate "higher level" / more abstract events, and act on those events (providing alerts, initiating automated recovery actions, and so on). In other words these systems implement complete event processing stacks along the lines of the architecture we highlight above.

Of course it's completely impractical to suggest that any organisation try to replace the event processing technology embedded in these hardened, professionally developed, commercial systems with general purpose, home-grown event processing environments. However there are clear opportunities to extend and integrate existing IT systems and network management environments with more general-purpose event processing systems.

In the past, IT systems management suites and network management products didn't directly contribute to improvements in business agility and business optimisation, but they were critical to helping organisations with operational support. However today, it's particularly worth considering how IT systems and network management technologies can profitably fit with general-purpose event processing technologies is in support of Business Service Management (BSM) initiatives, which aim to provide organisations with insights into service performance that make sense in the context of business activities (rather than purely in the context of IT infrastructure components).

As figure 9 shows, systems and network management technologies can provide source events to general-purpose event processing technologies, which can correlate these with other events emitted by Business Activity Monitoring (BAM) technologies (see below). At the same time, IT systems management technologies have value to add to event processing technologies by providing independent, centralised IT infrastructure monitoring and management tools.

Figure 9: The role of IT systems and network management



IT systems and network management tools can add value to event processing initiatives not only by helping administrators manage the technology; but they can also emit events that can be combined with events from multiple other sources.

Getting to grips with implementation practicalities

With business and IT now so intimately intertwined, if you're going to make an investment in event processing technology with the aim of boosting operational support in your business, or driving business improvement, your technology has to be able to eventually become part of the general-purpose IT infrastructure, in the same way that RDBMS technology provides general-purpose data management capabilities that can be used in a wide-variety of application scenarios.

You may feel that you don't need this in the short term, but to ensure business value delivery in the longer term, there are three particular practical issues you need to get to grips with. To help you maximise your chances of delivering ROI with event processing technology, you need to work to maximise:

- The extent to which you can bring IT and business people together to jointly develop solutions.
- The extent to which you can make deliberate and planned decisions about how you invest in the technology.
- The extent to which you can set up a governance framework that will help you develop and extend your capabilities and their scope over time.

We explore each of these three event processing implementation practicalities in turn in the sections below.

Ongoing business involvement is of paramount importance

There's no doubt that event processing technology is sophisticated stuff – and in the context of broader event-driven technology initiatives that may also integrate with BPM, BAM, BI, DW, BRM, BSM and IT systems and network management initiatives, there's also no doubt that many aspects of implementing event processing technology can require a disciplined, considered approach.

However it's really important not to underestimate the value of engaging business experts through your implementation of event processing technology, particularly when it comes to "programming" the system with the relevant domain knowledge – that is, significant event patterns, sensible correlation and context processing logic, and optimal actions and outcomes.

What's particularly important about the involvement of business experts is that business engagement shouldn't be a one-off requirements-gathering exercise (as it might have been in the "old days" of waterfall-style software application development) – to get the most value out of these experts, it's most likely that the process of knowledge transfer will have to be iterative and collaborative – indeed, just as is the case when pursuing Business Process Management (BPM) initiatives. One particular example of the likely iterative, collaborative nature of business expert involvement is the discovery of significant event patterns in a particular domain – let's say real-time online product merchandising and promotion. In this situation, simply asking a business domain expert to highlight the kinds of browsing and buying behaviours that signify potential for up-selling might yield a partial rule set, but that rule set is likely to be incomplete and will probably need significant testing, extension and refinement over time. Only by enabling the business domain expert to examine historical event patterns are you likely to uncover a more complete set of rules – and even then that rule set will likely need to be refined over time (quite possibly indefinitely, as product catalogues, promotions, fashions, seasons and buying behaviours change).

With this in mind, it makes sense to look to invest in technology offerings that ship with tools that can at least be shown to business people without scaring them. It won't always be feasible to expect business people (even deep domain experts) to use event processing development tools directly; but the more you can use the provided tools in collaboration with business experts, the better.

Take an architectural approach, or know the risks

The fact that most event processing technology historically has found its way into organisations via specialised applications (for fraud detection, network monitoring, algorithmic trading, and so on) means that it's not always been obvious to purchasers that they have been buying event processing technology.

Of course this isn't necessarily a problem: but if you're interested in exploring a more holistic perspective on how event processing technology can add value to your organisation – either to boost operational support or to maximise business agility and drive business optimisation – it makes sense to keep track of potential investments that will bring event processing technology into your organisation, and manage those investments to try and standardise, integrate, consolidate and reuse infrastructure and resources. It's fine for your organisation to buy and implement these technologies in silos, but such decisions should always be made consciously and in a way that ensures that all interest parties are aware of the risks.

