Service oriented architecture
White paper

Smart SOA: Best practices for agile innovation and optimization.

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SOA enables change

The forces of change are all around us.

- *Innovative new business models are emerging that are transforming and merging industries.*
- *New and fluctuating customer expectations are forcing organizations to rethink their position in the market.*
- *The* flat world *has made global integration necessary for survival.*
- *New standards, technology, methods and governance models have emerged to make these mandates possible.*

In this era of unprecedented change, organizations need agility to adapt rapidly. Part of what separates winners from losers is the ability to respond quickly and intelligently to market opportunities, competitive threats and regulatory constraints—in short, to innovate and create value. The best companies understand how to use technology for strategic advantage to help accomplish these goals. Service oriented architecture (SOA) can help.

SOA is a business-driven IT architectural approach that supports agile business innovation and optimization. SOA enables you to integrate your business as linked, repeatable business tasks, or services. But pursuing SOA on an ad hoc, scattered basis can drastically reduce its benefits. Fortunately, there is a smarter approach: we can learn from the thousands of clients who have chosen IBM for their SOA deployments. IBM has solidified the best practices and lessons learned from these experiences to help extend the value of SOA deployments in a set of guiding principles we call Smart SOA.

Smart SOA

These are the central tenets of Smart SOA:

- *There is a continuum of approaches, from basic to advanced, for pursuing SOA projects, allowing an organization to match its efforts to its objectives.*
- *All approaches mandate a commitment to simplicity and robustness, regardless of how basic or advanced they are.*
- *The approaches build on one another in such a manner that doing a basic project is valuable by itself but also lays the groundwork for more-advanced deployments without having to replace the original investments.*
- *Any approach needs to manifest integrity in the business processes it supports—drawing from the underlying integrity of the hardware and software platform, middleware, systems infrastructure and application design.*

Basic to advanced

In 2003, IBM assembled a team of leading technologists and business experts who are dedicated to working hand in hand with innovative clients. The team focused on the definition, development and dissemination of a business-oriented architecture and associated methodologies encompassing what is now known as SOA. This team used what was then cutting-edge, new technology with early adopter clients who were looking for a better solution to addressing their business transformation needs. IBM partnered with these clients to obtain valuable insight into the business challenges and what resolving these business challenges required from an architecture and methodology point of view. This business-driven IT approach to driving innovation can make an immediate difference to clients. Using these experiences to guide product and offering enhancements has always been core to IBM's investment in SOA and continues to be a cornerstone today.

Over the years, adoption of SOA has accelerated, and the first-of-a-kind software originally used by the Advanced SOA team has been refined and hardened into product-level offerings. IBM's original Advanced SOA team continues to push the boundaries of SOA, but in their wake, IBM has documented and solidified projects that have been implemented many times over. By establishing best practices based on these extensive engagements, IBM has helped make the once-uncharted waters of SOA safe for mainstream clients who demand proven, dependable solutions. In the process, IBM has captured best practices and used them to refine the guidance that now helps define Smart SOA.

Based on this experience, we have established that no single approach to SOA is right for all organizations. Indeed, even within a given organization, different business challenges often require different approaches. The approaches to undertaking SOA projects can be mapped along a continuum between basic and advanced. As long as projects are pursued in a way that is consistent and compliant with the principles of SOA, the more basic approaches provide the underpinnings and building blocks of more advanced approaches. Organizations should pursue the approach that matches their goals. For the sake of convenience we divide the continuum into these approaches, although there are no rigid boundaries between them:

- Foundational: *Departmental, very focused projects for solving immediate and, likely, straightforward challenges, such as connectivity, reuse, collaboration, information access and automation, in a way that can segue into more substantial changes, should they become necessary in the future*
- Extend end-to-end: *Collaboration between business and IT to optimize and bring greater innovation to business processes that span the organization and extend beyond it*
- Transform: *Reimagining the business, its markets, cost and revenue models and interactions with its ecosystem—linking capabilities to insight to create innovation within the business*
- Adapt dynamically: *The emerging ideal of rapid transformation in a semiautomated way, becoming possible as a critical mass of service providers in the ecosystem adopt SOA*

Simplicity and robustness

Smart SOA demands that we apply the principles of simplicity and robustness at every approach. No project is so basic that it can be allowed to undermine the integrity of the business. Although some projects clearly demand greater degrees of uptime, quality of service and security than others, the distributed nature of SOA means that the same service that participates in a casual process can also participate in a mission-critical process. For example, a major U.S. airline used SOA to create a service that managed ticket pricing in real time based on how soon the flight was departing and how full it was. This was a fairly basic service, but it was core to the business and needed to be robust.

