



Service-oriented architecture:
The foundation for enterprise
performance management

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Abstract

Efficient. Reliable. Agile. An enterprise performance management solution must be all of these. So the key is to build the solution on a service-oriented architecture (SOA) that is open and standards-based, platform neutral and location transparent, among other things. The IBM Cognos® 8 platform architecture is based on these SOA principles, providing a solid – yet adaptable – foundation that is ideally suited to the large enterprise.

Overview

The thousands of articles, presentations, podcasts and blogs that have been written about service-oriented architecture are a clear acknowledgement that SOA provides significant benefits for developing business applications. Yet, in a recent survey of almost five hundred business and IT professionals, Ventana Research learned that, while 81 percent of respondents view SOA as important for business intelligence (BI), many still have much to learn about what SOA is and what it means for BI, a key aspect of performance management solutions.

This whitepaper addresses that need for basic knowledge about SOA, and for a clear understanding of the value of SOA for deploying performance management solutions. It outlines the principles of SOA in the context of these key questions

- Why is SOA critical for performance management?
- How does SOA compare with other performance management architectures?
- How did IBM apply SOA principles to the IBM Cognos 8 platform to ensure that customers gain the value of SOA in their performance management deployments?

The paper also includes scenarios that illustrate how the SOA underlying the IBM Cognos 8 platform has helped real customers achieve very specific business goals.

Business problems

The importance of SOA for enterprise performance management

Time and again, companies tell us that their performance management requirements are not only increasing in importance, but in scope. There are many different factors that affect performance, but the most critical—and the most fluid—is the decision making that happens at every level, in every function, and in every region of your organization. Every one of those decisions is based on the information people have on hand. If that information is on target and reliable, timely and easy to consume, better decisions result. Information that is inaccessible or incomplete, late or inaccurate has a direct and negative impact on decision making and performance.

Decision makers throughout the organization that contribute to these performance areas need capabilities so they can find answers to three basic questions that drive performance. They need to be able to measure and monitor their business and share current status, and allows them to find answers to the question, “How are we doing?” The IBM Cognos 8 BI and IBM Cognos 8 Planning, underpinned by the IBM Cognos 8 platform, provide them with the following capabilities:

- **Reporting and analysis** – Allows users to dig down and determine why the situation is what it is. Business intelligence, specifically reporting and analysis, helps them make sense of what has happened, provides them with ability to look at historical data and understand trends, and the ability to look at anomalies in order to understand “why?”
- **Planning** – Takes the understanding of what’s going on and sets a forward-looking view of the business, which is used to measure and monitor against actual performance, and answers the question: “What should we be doing?”

- **Financial capabilities** – With automated planning, budgeting and forecasting, organizations have the ability to swiftly allocate and re-allocate resources to unlock opportunity, and set goals and expectations for those investments. This ability, to adapt to change, results in a more responsive business model and refreshed and forward-looking view of the business.
- **Scorecards and dashboards** – Provides the link back to strategy because they enable individuals – regardless of where they sit in the organization – to understand the goals and align their behavior and decisions against what's important.

Expanded use across the organization

As business intelligence and planning have become mission critical for managing the performance of their organizations, the use of performance management has expanded dramatically, crossing traditional departmental and divisional boundaries to span the enterprise.

Business users want BI and planning to be part of the world in which they work every day; to integrate with their company portals and search capabilities, to be accessible via mobile devices, to work within process flows and with other applications.

If it is to address these sorts of enterprise needs, performance management (PM) must fit into existing infrastructures that typically are varied, complex, and continually evolving. The PM platform must not only take into account multiple applications, platforms, and data sources, it must do it within the resource and budgetary constraints of an organization's IT department. Organizations must be able to scale their PM solutions from hundreds to thousands of users without imposing an unreasonable burden on IT resources.

SOA is widely touted as the foundation that enables performance management to meet these requirements and helps solve longstanding challenges faced by IT in an enterprise environment. To explain why this is the case, it is important to understand first what these new enterprise requirements mean for a PM solution.

Enterprise performance management must be efficient, reliable, and agile

Discussions with many of our customers about the value of architecture in enterprise performance management solutions have made it clear that three critical requirements make a PM platform effective in an enterprise environment: efficiency, reliability, and agility.