For this reason, it's really important to engage your IT architect community as early in the investment process as possible, as it's architects who should be best placed to outline the implications that new event processing technology investments will have for existing strategic IT initiatives; and also to devise an approach to effectively integrate the relevant technology components (as we outlined in the *Making event processing real* section above).

Governance, just as with SOA, will pay dividends

In the domain of Service Oriented Architecture (SOA), it's now well-understood that in order to get value over the long term, you have to invest in an approach that will guide all the different stakeholders to make the right decisions when they design, build, deploy and manage networks of services. Without a governance framework in place that directs these activities and ensures that both IT and business teams act in the best interest of the overall initiative, what tends to happen is that the real potential of SOA – which comes in large part from standardisation and reuse of language, technology definitions, code and infrastructure – is completely missed. Initiatives fracture, fragment – and organisations end up back where they started.

The lessons we've learned from SOA leaders are just as relevant in the domain of event processing. Just as a lack of SOA governance is likely to lead to redundant service interface and message definitions and low service reuse, lack of governance in your event processing technology initiative is likely to lead to over-proliferation in the definition of events, patterns, and event processing rules or code components. Just as a common information model is crucial to gaining medium- and long-term success with SOA, so it's also crucial to attaining the best results with event processing.

Externalising and sharing definitions of key event types and rule designs is a great way to promote integration between your event processing initiative and other strategic IT initiatives as well as promoting reuse. This means you'll need some kind of tool and store for recording and sharing that information – but in the early stages of your initiative, using a full-blown commercial-grade metadata registry may well be overkill: a simple set of spreadsheets or a simple database application is likely to be just as, if not more, effective.

Conclusion

Event processing isn't new, but the technology has now matured to the extent that it's breaking out of its historical niches and becoming much more immediately relevant to broad issues of business performance optimisation. However, although organisations of all shapes and sizes are becoming more event-driven as the level of work automation and integration increases, most haven't yet made the conceptual leap that enables them to see how they can harness the potential of knowledge about events that affect them, their markets and environments.

In this report we've shown how the effective application of event processing technology can boost the competitiveness of your organisation – through both driving operational improvement, and driving business agility. Now is the time to explicitly address the event processing opportunity and "close the event loop" – don't be satisfied to merely help your organisation record the shadows of events in databases for analysis after the fact; employ strategies to uncover and analyse key business events as they occur, and act on the situations that they signify as those situations unfold.

As you take the next step and start to explore how to invest in event processing technology, remember that each potential opportunity for application of the technology will likely make some capabilities more important than others. Analyse your needs in the light of potential use cases that may arise – looking at factors like event complexity, the speed of response required, and the type of business value obtained – and use these to prioritise your technology requirements.

A key task you need to start working on early is the engagement of domain experts within your organisation. Domain experts have the most useful insights into significant events and patterns, decisioning rules and actions – the "content" for event processing systems – and they will need to work iteratively with IT staff to give you the most value. With this in mind, the importance of tools that are easy for domain experts to engage with is obvious.

Lastly, although it might be unwise to kick off your event processing initiative with a "big bang" enterprise-wide technology investment, and instead pursue a series of more bite-sized projects that each build on the outcomes and skills obtained from previous projects, you nevertheless need to take investment decisions against a "big picture" backdrop of knowledge about other strategic IT initiatives in play.

To maximise the value of your event processing technology investments, you need to make sure you take account of how strategic IT initiatives (including Business Process Management (BPM), Business Activity Monitoring (BAM), Business Service Management (BSM), Business Rules Management (BRM), business intelligence and data warehousing) can add value to them. Without a "big picture" IT strategy view influencing your investment and linking it to business capabilities and requirements, you risk creating event processing silos and missing broader opportunities to drive the unencumbered flow of valuable business event information.

Appendix: Some background on event processing technology and its current variants

The 2002 publication of *The Power of Events* by Dr. David Luckham catalysed much of the current interest in event processing technology, with its introduction of the notion of Complex Event Processing (CEP). This is just one of what can seem a confusing array of technical terms and concepts.

A detailed discussion of the technical theory associated with event processing technology, and the numerous variations of event processing technology that are commercially available today, is beyond the scope of this report. If you're interested in finding out more about these topics, we recommend an excellent independent online resource dedicated to event processing technology: the website of the Event Processing Technology Society (EPTS) – a not-for-profit organisation, initiated by David Luckham and others, which aims to "*promote understanding and advancement of Event Processing technologies, [and] to assist in the development of Standards to ensure long-term growth [of this technology sector].*"

The EPTS publishes a good event processing technology glossary, which provides thorough explanations of relevant terms including Event Stream Processing (ESP), Complex Event Processing (CEP), and Event Processing Networks (EPN). You can find the glossary at:

http://www.ep-ts.com/component/option,com_docman/task,doc_download/gid,66/Itemid,84/