Likewise, no deployment is so advanced that we can tolerate needless complexity; Smart SOA requires simplicity as a tenet of design as opposed to projects that are simplistic. For example, a major U.S. bank created an advanced system of routing financial transactions to appropriate locations from multiple channels. Though it was quite advanced, the bank used an elegant SOA approach to cut through the complexity of its previous architecture.

Smart SOA grows with you

The needs of the business are evolving. The project that is currently used ten times a day might someday be used ten thousand times a day. The project that supported a hidden back-office task is now being used as part of a mission-critical, customer-facing business process. Small projects grow up. Sometimes they grow up fast. That is why Smart SOA is about solving basic business challenges with focused, proven design principles and best practices that produce service-oriented deployments that can grow as your needs evolve. Smart SOA allows you to meet the requirements of tomorrow's advanced deployments without undoing the basic projects that you undertake today.

For example, a major European financial services firm began its SOA journey with a foundational project to service-enable a small number of its existing assets and connect them to make them more widely available across the business. The firm built on this starting point with an extend end-to-end approach to encompass business processes that spanned the enterprise. It further invested in their business with a transform approach by expanding into new channels with innovative new offerings that resulted in outstanding client satisfaction. The firm accomplished all of this without replacing any of the software used in its original foundational deployments but instead, by increasing its reuse.

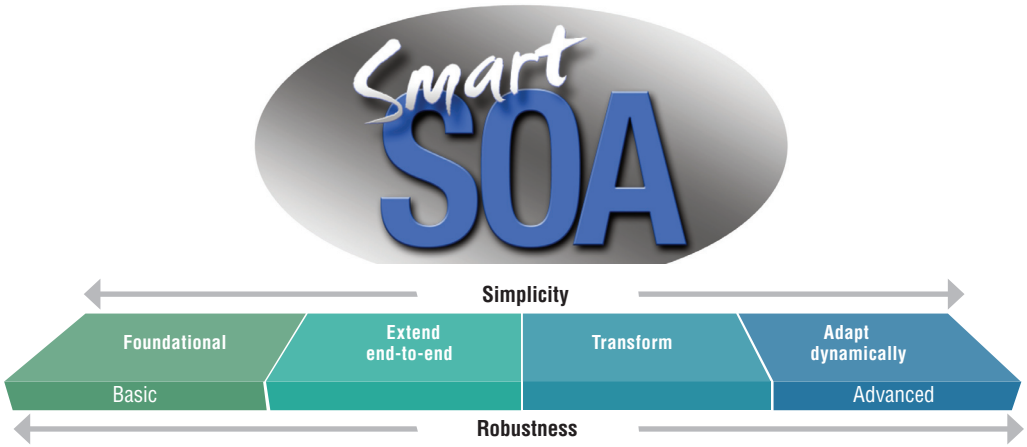
This firm has expanded its SOA exposure to encompass 150 core applications, calling 440 services with over 50-percent reuse, resulting in the equivalent of more than US$5 million saved in development costs and a 900-percent increase in transaction rates without an increase in IT staff. One service (customer search) is reused in 19 different applications.

Process integrity

In the past, when vertical processes were supported with individual applications, it was comparatively straightforward to roll back a transaction if the need arose, because the process was contained within a closed system. But as organizations continue to support more of their end-to-end business processes using the principles of SOA, some potentially unforeseen issues arise. Such processes need to synchronize a wide variety of platforms, applications, data sources, domains and users. Providing appropriate levels of access, authorization and security at every stage of the process becomes necessary. Maintaining integrity across such a process does not happen by accident. Process integrity is necessary to make the entire process behave as though it were being supported as a single unit, without losing the richness of the user experience.