A performance management solution must be efficient, must minimize the burden on IT, and reach more users with wider sets of needs. An efficient solution can be deployed, maintained and expanded with the fewest resources and without wasted effort. For PM, this means it must fit into existing infrastructures, adhere to policies and standards, and leverage the IT skill sets that drive overall information technology strategy. In a world of limited resources, the fewer moving parts there are for IT to deploy and maintain the better.

A performance management solution must also be reliable, performing predictably in increasingly complex environments, and provide the robust, dependable performance and 24/7 availability demanded of an enterprise solution. As PM expands across the organization, the PM platform must scale reliably to provide predictable, dependable performance for increasing numbers of users, many of them with new and different demands.

Finally, a performance management solution must be agile, respond quickly to rapidly changing business needs and ever-growing user communities, and adapt easily to new standards as technologies evolve. The PM platform must provide IT with the confidence that solutions can be implemented today and still align with the future vision for the architecture of the enterprise.

Business drivers

Built for the enterprise: The seven principles of SOA

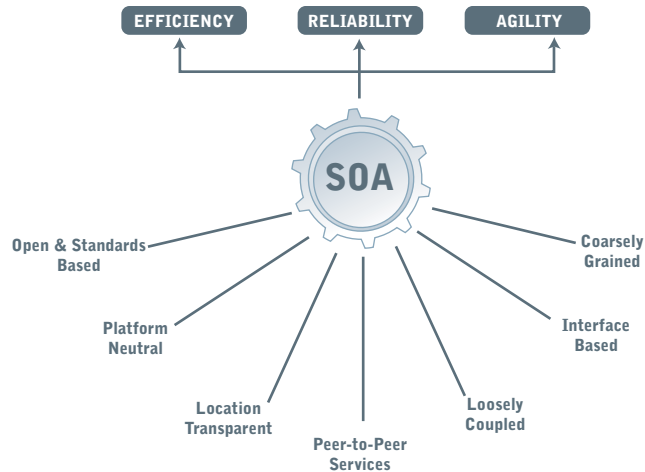
The architecture on which a performance management solution is founded can have a significant impact on its efficiency, reliability, and agility. It was these critical requirements of enterprise PM that led to service-oriented architecture (SOA) when designing the IBM Cognos 8 platform.

But what exactly is SOA? It is not surprising, given the overwhelming amount of information available on the topic, that there is no single, accepted definition of SOA in the marketplace. Often, the term SOA is used interchangeably with Web services. But while Web services are often used to implement SOA, it is important to distinguish between the two. As noted in the IBM article *Migrating to a Service-oriented Architecture*,

“It must be understood that Web services does not equal service-oriented architecture. Web services are a collection of technologies, including XML, SOAP, WSDL, and UDDI, which let you build programming solutions for specific messaging and application integration problems.”¹

SOA is more than just Web services, and it is more than just a type of architecture. It is a methodology; an approach to architectural design based on a wide variety of principles. There are seven key principles underlying SOA that make it the architecture of choice to deliver efficient, reliable, agile enterprise performance management:

- **An open, standards-based architecture** – one that can leverage other services, such as security, without duplicating them, and one that other services can access without needing to duplicate any of the architecture’s components. Adding standards to this openness ensures that all of the services speak the same language, share the same protocols, and can easily communicate among themselves.



Seven key principles of service-oriented architecture (SOA) enable BI solutions built on SOA to be efficient, reliable, and agile in meeting the needs of business users.

With open standards, SOA-based platforms provide organizations with an efficient way to integrate with existing IT infrastructures without having to duplicate functions or deal with issues associated with proprietary application servers. Modern Web standards, such as Simple Object Access Protocol (SOAP), Web Service Description Language (WSDL), and Web Services for Remote Portlets (WSRP) underlie SOA, providing the common language and protocols needed for communication and ease of integration. They ensure that SOA environments can leverage existing infrastructure components, such as the Web, routers, and firewalls, and that the solution can integrate with other programs and easily be extended to meet overall business needs.

- **Platform neutral and location transparent** – not tied to a particular operating system or platform. Organizations can run SOA-based solutions on their existing, often heterogeneous mix of hardware, databases, and application servers without having to maintain different executables for different environments. For example, services for the same solution can be located on both Microsoft® Windows® and UNIX® environments without needing additional effort to ensure they can communicate with one another.

