



Rolta India Limited

Rolta Technology Park,
MIDC, Andheri (E), Mumbai 400 093

Tel: +91 (22) 2926 6666

Fax: +91 (22) 2836 5992

www.rolta.com

Essential Services for Engineering

By:

The Experts at Rolta –TUSC’s SOA Centre of
Excellence

Rolta USA

info@tuscsoftware.com

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1. Introduction

Engineering services opportunities involve increasingly complex problems and environments. Client organizations demand global solutions involving the entire supply chain. Expectations escalate toward ubiquitous capabilities with the growth of technology and networking. With the increase in complexity comes the increase in risk, including liability risk, security risk, safety risk and, ultimately, profit risk. With the recent decline in the world's economies, profit risk can mean the difference between survival and business failure. The best defense against the downside of risk is knowledge: accurate, timely, robust and complete information relevant to the challenges and opportunities at hand.

Engineering services companies can leverage knowledge to manage risk in a variety of ways, including:

- Improve inter- and intra-project **communication**, from the level of the individual to that of the project team and all the way up to the executive ranks. Improvements in communication reduce the risk of acting on bad or outdated information.
- Increase in **agility**, enabling project teams to adapt to changes or anomalies with minimal cost to the project. This capability plays a particularly important role as complexity increases, which increased the probability of unexpected situations and events.
- Building of **resilience** factors, creating autonomous, self-healing, self-diagnosing, self-recovering features of key project systems. Resilience in critical path tasks can reduce project risk by orders of magnitude.

Service oriented architecture approaches offer ways for engineering services companies to manage risk by improving communication, increasing agility and building resilience in projects and programs.

2. High Level Solution

Engineering deliverables are largely produced through project work. Successful projects depend on successful communications inter- and intra-project. *Successful communications come from being able to securely share knowledge.* This secure knowledge sharing provides a critical route to reducing risk for engineering firms.

Communications

Secure knowledge sharing involves creating the knowledge and then finding secure mechanisms for sharing. Knowledge evolves over time and is refined by unrestrained contributions from numerous people, according to recent works like Wikipedia (www.wikipedia.com) and the book *The Wisdom of Crowds* by James Surowiecki. Surowiecki states:

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Groups are only smart when there is a balance between the information that everyone in the group shares and the information that each of the members of the group holds privately. It's the combination of all those pieces of independent information, some of them right, some of them wrong, that keeps the group wise.

In a similar way, six sigma methodologies accumulate data relative to improvement of systems, using continuous knowledge capture and refinement to focus on identified business goals. Secure knowledge sharing therefore involves not only communications at any point in time, but the ability to convert the knowledge communicated over time and act upon it. This ability requires system-wide and enterprise-wide agility.

Agility

Agility implies the ability to exploit continuously improving knowledge capabilities to create and refine standard methodologies and processes to be increasingly efficient and effective in delivering value to customers. Agility enables longevity, extensibility, scalability and innovation. Software provides a great mechanism to manage methodologies and processes that provide engineering services. One way to enable agility in an engineering environment is to provide an agile software foundation for engineering services. Gartner (pub. # G00149891, July 2008) states that an intermediation approach to software architecture provides a solid basis for agility:

Through 2013, intermediation as a core design principle will result in applications of the best scalability, extensibility and longevity in the software industry.

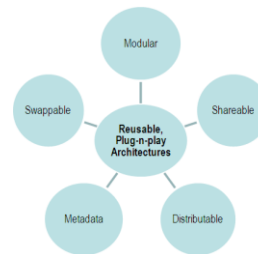
Service-oriented architecture (SOA) provides well-accepted and well-used standards for intermediation. Gartner reports that all Global 1000 companies polled are using SOA and that on the Gartner world-wide technology “hype curve,” SOA is well along the slope of enlightenment (pub. G00168593), which means it is well accepted and offers productive solutions to a significant portion of the marketplace. SOA offers a flexible approach to continually improve the software that supports engineering methodologies and processes, enabling organizational optimization of that support and the methodologies and processes over time.

SOA is an approach to information systems that subscribes to the following statement from Gartner (pub. # G00166742, April 2009):

Systems that are built to change are more valuable than those that are built to last, because systems built to change are the only ones that do last.

