IBM

Empowering product lifecycle management with service oriented architecture

How SOA makes PLM more flexible and cost-effective to support business imperatives

Contents

Corporate leaders make tough decisions every day, usually without all of the information they would really like to have. For example: Engineering has proposed a change to a top-selling product. The change will make the product better, but at what cost? How many parts in inventory will be made obsolete? What new tooling will need to be designed and developed, and how long will it take? What customers will be affected, and how are they likely to respond? In short, is there more risk than reward in making the change?

Traditionally, answering these questions has required a combination of Product Lifecycle Management (PLM) and Enterprise Resource Planning (ERP) information that was available only through complex manual data compilation and analysis. Finding the answers could take weeks, time that often is not available or that could give a competitor an advantage in the marketplace.

But profound changes in information technology infrastructures are changing this paradigm. A powerful new approach to Information Technology (IT) known as Service Oriented Architecture (SOA) is breaking down the barriers between IT systems and applications to deliver actionable business intelligence in ways never before possible.

The combination of SOA with PLM is especially powerful, enabling greater insight into the business impact of engineering decisions, facilitating collaboration with external partners regardless of the systems and applications they have chosen, and leveraging legacy PLM investments while reducing the cost and complexity of deploying new or updated applications. As CIMdata recently observed, 'SOA can significantly reduce a (user's) exposure to costly upgrades and deployment expenses and will preserve their tailored implementations'[1].

What is more, SOA offers the potential for companies to empower the investment they have already made in PLM, transforming it from a tool used primarily by product engineers into a powerful business decision support enabler that allows users to react quickly to sharp changes in market direction – or to initiate changes the rest of the market must scramble to match.

To understand how and why PLM is poised to become a key driver of competitive business advantage, however, it is important to first understand the forces at work in the market, the forces at work on PLM, and how the two are converging to give business leaders unprecedented power to innovate their businesses.

A new approach for a new world of challenges
Today, Chief Executive Officers (CEOs) are concerned with the same business objectives that have consumed them through the ages, including revenue growth, cost reduction, asset utilisation and risk management. But how CEOs expect to achieve these business objectives has made a radical shift.

For several years, CEOs have been focused on product innovation as a driver of competitive advantage, recognising that innovation is a means to achieving all those other goals.

Just recently, however, their understanding of what enables innovation has changed, leading to a new focus not just on innovating products and services, but also on innovating the business processes and business models that influence the creation of innovative products.

This new focus on innovating not just products, but how products are created and commercialised, is a reaction to rapidly accelerating change. In a world where competitors can emerge overnight from anywhere on the globe and breakthrough innovation can fundamentally shift the competitive landscape, the ability to continually scan the horizon for threats and opportunities and then change directions on a dime to meet or seize them has become paramount.

To succeed in this environment, key players throughout the extended organisation need the information to quickly make good business decisions while achieving flexibility within the business model. They need a supporting IT infrastructure that allows them to immediately act on those decisions, and they need to be optimally integrated with their customers and value chain partners to implement those actions. Specifically, they need:

- *Robust business decision support* to enable the right decisions at the right time
- *Flexibility and responsiveness* that allow organisations to change directions in an instant if market forces dictate
- *Tighter integration with the value chain* to leverage contributions from partners while ensuring multiple organisations act as one.

Industry studies show, however, that most companies are not achieving these objectives. For example, two-thirds of Chief Financial Officers (CFOs) responding to a recent IBM survey believe that their product information is not easy to use, tailored, cost-effective or integrated. One contributor to this problem is the fact that most companies have multiple product information repositories – 25 percent of companies have at least 15 of them! That makes information difficult to find and act upon in a timely way; In fact, CFOs estimate that people in their organisations spend at least 20 percent of their time just searching for information.