- **And SOA is location transparent** – all services plug into a ubiquitous network using the Internet protocols of SOAP and XML. As a result, services don't need to know where other services reside to communicate with them. This provides IT with an efficient means to leverage the available capacity across the entire network. And it ensures that the business does not have to concern itself with where a particular service is deployed. This means, for example, that a solution built with SOA can fit with the IT hardware strategy that a company has deployed, from centrally managed large-capacity servers, to geographically dispersed clusters.
- **Peer-to-peer and loosely coupled** – no master service, and no service is more important than another. This means that every service is capable of complete fault tolerance. Any request can be handled by any service of the same type within the overall configuration of services. Peer-to-peer services are self-aware, so they can spawn to manage an increasing workload. If they do happen to fail, they will try to restart themselves.

To be efficient, these peer-to-peer services must be loosely coupled, with each service performing a discrete function. No service needs to know how the others do their jobs, what they are doing at any time, or where they reside. As a result, loosely coupled, peer-to-peer services provide tremendous reliability by ensuring built-in, automatic redundancy for uninterrupted access if a server fails.

- **Interface based and coarsely grained** – common messaging protocols enable communication between services. A service publishes what it does and how to communicate with it without requiring other services to understand how its task is completed. It only requires an interface for communication. Once this interface is established, a world of possibilities opens when it comes to how you can leverage the different services.

With SOA, services are coarsely grained. This is at the heart of one of the most touted of SOA's benefits – the ability to reuse services across processes and applications. Services that are defined at a low level – that are too finely grained – create an overloaded, unmanageable catalog. On the other hand, services that are too high-level result in less meaningful reusability and integration. Coarsely grained services, which are purpose-built for a specific business function, reduce traffic and ease integration because services are defined at the business level rather than at a lower or higher level.

Building a platform based on SOA means incorporating all of these principles – open and standards based, platform neutral, location transparent, peer-to-peer, loosely coupled, interface based, and coarsely grained – when designing and building the architecture. By applying these principles within a platform design, the enterprise solution requirements for efficiency, reliability, and agility are addressed as part of the underlying platform on which the entire solution is built.

What about other architectures?

The principles that enable SOA to meet the criteria for an efficient, reliable, and agile performance management solution are often mistakenly attributed to other architectures as well, such as traditional client-server architectures and client-server architectures with Web-services wrappers. But these architectures do not match SOA when it comes to delivering the efficiency, reliability, and agility demanded of enterprise PM.

Efficiency challenges

We have noted that an efficient performance management solution expands easily in a complex and changing technical environment, without wasted effort. When it comes to reaching more users and to delivering information in different ways to an increasingly mobile work force while staying within the resource constraints of the IT department, the client-server approach has its challenges. Client-server applications must be pushed out to the desktops of increasingly large numbers

of users with greatly varying access requirements, which results in considerable deployment and maintenance efforts. Separate executables are needed for different platforms. And, since client-server is designed for a complete infrastructure stack, leveraging new technologies requires replication or intermediation. Client-server architecture is just not as efficient, and consequently not as cost effective, as an SOA platform.

Some performance management providers have dealt with these limitations of client-server architectures by wrapping their client-server solutions in Web services in an attempt to provide a Web front end for users across tools. But this does not change the underlying infrastructure. With the same components under the covers to deploy and maintain, the IT burden associated with administering a client-server solution is not addressed. With a service-oriented architecture, the efficiency is built into the design – through re-usable, coarsely grained services purpose-built for business functions. With open, standards-based services that are platform neutral, duplication across stacks is eliminated and applications are no longer tied to a desktop.

Reliability challenges

We also noted that a reliable solution performs predictably and robustly, providing dependable 24/7 service in a complex, rapidly changing technical environment. With a client-server approach, an entire application can be brought down by a single server failure, jeopardizing reliability. Although reliability can be achieved with client-server, the cost can become prohibitive, since failover strategies for mission-critical applications often require excess capacity and additional administration to manage the risk of system failure.

As well, with performance management solutions, usage is cyclical, with peak periods aligned with standard review periods. For example, there is often increased demand for reports at the end of a month or quarter that causes a brief spike in system usage. Mission critical client-server solutions are tied to specific stacks, and require hardware sizing to manage for this peak usage. Again, adding a Web-services wrapper does not resolve the risks associated with a single point of failure. The same steps must be taken, and the same costs incurred to ensure reliability where Web services wrappers have been introduced.

Service-oriented architectures built on peer-to-peer services have no single point of failure. The nature of the services delivers reliability. Because services are not tied to a specific hardware configuration, and can be located anywhere on the network, excess capacity in an infrastructure can be leveraged for peak periods. It does not necessarily require the additional investment of a client-server environment to ensure 24/7 reliability.