Gartner defines the leading characteristics of an enterprise SOA as being made up of elements that are:

- Modular
- Distributable
- Discoverable
- Swappable
- Shareable



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These attributes are critical to agility and must be driven by processes that not only subscribe to the corporate strategy, but also react optimally to changes in the business. SOA services assembled and used to provide the above characteristics ideally map to actual business services being performed by the organization, such as project plan updates, safety procedures and system shutdown or start-up processes. SOA uses organizational governance rules to drive the creation of and policies for these SOA services, ensuring the proper access and operation of the business processes represented. Business Process Management (BPM) tools, commercially available from numerous vendors, often provide the mechanisms for this governance structure based on standard SOA service elements. (For more information see “Aligning SOA and Process Governance: Steps Toward Your Business Service Repository,” Gartner publication G00162687, L. Frank Kenney)

SOA-driven optimization decreases risk by:

- Aligning business system elements through software constructs called SOA services that can be easily changed and improved through use
- Capturing knowledge within operations through refinement of the SOA services across the engineering services and projects over time
- Monitoring business-driven metrics that empower governance models
- Improving and changing as new opportunities or learning presents itself

At a very abstract level, here’s how business improvement through SOA works. With an agile approach to SOA, these steps are executed iteratively, improving the depth to which each area is addressed with each iteration.

- **Identify business services:** Business system and services analysis reveals sets of modular business services that define operations within the organization, and the governance models needed to manage those services.
- **Establish governance:** Using the business services as models, establish governance models as guidelines, definitions and constraints. To establish these models, business leaders and governance entities define and endorse requirements, rules and policies that then can be applied to SOA-based information services.
- **Create SOA services:** Information Technology (IT) enables the expression of those business services into SOA services, enabling secure sharing of software technology components (see Gartner paper #G00162687 for more info on aligning business and SOA services). These modular business services are built for interoperability using specifications such as WS*I (www.ws-i.org) or special styles of HTML, such as the Representational State Transfer (REST) (defined originally by <http://www.ics.uci.edu/~fielding/pubs/dissertation/top.htm>).
- **Publish/use SOA services:** Deploying the SOA services to servers that make the services available to applications (or “applications servers”) enables the entire enterprise to use a common set of services. The resulting consistency allows better predictability, higher IT resource efficiency and lower risk of error:

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- Predictability – if the entire enterprise is using the same set of services for the same operations and systems, it is easier to predict the outcome in terms of deliverables, resources and timing.
- Efficiency – if a common set of services is available instead of written/rewritten for each project/system, IT personnel can spend time on more value-add activity rather than re-creating the wheel or maintaining multiple versions of essentially the same thing.
- Lower risk of error – if multiple people, projects and systems are using the same set of services, any errors in those services will be found early and corrected for enterprise-wide benefit and lower risk of future error.

Resilience

SOA offers the basic elements needed to provide a resilient architecture. The International Council on Systems Engineering (INCOSE) defines resilience as, “the ability of organizational, hardware and software systems to mitigate the severity and likelihood of failures or losses, to adapt to changing conditions, and to respond appropriately after the fact.” Characteristics that support resilience include

- Robust to disasters

Enterprise business systems show resilience when they can continue to produce the expected business results within a negligibly short time after a disaster. SOA systems enable robustness by supporting failover capabilities within the services repository, the applications server and in being able to access redundant copies of a data provider as needed.

- Distributed

Distributed systems consist of two or more autonomous computing elements that communicate over a network and interact to achieve a common goal. SOA provides an intermediary layer for distributed systems, supporting plug-n-play autonomy of the various computing elements in the distributed systems that deliver business services.

- Decentralized control

Resilient systems allow control from the optimal control point. Often that control point is within the computing element. Autonomous, self-managing elements form the basis of the most highly resilient systems, as those elements can survive on their own for extended periods no matter how many related elements become unavailable. SOA service repositories contain all the information necessary to enable the services to be self-managing.

- Evolutionary

An evolutionary systems learns with each experience. An agile approach optimizes the evolutionary benefits of a resilient system by offering frequent retrospectives (at the end of each iteration) and the chance to incorporate new knowledge into

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operations at the beginning of each iteration. SOA services capture the knowledge in a way that can be deployed quickly into the operational environment.

- Adaptive

Self-describing interfaces enable communications with other elements in the business systems that allow adjustment according to survival requirements or other resilience factors. SOA Services include such self-describing interfaces in the form of the Web Services Description Language or WSDL (pronounced “whiz-del”).

- Self-organized

SOA services have well-define interfaces that enable self organization according to a governance model over aspects such as security and quality of service. Services can be designed to interface with other services to organize prevention (e.g. security identity management) or recovery (e.g. failover) needed for resilience.