CEOs recognise the need for improved flexibility and responsiveness. In the recent IBM Global CEO survey, which drew responses from 765 companies of all sizes in a wide variety of industries, 87 percent of respondents said their organisations will require fundamental change to succeed in driving innovation in the next two years (Figure 1). More than 80 percent said their organisations traditionally have been largely unsuccessful in managing change in the past, and only one in ten CEOs believes their organisation has the ability to respond to rapidly changing market conditions.
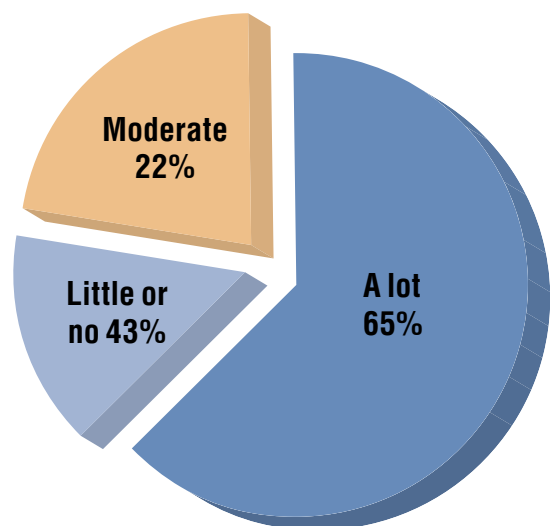

Figure 1 – Extent of fundamental change needed over the next two years.

CEOs also recognise the important role that the integration of business and technology plays to improve the flexibility and responsiveness of their organisations. Nearly 80 percent of CEOs responding to the IBM survey rated business and technology integration of great importance – but only half said they are executing at the levels required. This failure is costly: 'Extensive integrators' reported three times the revenue increases of less integrated companies. IBM's own financial comparisons estimate that 'extensive integrators' grow revenues five percent faster than their competitors.

An ecosystem of partners, a web of relationships
The challenge of meeting these objectives is compounded by the need to operate effectively within a value chain. Today, delivering the product the market wants requires cooperation among a complex ecosystem of players, from the customer-facing OEM to its design partners, their suppliers, and a host of manufacturers. Simultaneously, distributors and retailers join the network, delivering the product to customers and providing in-field service after the sale (Figure 2).
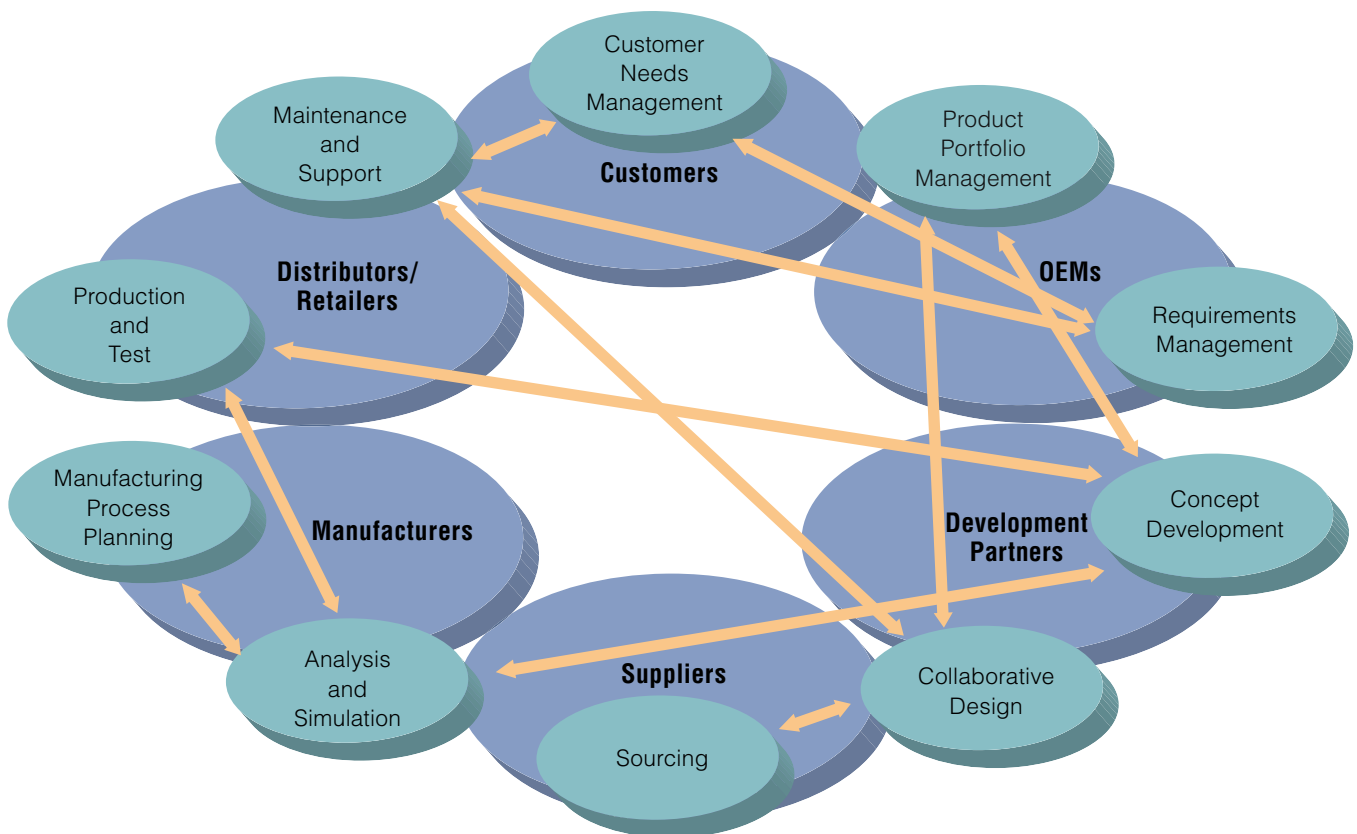