Process integrity is the degree to which loosely coupled, open systems deliver the reliability, consistency, scalability and predictability of tightly coupled, closed systems. On the one hand, users of the process need a rich user experience with up-to-date, secure access to information and content. On the other, when it comes time to complete a transaction, the process must run consistently with the ability to recover as required. And across the board, the information used by the process must be reliable, complete and manageable.

What makes this nontrivial is that it must all take place in a highly distributed and ever-changing environment. Let's say a business process taps into eight systems to accomplish eight individual tasks. Maybe it's a globally integrated supply-chain process. Now let's say step number eight fails. Suddenly, the last item in inventory was taken by someone else. Could the other seven steps in the process be rolled back, or would accounts be billed and shipments be reported as confirmed without merchandise being actually shipped? Maintaining the integrity of individual services and sources of information is not enough; integrity needs to be maintained across the entire end-to-end process. Smart SOA delivers this process integrity in the right degree across all approaches.



What is it?

Departmental, very focused projects for solving immediate and, likely, straightforward challenges, such as connectivity, reuse, collaboration, information access and automation, in a way that can segue into more substantial changes, should they become necessary in the future

Foundational

New applications are composite in nature, consisting of discrete business functions defined and invoked through service interfaces. These are free-standing projects but are modular and build upon one another to lay the groundwork for more sophisticated undertakings. IBM has created the SOA entry points to lay out these projects in greater detail.

The SOA entry points are about undertaking a well-defined, focused, individual project to meet an individual business need. Given the volume of SOA projects now in deployment, the foundational approach typically leverages proven, well-documented, repeatable cookbook-approach procedures. In many cases, the project might focus on bringing about specific improvements in a business area. The SOA entry points provide the means to pursue this approach in a proven, well-established way.

The SOA entry points were defined from the work of more than 150 of IBM's leading architects and business and technical consultants working with clients for more than 18 months to identify and document the most straightforward challenges that clients are addressing using IBM's SOA portfolio.

Why would I do it?
Solving the basic problems of connectivity and reuse are the most common drivers for this approach. Automation of previously manual business processes is the third most-common reason that organizations embark on a foundational SOA project, with the issues of collaboration and addressing information access ranking close behind.

Like all four approaches of SOA, the foundational approach delivers distinct value to both business users and IT professionals by standardizing service elements and structuring their use, delivery and governance. Projects that adopt the foundational approach often deliver greater agility within a given specific line of business. Proven projects such as these provide predictable return on investment and build experience and skills for future deployments.

A major wireless telecommunication company is adopting this approach. The company found that the cost and delay of integrating all its systems with new applications for its customers had put it at a competitive disadvantage and was affecting customer satisfaction. The company used the foundational SOA approach to accelerate the process of integrating new services into its network.

How do I do it?
Although awareness of more general best practices for SOA governance is important, organizations using the foundational approach should focus on architectural governance rather than larger scale governance concepts, to keep overhead to a minimum. The best small SOA projects bring significant business value but are not critical to the viability of the organization. Define project requirements and scope clearly to avoid unanticipated expansion. Develop or engage trusted guidance for the processes and best practices around the technology. A good understanding of business needs is also critical in order to identify an appropriate challenge to solve and build confidence.

Typical projects

Here are examples of typical projects, based on the SOA entry point that is best suited to the purpose:

- *The reuse entry point covers identifying high-value, existing IT assets and service-enabling them for reuse by creating flexible, service-based business components. Common projects associated with this entry point include developing new services from scratch or out of services from third-party vendors, and creation of services out of existing assets such as IBM CICS® applications.*
- *The connectivity entry point links people, processes and information from virtually anywhere in the business through the use of an intermediary service gateway or bus. Common projects include enabling a business process to be accessible from multiple channels, such as call centers and Web sites; integrating with a service registry and host-based application and data sources, including CICS; and supporting the transmission of both XML and binary data.*
- *The people entry point improves productivity by aggregating services as views, as well as enabling human interaction in the context of the business process. Common projects include creating a portal to provide information over the Web by aggregating and invoking services on-the-glass through portlets as well an enhancing the portal to include rich Web-based applications using Web 2.0 technologies.*
- *The process entry point helps achieve greater innovation and flexibility through faster deployment and modification of business processes by treating tasks as modular services. Common projects include automating and optimizing manual business processes and human workflows, such as setting up new accounts. These projects often require the integration of multiple back-end systems, human workflow integration and composite services to support an end-to-end solution.*
- *The information entry point provides access as reusable services to complex, heterogeneous data sources within an enterprise to better leverage and manage existing information. Common projects include service-enabling access to relevant information that needs to be shared across an organization, enabling real-time capabilities to access and manage both structured and unstructured information, and providing an interface to both automated and manual data-cleansing functions.*

Each of the projects has been well documented through white papers, tutorials and solution architecture guides. To help accelerate foundational SOA projects, this information and software is available free of charge for download or use in a hosted environment through the IBM SOA Sandbox at **ibm.com**/developerworks/downloads/soasandbox.

The approach in action

Let's look at an example of a client that pursued SOA using the foundational approach. OAG, based in Dunstable, England, operates one of the most comprehensive content systems in the commercial aviation sector. Its core business is to gather and manage enormous volumes of airline schedules and flight status information for 1000 airlines. Its databases store more than 1.5 billion records, including data for 27 million planned flight departures for the next 12 months, and historical data for nine years. Its business challenge was that it saw rapidly increasing and extremely customized real-time customer airline requirements, yet it had multiple sources of data and languages and massive amounts of information. OAG used well-defined SOA projects on its information and its processes to address these concerns. Its solution included creating workflow processes that are modularized into specialized services and using process choreography to meet customized requests. As a result, OAG has seen an 80-percent reduction in time to market for customized services and has increased its business resiliency.

What is it?

Collaboration between business and IT to optimize and bring greater innovation to business processes that span the organization and extend beyond it.

Extend end-to-end

Business processes are what make an organization tick. And though the vertical processes that live within individual lines of business and are supported by individual applications will always be important, today's business climate is bringing increasing focus on end-to-end business processes as the primary means of defining the business and creating differentiating value. These end-to-end business processes span lines of business, tapping into functional tasks within each of them and beyond the boundaries of the enterprise to trading partners and external service providers.

Business processes and the tasks that they include provide a common vocabulary for business and IT to use in collaboration. Innovating and optimizing these processes can be driven by top-down or bottom-up initiatives. But with technology so intertwined in every step of these business processes, how can these processes be optimized and innovated? How can integrity be maintained across such a distributed process? These are the questions that the extend end-to-end approach to SOA addresses.

Using this approach, as much as 40 percent of relevant business function might be provided as services, and up to 20 percent of these services might be reused.

Why would I do it?
Consider using the extend end-to-end approach to achieve these goals:

- *End-to-end business process optimization and innovation*
- *Reduced costs through optimization and automation*
- *Increased revenue through access to new channels and improved customer experience*

How do I do it?
SOA at this level cannot succeed if it involves only IT; business and IT have to work together in continuous alignment to achieve the full potential value. Business analytic skills to not only automate but also optimize the business processes are necessary at this level. As with foundational projects, skills to leverage the technology to its best advantage are also critical. SOA governance processes that unify business and IT need to be in place to provide oversight and control across and beyond the organization.

Look for documented patterns of service mediation and proven methodologies for service identification and definition. Identify, specify and realize services through service-oriented modeling.

Typical projects

This approach builds on the groundwork established by individual foundational projects, and scales up into higher profile business processes and scales out into business processes that involve a broader cross-section of the business. Taking a smart approach to SOA means that the investments made for foundational projects are completely reusable and extensible in this extended approach. Business process management (BPM) enabled by SOA (along with maintaining integrity across these processes) is a major component of the extend end-to-end approach.