- Emergent

Resilience of a system emerges from the interactions of underlying components. The self-organized, adaptive nature of SOA services enables them to create emergent phenomena required for survival or recovery of the system.

3. Solution Details

Solutions from Rolta involve three main components for delivering the capability to share knowledge in an agile manner, resulting in resilient operations. Our **SOA-today** packages are pre-defined consulting services that bring organizations into productive use of SOA within weeks. These packages present great value to organizations just starting with SOA, as well as those that need to re-energize stalled SOA efforts. For organizations that have successfully embraced SOA, our **SOA Center of Excellence (SOA CoE)** consulting elevates SOA to greater levels of productivity. Both SOA-today and SOA CoE exploit a workshop of software-based tools we offer under the name iPerspective. **iPerspective™** automates and accelerates the creation and management of SOA Services. iPerspective can be used stand-alone, or can be integrated into an already-existing SOA stack to provide fast and frequent return on investment. iPerspective can also be used as a “universal connector” in data integration environments where SOA may not be the ultimate goal, but instead, secure access to multiple different databases may be the goal.

SOA-today

SOA-today consists of four components that may be selected in any combination. Figure 1 illustrates those components.

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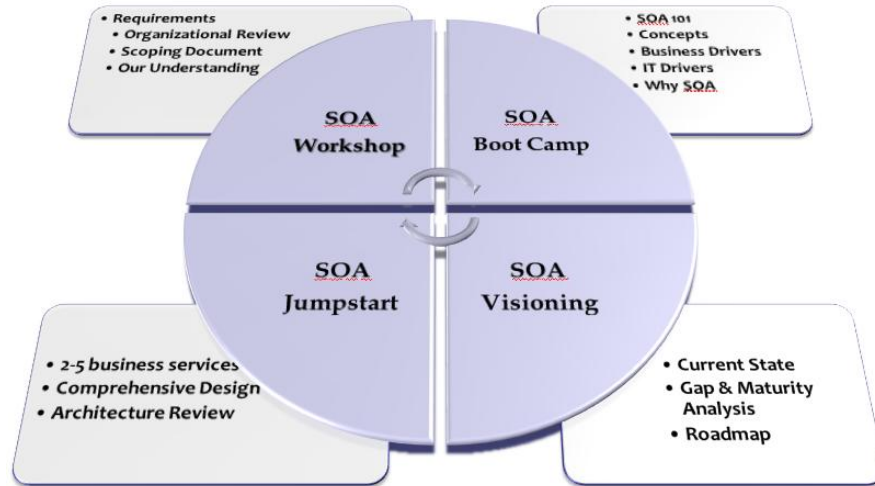


Figure 1. The components of SOA-today.

The components delivered in an agile fashion, as implied by the cycle arrows in the middle of the diagram, yields the best results. Agile delivery means that the components are delivered in iterations, starting at a high level with any target user requirements already known at the beginning of the project. As the first iteration progresses, more becomes known about user requirements, which can be integrated into the next iteration, and so on until the user accepts the final result of a progressive iteration. At the end of each iteration, the team conducts a retrospective that enables new insights to improve future iterations.

The agile approach yields results early in the production process, since the results of each iteration deliver value that a user can use (ROI), based on what is known at that point in the project (see Figure 2). This approach also gains buy-in from the intended users at an early stage by involving them in reviewing deliverables and design on a daily basis. Agile retrospectives can often reveal emergent opportunities to increase solution resilience, as well.

The Advantage of Agile

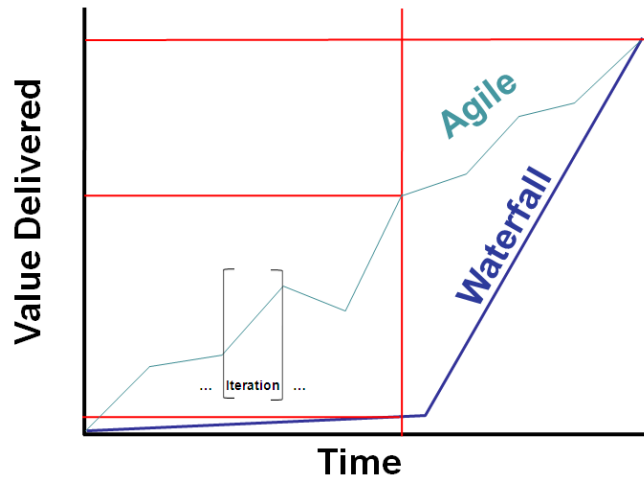


Figure 2. The advantages of agile over waterfall: agile delivers value at the end of each iteration, whereas Waterfall only delivers value at the end of the project. By the end of a Waterfall project, many conditions may have changed, making the project results irrelevant. Agile catches any changes at the end of each iteration.