Figure 2 – Product development takes place within a complex ecosystem.

Finance and business controls govern revenues and costs. But because product development processes extend across multiple companies, much of the information required to establish these financial targets is known only by the partners, suppliers and manufacturers who design and source the components. Their activities, in turn, rely on information in systems they may not fully control, such as inventory and manufacturing scheduling. The OEM's sales and marketing organisations, meanwhile, need visibility into all of these activities to gather market requirements and condition the market to demand the product.

The truth is that until recently, the IT tools and strategies available simply were not up to the challenge of sharing information across such a complex web of players in an efficient way. In fact, hard-wired links between enterprise applications compounded the very challenges they were meant to address. Those links also were difficult, expensive and time-consuming to build because developers had to compensate for the incompatible architectures of the systems involved. This resulted in redundant and contradictory data and a hopeless jumble of connections that were costly and difficult to manage and maintain. And when business priorities changed, changing the links could take so long that companies were late in responding to opportunities – or missed them entirely.

The way business leverages information technology must therefore change radically if enterprises are to garner the insights and achieve the agility CEOs require to respond to business conditions. Fortunately, the development of a Service Oriented Architecture (SOA) approach to building information technology systems promises to overcome the challenges of inefficient and inflexible architecture through adoption of an architecture specifically designed to accommodate rapid and frequent change.

The power of the SOA approach
SOA is an approach to enterprise computing that works in a way that resembles LEGO, the popular childhood construction toy. LEGO can be assembled into one structure today, then broken apart and reassembled into something else tomorrow. The blocks do not change, but their modular structure allows each block to play many different roles, depending on how it is assembled with other blocks.

SOA works much the same way, allowing an IT analyst to break business functions and processes into small chunks known as services and then reassembling them to support different business models. Services are functions that when invoked accomplish some specific task. They expose a well defined interface, hide their implementation details, and are callable through open standards mechanisms. As CIMdata recently observed, 'Key characteristics of (an) effective SOA include that it is loosely coupled, highly reliable, business process-focused and supports heterogeneous IT environments'[1].

Services can be used to perform a wide variety of tasks, such as enabling critical business processes including portfolio and program decision support; requirements, configuration, or engineering change management; supplier and OEM collaboration; commonality and part reuse; analysis and simulation; or system integrity validation, to name a few.

These modules can be snapped together on a standards-based framework to support one business model today, and a different business model when market conditions change. SOA enables a business-centric view of the enterprise, orchestrating functions in terms of people, processes, and information. SOA allows you to integrate these services with customers, partners, and suppliers when everyone in the chain has different applications and computing platforms. 'Partner/supplier users and other business systems can request the service without needing to know what application will deliver that service'!

Just as businesses are adapting to changes in the environment, so must their supporting systems like PLM. The consistent growth of PLM is proof of its ability to deliver business benefits specific to design, engineering and manufacturing, such as providing a 3D model-based development approach and enabling concurrent engineering to reduce time-to-market and development costs across a wide range of industries.