Agility challenges

Finally, an agile solution is one that can respond quickly to changing business needs and integrate easily with new and changing components in an evolving technology infrastructure. New methods of delivering information mean new integration points. There is increasing demand to deliver performance management into the world in which users work every day, including company portals, existing applications, on mobile devices, and using enterprise search. With client-server, this type of integration often comes with a sizeable effort and cost, as specific interfaces must be built for each new integration point.

While embracing standard communication protocols can ease some of the short-term integration pains associated with a client-server infrastructure, wrapping existing applications in Web services has longer-term implications for a solution's agility. It does not provide long-term agility, and it typically results in one of two outcomes.

When entire applications are wrapped, integration is eased at the application level. At this high level, these Web services represent a collection of business functions, making re-use of them impossible. Consider an example of wrapping an entire order-processing application. There are several business functions within the application, such as order entry, credit authorization, and order confirmation, which are now combined into one service, making re-use at the business level out of the question.

At the other end of the Web-service definition spectrum, when Web-services wrappers are applied, because the services have not been built to be coarsely grained, the APIs are at a lower level based on technical functions. As a result, many services are needed to represent one allow for the agility that a coarsely grained service provides. It simply becomes too difficult to manage all the parts required for re-use. To continue our example, with Web services wrappers at a technical level, several APIs may exist for a business function, such as credit authorization. Re-using these in a different business context would require identifying and managing all of the services.

A Forrester Research report noted that:

“Developers can quickly connect two systems using Web services without thinking through the broader design issues associated with a full view of SOA— and even without thinking much about the design of service interfaces at all. However, without SOA’s broader design concepts, developers risk creating services that are not as flexible and reusable over the long haul.”²

Clearly, client-server and Web-services-wrapped architectures cannot compete with SOA when it comes to providing a cost-effective foundation for efficient, reliable, and agile enterprise performance management.

Requirements	SOA	Client Server	Web Services Wrapper
Efficiency			
• Leverage existing infrastructure and easily adapt to change	✓	✗	✗
• Minimize solution components to deploy and maintain	✓	✗	✗
Reliability			
• Scale to support mission-critical deployments	✓	✗	✗
• Meet service delivery commitments while minimizing burden on IT	✓	✗	✗
Agility			
• Adopt new standards to deliver on new business requirements	✓	✗	✓
• Ease integration points to respond quickly to changing business needs	✓	✗	✓

The solution

We've seen that service-oriented architecture provides a superior foundation for developing an efficient, reliable, agile enterprise performance management solution. That's why the SOA principles were adopted when building the IBM Cognos 8 platform, the foundation for the IBM Cognos performance management solutions, including IBM Cognos 8 BI and IBM Cognos 8 Planning. And it's an important reason why the IBM Cognos 8 platform is so adept at helping organizations, like those described in the scenarios that follow, to meet their PM solution needs.

A single set of standards-based services for efficiency

The SOA principles of open and standards-based, platform neutral and location transparent enable a performance management platform to fit into existing and changing IT environments, so that IT can leverage their infrastructure investments. Efficiency is further delivered through coarsely grained services built around reusable, business-relevant functions.

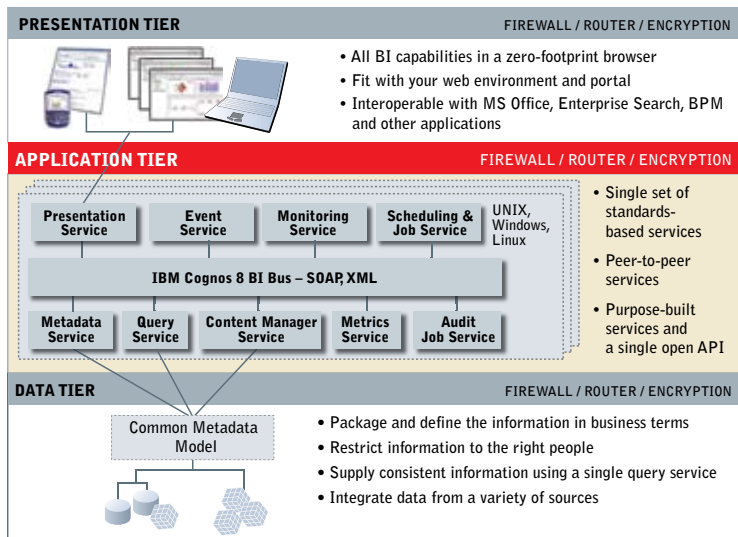
The IBM Cognos 8 platform was built with these principles in mind. A single set of standards-based, peer-to-peer services ensures that IT can leverage their existing operating systems, hardware, and security. A single set of services underpins performance management capabilities, including reporting, analysis, ad hoc query, scorecards, dashboards, planning and event management. This means there is only one presentation service, one query service, and so on, to be managed for all types of performance management requests. With the IBM Cognos 8 platform, there are fewer moving parts to deploy and maintain.