To keep these end-to-end business processes in line with the ever-changing demands of the market, you need a deliberate, thorough approach to managing them. BPM enabled by Smart SOA is a discipline that combines software capabilities and business expertise to accelerate innovation and optimization of these critical end-to-end business processes.

Model and simulate: Take a business process that might exist on paper or even in the minds of some subject matter experts and document it with business modeling. In many cases, some measure of business process documentation might already exist in organizations' training departments. But the real value of modeling comes with running simulations and what-if scenarios to forecast what would happen if you altered the process. You can take an iterative approach to these simulations, quantify the results and arrive at an optimal process design — all before changing a single line of code in your business applications.

Deploy: After you've optimized the process in theory, it's time to make it a reality in deployment. But it never makes sense to reinvent the wheel. There is a wealth of prebuilt, customizable business process assets and best practices available to facilitate deployment. And because business processes vary dramatically from industry to industry, you'll want to tap into best practices gleaned from thousands of client engagements and years of research and development when using these prebuilt resources for production. Deployment on an SOA-based, integration-rich, scalable process engine will help ensure that regardless of the business demands, companies with even the most complex processes can adapt and efficiently support those changes.

Monitor: After you have your optimized, end-to-end business process in production, you should monitor and measure the results. This data will help you evaluate not only how the business is doing today, but also how well you are poised to react to market forces tomorrow.

Continuously improve: The business world does not stand still, and neither should your end-to-end business processes. You need to continuously look for ways to innovate and reoptimize the process as conditions change. You need to use the information you gain from monitoring your business to make better business decisions about where to take the business in the future.

To ensure that the end-to-end business processes you have in deployment are performing with integrity, the principles of process integrity outlined earlier become especially important.

The approach in action

The University of Florida was faced with a new business requirement for all incoming students to take a third-party prerequisite health class. The university needed to integrate with an outside vendor to ensure that the prerequisite was met before allowing student registration to proceed, and it had only two months to implement the solution to be ready for semester registration.

Because it had already adopted SOA as a foundational architectural approach, the university was able to easily expand its existing systems and business processes to accommodate the new business requirement. The university quickly integrated with its existing systems through Web services to the third-party vendor. As a result, the university improved customer satisfaction. Students were seamlessly transferred to the prerequisite if they attempted registration, and the university's systems continued to deliver 98 percent of transactions with subsecond response time. The University of Florida met its deadline of completion within two months.

What is it?

Reimagining your business, its markets, cost and revenue models and its interactions with your ecosystem — linking capabilities to insight to create innovation within the business.

Transform

Switch from thinking about doing things right to doing the right thing, which naturally shifts the focus from IT to the line of business (LOB).

Transformation is about using technology for strategic advantage. It is about innovating your business model as opposed to the individual end-to-end business processes through which that business model is implemented. It is broader in scope than the previously described SOA approaches in that it affects large segments of the entire enterprise. Again, it can build upon investments made during deployments that followed earlier approaches. Or it could be part of a top-down transformation that recognizes the need for continuous alignment between the business intent and the IT that supports it.

Why would I do it?

Strike a bold new course, or respond decisively to a sea change in the industry.

Sometimes it is not enough to make iterative adjustments to existing processes. Sometimes it becomes necessary to take more fundamental action. Perhaps a government regulation has suddenly imposed radically new rules to a well-established game. Maybe a nontraditional competitor has suddenly redefined what it means to participate in a given industry, such as the effect that MP3 players and music downloading had on the recording industry. Maybe you want to introduce such proactive disruption yourself. Or possibly some other force has led you to the realization that your current business model needs significant change. Any of these drivers can be cause for taking the transform approach to SOA.

A leading Asian telecommunications company recognized that its core competency was its ability to craft flexible plans targeted at specific customer segments. Unfortunately, some of its noncore IT systems were inhibiting its ability to quickly integrate new offerings. As part of its transform approach to SOA, the company outsourced the design and provisioning of these IT systems. The new service delivery platform provided by IBM has fostered a healthy ecosystem of business partners with related solutions and has positioned the company well for the future. As a result, the telecommunications company has doubled its customer base.