SOA is a key technology for enabling such growth in PLM. Combining PLM with SOA delivers the flexibility vital to enabling innovation and achieving desired outcomes. This is a breakthrough for integrating applications around the product development process and breaking down the silos that traditionally have limited PLM. By integrating PLM with the rest of the enterprise, SOA transforms a formerly engineering-centric solution into a federated source of all product information, including pricing, market demand, portfolio costs and more.

Together, PLM and SOA enable flexible, standards-based access to product information regardless of which software applications or hardware platforms are in use throughout the enterprise and out into the value chain. The result is total product information visibility for product and portfolio planners, support engineers, sales and marketing – even line-of-business executives.

Applying SOA to PLM
SOA addresses the needs of CEOs, delivering an entirely new approach that rises above the complexity of current IT systems to give enterprises the insight and ability they need to thrive in today's competitive reality. SOA allows organisations to more easily link and share PLM product data with information from other enterprise systems, effectively supporting approaches that require multiple-team collaboration, such as functional design, design-for-compliance, design-for-cost and service after sales.

Using SOA to combine the value of PLM and ERP, for example, allows users to understand costing and inventory levels of existing components, as well as their associative sizes and tolerances, to make better upfront design decisions. This lowers the cost to develop new products by leveraging existing components, which results in less excess inventory, fewer design iterations, and faster time to market.

By combining PLM with Customer Relationship Management (CRM), on the other hand, SOA allows organisations to simulate products, allowing them to better understand the features that could be highlighted in their sales initiatives. This is but one example of how product development could be tied more closely to market introduction processes. Similar benefits are available by federating PLM information with Requirements Engineering and Systems Definition, as well as with other downstream enterprise systems, such as Manufacturing Planning and In-Field Service Management.

How and why the combination of SOA and PLM works
Traditionally, most PLM environments utilise multiple applications, each of which has its own database. Each of these databases contains not just information, but knowledge about the relationships between the information – the context in which the information makes sense. When these databases attempt to share information through an enterprise PDM (Product Data Management) system, a traditional engineering tool, the knowledge embedded within the data relationships specific to each application is lost.

Attempts to overcome this limitation by integrating proprietary applications require hard-coded, difficult-to-change links. This defeats the goal of creating agile, flexible business models. This challenge is compounded when an OEM, for example, attempts to work closely with multiple partners and suppliers. Now each organisation in the chain must deal not only with its own application complexity, but the complexities of its partners as well. Barriers between disparate systems make it difficult for people in interrelated functions to collaborate.

To get around these walls, people must schedule meetings, send e-mails or make phone calls to share information that cannot be shared by the organisation's disparate systems. This ad-hoc system of collaboration is fraught with problems, however, including failures to include key people in critical decisions, or difficulties determining whose data to trust. This further stifles the goals of collaboration, innovation, and flexibility.