Because it has a single set of standards-based services, the IBM Cognos 8 platform is easy to integrate into your IT infrastructure. For IT, this translates into ease of deployment, maintenance, and change. For business, it means that users can access the information they need, no matter where the data resides or what changes are taking place in the infrastructure. This ease of deployment puts information into the hands of decision makers faster, accelerating the impact of the performance management solution on the business.

Customer scenario 1: IBM Cognos 8 BI in a changing environment

The efficiency that the SOA foundation provides IBM Cognos 8 BI is illustrated by a global organization that wanted to reduce the total cost of ownership of its BI solution by standardizing on an open performance management platform. At the same time, a large project was underway to consolidate the organization's IT infrastructure. They needed to be confident that the BI solution they implemented would operate effectively on their current infrastructure, yet be easily managed as they moved to new infrastructure standards in their evolving, rapidly changing IT environment.

For this organization, SOA was a deciding factor in choosing IBM Cognos 8 BI as their solution. The standards-based, platform neutral, location transparent nature of IBM Cognos 8 platform meant they were confident they could successfully deliver BI without interruption to the business community, despite their ongoing large-scale infrastructure changes. This would not be possible with Web services wrappers alone, because the underlying infrastructure would remain dependent on platform and server location. With the IBM Cognos 8 platform underpinning the BI solution, the result was an efficient solution that accommodated the customer's infrastructure changes, could easily adapt to future changes, and enabled them to realize a recurring annual savings of \$60 Million.



Service-oriented architecture

Peer-to-peer services for reliability

Not only does the IBM Cognos 8 platform architecture feature a single set of standards-based services, these services are also peer-to-peer. There is no concept of a master service. All services are loosely coupled, so no service needs to know what each of the others is doing or where it resides. This independence means that if one service fails, others are not impacted.

IBM Cognos 8 platform services are self-aware. As load increases, they spawn to automatically handle additional workload. If a service fails, it tries to restart itself. In the meantime, requests sent to that service are routed to another service of the same type, which can be located anywhere on the network. This provides tremendous reliability, because the configuration has automatic redundancy built in. And, because services don't need to know where they reside, organizations can leverage idle capacity during peak periods by re-routing requests to services on different servers in different locations. The result is mission-critical, 24/7 reliability. IT can be confident in their ability to manage the solution, and business users know the service-level commitments of IT will be met.

As we noted, with Web-services wrappers and client-server environments, bottlenecks and failover strategies have to be carefully planned and managed, adding administrative overhead. Although reliability can be attained, it comes at a price. As with any cost-benefit tradeoff, it comes down to deciding how much of an investment you are willing to make in hardware and administration to achieve the reliability you need. With SOA-based performance management platforms, such as the IBM Cognos 8 platform, reliability is built into the architecture's design.

Customer scenario 2: Managing for peak periods with IBM Cognos 8 BI

The reliability of the IBM Cognos 8 platform is illustrated by a customer who leveraged the peer-to-peer services to manage for peak periods of usage. They knew there was increased demand for reports every month-end. They needed to accommodate the demand, but they didn't want to invest in idle capacity to address those few days of increased usage each month.

Because the IBM Cognos 8 platform architecture is peer-to-peer, platform neutral, and location transparent, the customer has a lot of flexibility in how to distribute services. For those few days in the month when demand peaks, they leverage their development and test environments to accommodate the increased demand. As a result, they are able to meet their service-level commitments without having to invest in additional hardware.

With Web-services wrappers and client-service applications, this type of flexibility is not possible. Once the application is deployed, it cannot be reallocated as needed to meet changes in demand. Users either face slower response times, or IT must invest to ensure enough capacity is available to meet peak demands – even if it is only needed once a month.