How do I do it?

Ask the big questions. What do you want your business to look like? Consult thought leaders to gain insights into what your industry will look like three, five, ten, maybe fifteen years in the future. How will you compete in this evolved world? What will you need to do differently? What steps can be taken today in preparation and to anticipate tomorrow's needs?

Focus at the business level. Prioritization is often another key element in transformation. Think about everything that goes into delivering your company's product or service. Many of these activities are commodity-level overhead. Others might be too costly to perform within your own organization. Weeding these out will leave a much shorter list of differentiating activities that set you apart from your competitors and which are fertile ground for greater investment. The others are opportunities for outsourcing or partnering to fulfill, or just eliminating altogether.

Because of the scope and nature of the changes being introduced with this approach, organizational change management is going to be crucial. With the bulk of an organization's business functions consumed through services and its processes managed and automated, advanced tooling will be needed to help finesse the complexity.

Typical projects

Transformation takes an enterprise-wide view of where you are and where you want to go. Transformation can sometimes shake things up. It could be proactive in cases where an organization seizes a new opportunity that might never have been tried before. It could be reactive in cases where disruptive change has been introduced from outside. In either case, it is the recognition that continuing business as usual is no longer sufficient. From a technology perspective, it leverages the groundwork from the foundational approach as the underpinnings of support. It also leverages innovation, optimization and integrity at the process level as defined by the extend end-to-end approach. The transform approach is a prime example of how Smart SOA builds upon existing investments.

The approach in action

An automotive service center and parts distributor was struggling with inadequate customer satisfaction that was becoming a burden on its business. The company's IT systems were contributing to this dissatisfaction, because there were serious barriers between the service and parts groups, and poor collaboration among the company's network of retail centers. The company overhauled the way it went to market as a matter of survival. It used SOA comprehensively across the business to create a new customer experience. It created functional services from various custom and packaged applications and connected them through a service integration layer. Then, it orchestrated these services to define its order-management, supply-chain-management and task-management processes. It created a single view of the customer for work activities, including parts and labor and warranty support, that enhanced cross-sell and up-sell opportunities. As a result, it created a fundamentally better customer experience with greater efficiencies and satisfaction. The company's employees were trained more effectively and were more efficient on the job. Best of all, the company had a platform that allowed it to shift these processes in the future to accommodate changing customer requirements. Its lower IT costs were a fringe benefit.

What is it?

The emerging ideal of rapid transformation in a semiautomated way becoming possible as a critical mass of service providers in the ecosystem adopt SOA to enable the business to respond with agility to business opportunities.

Adapt dynamically

What does the future of business hold? The barriers that make it difficult to identify the best service provider and incorporate that provider's service into your end-to-end business processes disappear. So does the inertia that prevents these relationships from dissolving in favor of forming new partnerships when needs change. Traditional structured, linear value chains give rise to interconnected, dynamic value nets of service-enabled best-of-breed participants. More and more organizations identify themselves as both service providers and service consumers in a global service marketplace. The means to contribute real groundbreaking innovation are put into the hands of more participants by a factor of several orders of magnitude.

Adapting dynamically using SOA means creating a predictive business that responds to market forces in a semiautomated, intelligent way. It gives business users the ability to enact significant shifts in direction—transforming existing services or adopting new services without the need for extensive redeployment. In the same way that plumbing and electricity have become nearly invisible in the lives of most households, technology becomes nearly invisible to those charting the ever-shifting course of the business. IBM anticipates that organizations that use SOA to adapt dynamically will express over 80 percent of business functions as services, with over half of these services being extensively reused.

Why would I do it?

The future of business is a bold new world of innovation, and we see evidence that the seeds of this approach are already in place in several industries today. To fully thrive in such an era, organizations must develop the ability to adapt dynamically using SOA.