The combination of PLM and SOA, which IBM calls the Product Development Integration Framework (Figures 3 and 4), eliminates this complexity by changing the way data is structured. SOA-enabled PLM removes the problems inherent in duplicating data from individual applications into an enterprise PDM system by creating a federated information mechanism that all applications access and share. Business processes exist independent of specific applications and can be viewed and accessed by all companies participating in a product development value chain. Portals provide access and visibility into all business processes relevant to particular user roles.
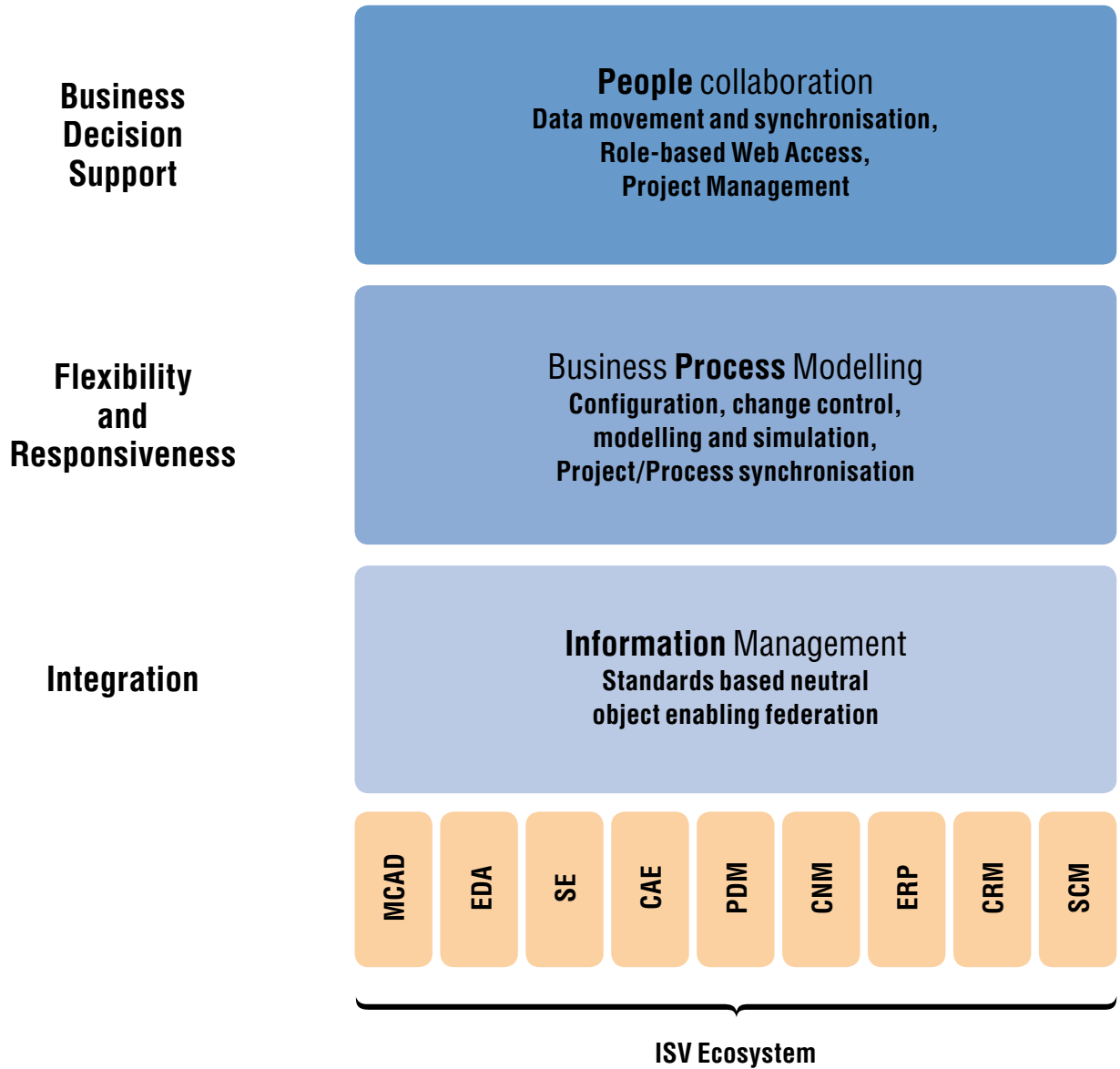
Business Decision Support

People collaboration
**Data movement and synchronisation,
Role-based Web Access,
Project Management**

Flexibility and Responsiveness

Business **Process** Modelling
**Configuration, change control,
modelling and simulation,
Project/Process synchronisation**

Integration

Information Management
**Standards based neutral
object enabling federation**

MCAD | EDA | SE | CAE | PDM | CNM | ERP | CRM | SCM

ISV Ecosystem

Figure 3 – The Product Development Integration Framework supports executives' primary business needs as determined by the 2006 IBM CEO Survey.