Purpose-built services for agility

The IBM Cognos 8 platform also uses SOA principles to enable one of the most heralded of SOA benefits – business agility. Customers tell us they are looking for agility in a number of ways. They want to deliver performance management to their users in the environments in which they work every day. This includes corporate portals, applications such as Microsoft Office, their enterprise search facilities, and mobile devices. When implementing PM, they look for a solution that not only delivers on today's PM requirements, but that can evolve with changing business demands. They want a technology built on principles that align with their evolution to SOA.

From an SOA principles perspective, agility results from being open and standards based, interface based, and coarsely grained. With the IBM Cognos 8 platform, we deliver that ease of integration with a single open application program interface (API) founded on SOAP and XML. The API enables our performance management platform to integrate with Microsoft Office, business performance management (BPM) solutions, enterprise search capabilities, and other applications. The IBM Cognos 8 platform API also allows us to work effectively with partners to help customers easily leverage their infrastructure investments, including software, hardware, and middleware.

Because our services are coarsely grained, customers can easily integrate other business functions. And the purpose-built nature of the IBM Cognos services means that additional innovations, such as mobile technologies, can leverage existing query and presentation services and other resources.

Often, when Web-services wrappers are applied, the APIs are at a lower level, based on technical functions, because the services have not been built to be coarsely grained. The use of standards does ease the integration, but does not allow for the agility that a coarsely grained service provides. Recall that, with Web-services wrappers at a technical level, several APIs may exist for one business function. These must not only be managed, but can only be reused at the business level with great difficulty.

Customer Scenario 3: Delivering innovation with IBM Cognos 8 BI

One of our customers wanted to deploy BI as part of a broader data management solution. They were trying to get a handle on large volumes of data, both structured and unstructured, residing in many disparate systems. They knew the users' requirements would include leveraging new ways to access data, such as on mobile devices or through enterprise search. And they wanted an integrated solution to provide an infrastructure that could help them with both their content management and BI needs.

With IBM Cognos 8 platform and our open API, they were able to easily integrate with their other solution partners and successfully manage their data and data sources. They can address future needs to access data with a PM roadmap that includes our search and mobile capabilities. Because the IBM Cognos 8 platform is built on a service-oriented architecture, they have the confidence their business intelligence needs will be met now and in the future.

Conclusion

With enterprise performance management solutions comes new requirements for the underlying platform, on which the solutions are built, deployed, maintained, and evolve.

The key to ensuring that an enterprise performance management solution meets the requirements of efficiency, reliability, and agility is to build it on an architecture designed for the enterprise – one that is open and standards-based, platform neutral, location transparent, and that features peer-to-peer services that are loosely coupled, interface based, and coarsely grained. While architectures such as client-server and client-server with a Web-services wrapper typically cannot deliver on these requirements, service-oriented architecture (SOA) fully meets each and every one of the requirements.

It was the need for efficiency, reliability, and agility described by countless IBM Cognos customers that led us to build the IBM Cognos 8 platform on an architecture based on SOA principles. With this foundation in place, customers have efficient solutions that fit within fast-changing environments, the reliability needed to function effectively in the face of diverse and changing business requirements, and the ability to be innovative in their approach to doing business – raising their performance to a higher level.

Customer Requirements	Cognos Provides	Benefit	
		To IT	To Business
Efficiency	<ul style="list-style-type: none"> Single set of standards-based services 	<ul style="list-style-type: none"> Fit within your environment 	<ul style="list-style-type: none"> Shorten time to adoption
Reliability	<ul style="list-style-type: none"> Peer-to-peer services 	<ul style="list-style-type: none"> No single point of failure 	<ul style="list-style-type: none"> Builds user confidence
Agility	<ul style="list-style-type: none"> Purpose-built services and a single open API 	<ul style="list-style-type: none"> Deliver on changing user requirements 	<ul style="list-style-type: none"> Deliver on changing user requirements



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Endnotes

¹ IBM, *Migrating to a Service-oriented Architecture, Part 1*, Kishore Channabasavaiah, Kerrie Holley, Edward Tuggle, Jr., December 2003. <http://www.ibm.com/developerworks/library/ws-migratesoa/>

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About IBM Cognos BI and Performance Management

IBM Cognos business intelligence (BI) and performance management solutions deliver world-leading enterprise planning, consolidation and BI software, support and services to help companies plan, understand and manage financial and operational performance. IBM Cognos solutions bring together technology, analytical applications, best practices, and a broad network of partners to give customers an open, adaptive and complete performance solution. Over 23,000 customers in more than 135 countries around the world choose IBM Cognos solutions.

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