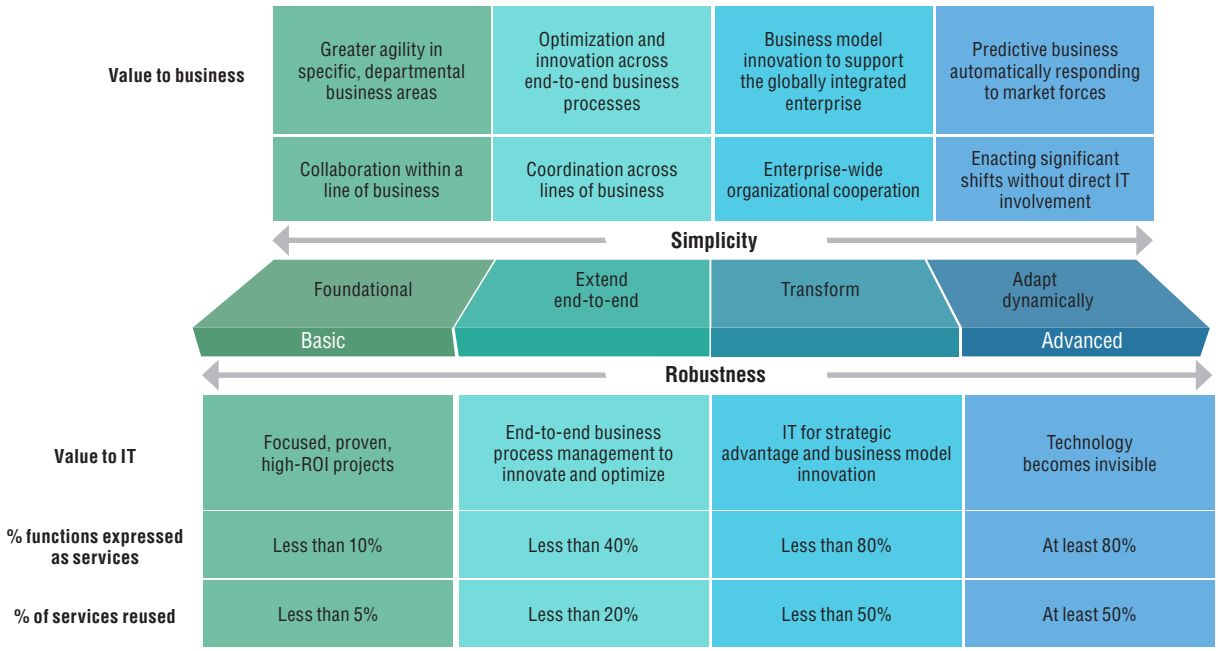
Organizations will pursue this approach to confidently take advantage of opportunities and immunize themselves against threats that will present themselves when SOA principles have attained critical mass in the ecosystem they work in.

How do I do it?

Although adapting dynamically is presently an emerging state rather than something that is prevalent using today's capabilities, some industries are closer to leveraging this idea than others. See the white paper by IBM Software Group Senior Vice President and Group Executive Steve Mills on *The Future of Business* (June 2007) at **ibm.com**/services/us/cio/pdf/wp-enbusflex_raw11032-usen-00_hr.pdf for a more comprehensive look at the upcoming realities that will drive winners to adapt dynamically. In the paper, concepts such as dynamic value nets, the service marketplace, frictionless identification, integration and substitution, and the democratization of innovation are explored in detail.

The beginnings of this approach in action

Some organizations are actively bringing elements of this approach into practice. For example, NY State Tax Board is pursuing the ability to accept and process individual filings and payments at any time, from all sources (such as taxpayers, tax preparers and partners) over multiple channels, such as paper, electronic media and the Web. It is seeking ways to adapt how it achieves the business process dynamically as conditions change.



Smart SOA: What is your approach?

Smart SOA is a set of guiding principles based on thousands of real-life deployments and experiences with SOA. It is not a product you can buy, nor does it require you to abandon your existing, dependable investments. It is a way of leveraging the value of your SOA deployments, regardless of whether a basic approach, an advanced approach or an approach somewhere in between makes the most sense for your given situation.

What approach makes the most sense for you? It depends on where you are today, what your priorities are and how you want to get from here to there. Put a plan together to make it happen based on established best practices. And above all, select a trusted guide to help you chart your course. IBM can help.

For more information

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