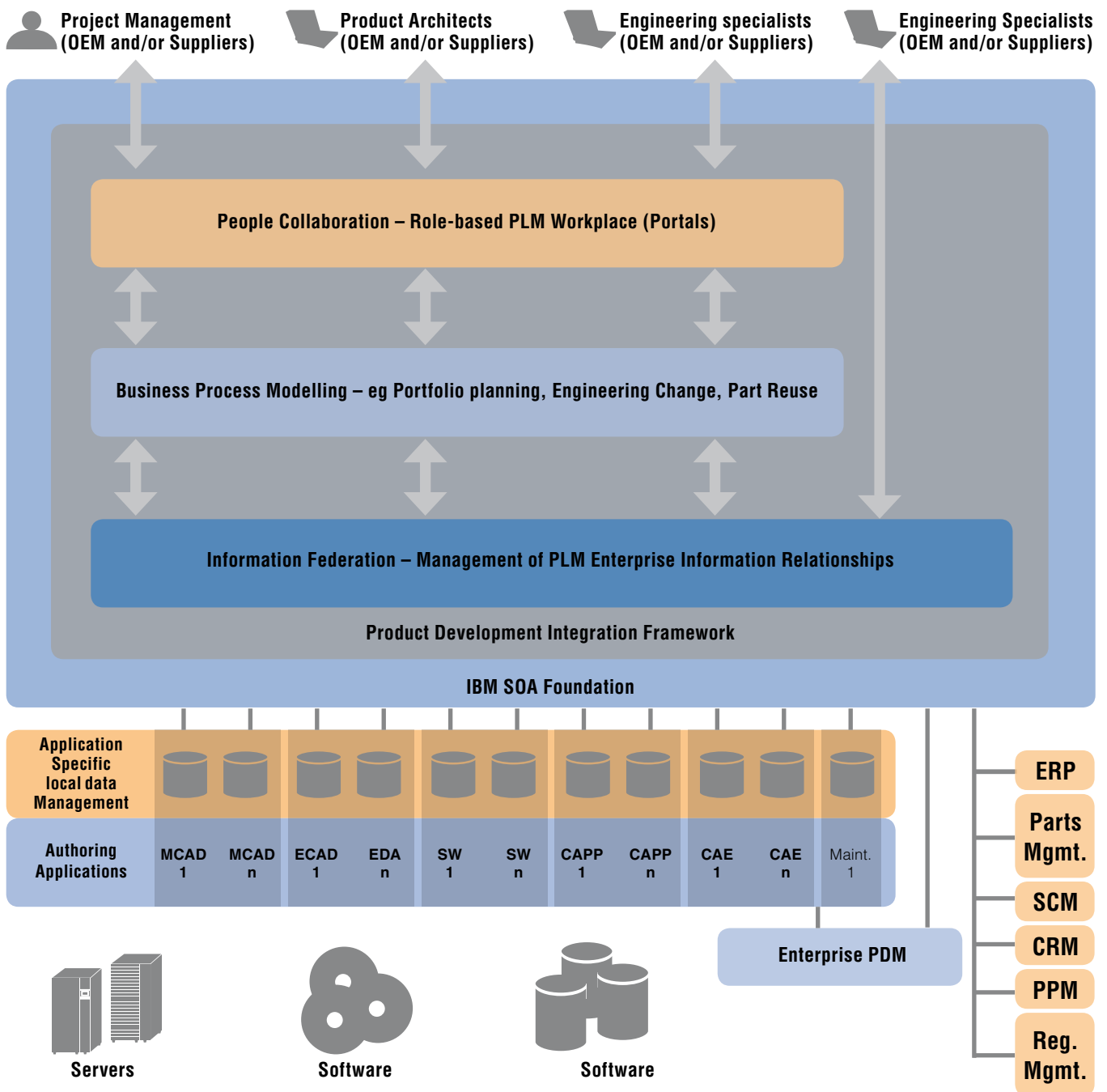**Project Management
(OEM and/or Suppliers)**

**Product Architects
(OEM and/or Suppliers)**

**Engineering specialists
(OEM and/or Suppliers)**

**Engineering Specialists
(OEM and/or Suppliers)**

People Collaboration – Role-based PLM Workplace (Portals)

Business Process Modelling – eg Portfolio planning, Engineering Change, Part Reuse

Information Federation – Management of PLM Enterprise Information Relationships

Product Development Integration Framework

IBM SOA Foundation

**Application
Specific
local data
Management**

Authoring Applications	MCAD 1	MCAD n	ECAD 1	EDA n	SW 1	SW n	CAPP 1	CAPP n	CAE 1	CAE n	Maint. 1

Enterprise PDM

ERP

Parts Mgmt.

SCM

CRM

PPM

Reg. Mgmt.

Servers

Software

Software

Figure 4 – The Product Development Integration Framework is built on the IBM SOA Foundation.

By eliminating traditional information silos and making vital product information visible throughout an enterprise, SOA-enabled PLM transforms PLM from an 'engineering' application into a source of all product information. SOA-enabled PLM provides business decision support, increases flexibility and responsiveness and improves integration with the value chain, enabling CEOs to continually innovate their products, their business processes and their PLM infrastructures.

SOA also creates an ecosystem in which multiple solution developers, integrators and IT consultants can collaborate, replacing competition with cooperation – a profound benefit to the client. By permitting heterogeneous hardware and software to operate together smoothly through a shared commitment to open standards, SOA truly delivers on the long-held client dream to mix and match best-of-breed applications to achieve a system uniquely suited to their special goals and challenges. The result is tailored client solutions for the electronics, aerospace and defence, automotive, consumer products and fabrication and assembly industries.

Flexibility made possible by SOA-enabled processes
The SOA-enabled PLM approach gives rise to several real-life PLM Solutions that help clients put these concepts into practice today. These include: Enterprise Integration, Supply Chain Collaboration, Product Performance Simulation, and Systems Design.

Enterprise Integration
Enterprise Integration links engineering disciplines with product development stakeholders in commercial and operational functions. It connects disparate CAD and PDM systems to other enterprise systems, enabling an enterprise-wide view of product data that even extends into the value chain. When connected applications are accessed by users throughout the value chain through a Web-based portal such as Websphere Portal, each user gets role-specific, secure access to the critical business applications they need to do their jobs. Data is presented to each user in a manner consistent with their role and in a way that they can understand. These flexible access tools help to ensure better business decision support and lower product development time and cost. Improved integration within the enterprise and into the supply chain ensures an agile and responsive organisation with strategic flexibility and activity-centric collaboration with people throughout the product development process.

For example, Volkswagen AG has used such portals to improve productivity in its procurement department by improving access to product information. The portals have shortened order-to-delivery cycles while making the procurement staff 20 percent more productive and improving their ability to focus on high-value-add activities. Meanwhile, another leading OEM is using portals to streamline the communication of design changes between its own development teams and its suppliers, cutting the design/engineering cycle by more than a third, reducing development costs by 25 percent and replacing manual distribution of time-sensitive change orders with an automated, real-time system.

Collaboration between engineering and field services speeds the communication of field issues back to the engineering department, allowing OEMs to identify design issues earlier, design fixes and communicate them to the field to reduce warranty claims and improve product reliability.

Supply Chain Collaboration
Many OEMs today depend on their supply chain not only for parts, but also for design and assembly services. Unfortunately, the processes and technologies required to support such an extended enterprise business model have been slow to develop. This has led to unanticipated costs and has inhibited innovation. The business flexibility enabled by SOA-enabled PLM is finally making true supply chain collaboration a reality.

Supply Chain Collaboration extends the engineering capabilities of the enterprise into the supply chain, improving collaboration and integration through an optimised infrastructure, improving the management of data and development processes by suppliers, reducing program risk, improving business model and process innovation support, and reducing administrative costs for activities such as manual exchange, checking and data translation.

Suppliers benefit, too, through reduced IT resource requirements, pre-defined solutions with industry templates that reduce implementation time and time-to-productivity by as much as 30 percent and a 10-20 percent reduction in overall engineering costs. Other likely benefits include a 30-35 percent reduction in engineering time, a 15-20 percent increase in profitability, and reduced program risk.

For example, to build its Falcon 7X business jet in four years rather than the traditional seven, Dassault Aviation assembled a team of 27 design partner firms scattered around the globe. The company employed a fully digital process to eliminate physical prototypes, and built a collaborative workspace that allowed all of its partners to share data online in real time. The resulting productivity gains have allowed the aircraft company to decrease its time-to-market plan by 30 percent. Similarly, an automotive OEM identified and eliminated bottlenecks in its collaboration processes after establishing a supplier portal as a single data exchange source with its suppliers.

Product Performance Simulation
Product Performance Simulation analyses the flexibility and performance needs of all engineering disciplines while simulating the behaviour of a virtual product. It includes Desktop Analysis/Simulation plus DMU (digital mock-up) to improve product quality and shorten development time by detecting design problems early; Enterprise Simulation/CAE, which provides complex analysis and simulation; and IT Resource Optimisation for Engineering, which optimises the supporting infrastructures used to run compute-intensive analysis applications.

Daimler-Benz Truck Division used mechanical analysis solutions earlier in its engineering developing cycle, improving its cycle time to product introduction by 60 percent. Meanwhile, a leading automaker reduced the time needed for engineers to compile their reports by employing a systematic approach to simulation data management for CAE that managed many terabytes of simulation data spread across several million files. The solution not only saved time; it also improved user confidence in the resulting data. And Magna Steyr, a Tier One automotive supplier, applied grid technology to its clash detection environment, reducing run times from 72 hours to four hours, which reduced costs, improved time to market and resulted in higher quality products.

These and other examples demonstrate just some of the benefits real companies are achieving on a daily basis with an SOA-enabled PLM approach to managing their product lifecycle data and business processes.

Systems Design
To create virtually any new product today, it is necessary to synthesize the engineering disciplines of mechanical, electronic, and software development. Engineers must understand, simulate, and validate a broad set of factors that influence product success. Customer requirements must be captured, understood, and allocated to functions and system architectures, which can then be analysed and simulated again, to enable the development of an optimal design that balances risk, cost and time-to-market constraints.

A Systems Design solution delivers the tools, methods and infrastructure needed to feed engineers the information required for this important and complex task, channelling input from downstream processes across multiple domains and stakeholders.

The software approach creates a systems-level view of PLM applications and databases on a SOA, regardless of their engineering domain (for example, e-CAD, m-CAD, software, hydraulics, simulation, verification) or their internal development cycles and rules.

An integrated and unified view of requirements and components in a design saves cost and time previously consumed by communication flaws, long document preparation cycles, and design errors caused by the misinterpretation of information, either by an internal department or a supplier. With an SOA-enabled PLM Systems Design solution, companies know they are building the right product the right way.

Systems Design solutions provide the tools and methods to manage a repository of architectural components. This allows for efficient reuse of system-level design know-how to drive lean, effective, global and innovative product development initiatives.

How to get on board with SOA-enabled PLM
When choosing a PLM partner, executives should look for one with deep industry knowledge, experience as a world-class manufacturer, strength in Research and Development (R&D), breadth of PLM offerings, and a long-standing commitment to PLM. Because SOA-enabled PLM depends on standards and open architecture, a partner must have demonstrated an unflagging commitment to both. And because business models and product development chains are increasingly global, it is important to pick a partner with a global reach and the resources to support you anywhere in the world. Also look for a partner ranked as a leader in SOA capabilities by the top business analyst firms, including Gartner, AMR, Forrester, and Yankee Group.

IBM meets all of these criteria. With IBM PLM you get the full value of the IBM brand: trust, quality, experience, financial stability, global reach and a proven code of conduct. Only IBM has the global reach to provide consistent and uniform implementation practices across your entire enterprise and supply chain, whether it is design configuration or licence management. IBM brings a proven set of practices, policies and procedures that minimise disruption as you deploy PLM globally. IBM boasts over 11,000 SWG representatives, over 1,500 PLM representatives, and over 250 dedicated IT specialists; 1,769 ISV's with over 40,000 dedicated IBM sales and support resources; and tens of thousands of business partners. PLM is more than a tool decision – it is a mission critical business decision that IBM is dedicated to helping you get right and then execute.

To learn more, ask your sales representative for executive education on possible solution initiatives, or consider attending an SOA workshop. IBM can offer assistance in performing a Capabilities and Needs Assessment or evaluating the readiness of your supply chain to support your collaboration goals. A business process review focused on product performance, coupled with an opportunity analysis, is another option.

Improved business decision support, flexibility and responsiveness, and integration with the enterprise is not only possible, it is real. The best time to start is now.

Learn more by visiting the Product Development Integration Framework Website at:

ibm.com/solutions/plm/pdif

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The IBM home page can be found at **ibm.com**

1 CIMdata Program Review, September 2006. http://www.cimdata.com/php/download_ reports.php

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