Traditional methods of creating SOA services take many days to several weeks, and in extreme cases, several months. With such long development cycles, it is hard to deliver something useful at the end of each iteration. The iPerspective tool alleviates this problem by enabling IT staff to create SOA services in minutes through a point and click interface, requiring no new skills. iPerspective's automation allows multiple feedback sessions with the users, to help refine the product toward value for the users. Figure 3 illustrates the iterative process used with SOA Today and SOA. This cycle can occur in well under an hour, depending on the scope of services involved.

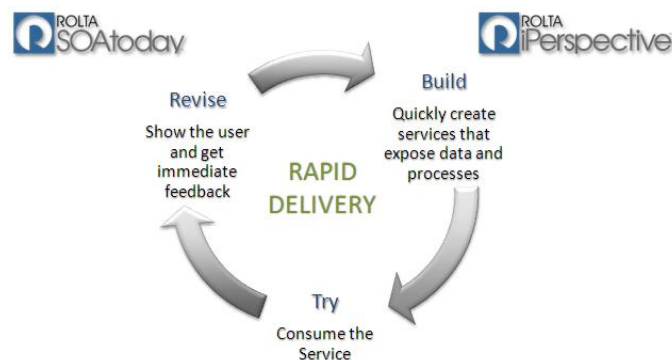


Figure 3. The iterative process used in SOA-today and SOA CoE.

SOA CoE

The SOA CoE services bring an organization up the maturity curve for realizing returns from SOA. This maturity curve, shown in Figure 4, can progress along a centralized path, or may occur within different portions of an organization in a federated manner.

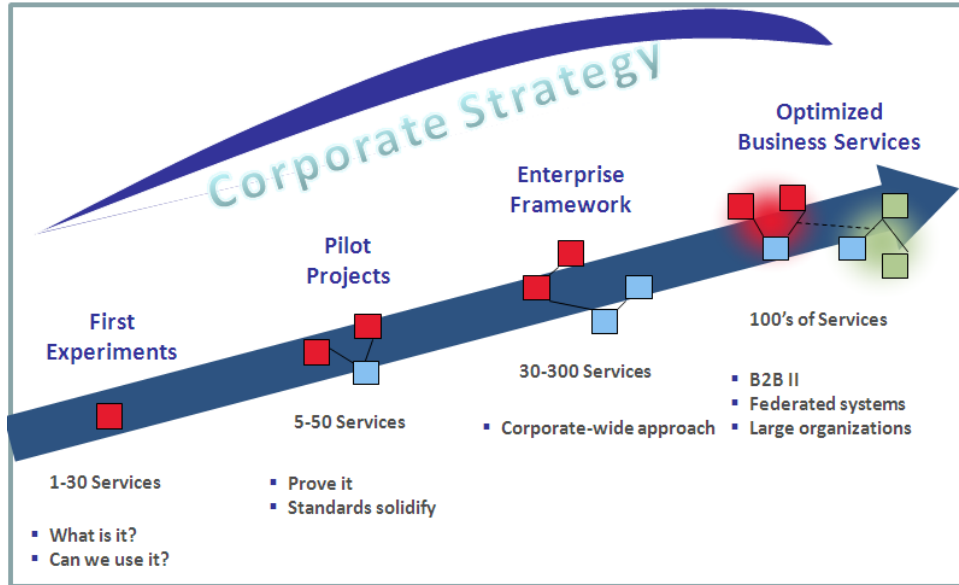


Figure 4. SOA maturity progression.

While an organization's first SOA experiments and pilot projects can be easily deployed using SOA-today, as the number of services increases beyond a few dozen, more sophisticated aspects of SOA become critically important, as illustrated in Figure 5. These elements start with the highest layers, enterprise strategy and governance, and work toward building the underlying layers at a very abstract level to start in the first iteration, and then build in more detail with each successive iteration. This approach enables the near-immediate incorporation of knowledge acquired during development process. It also enables construction of logical self-organized systems of services as emergent opportunities present themselves.

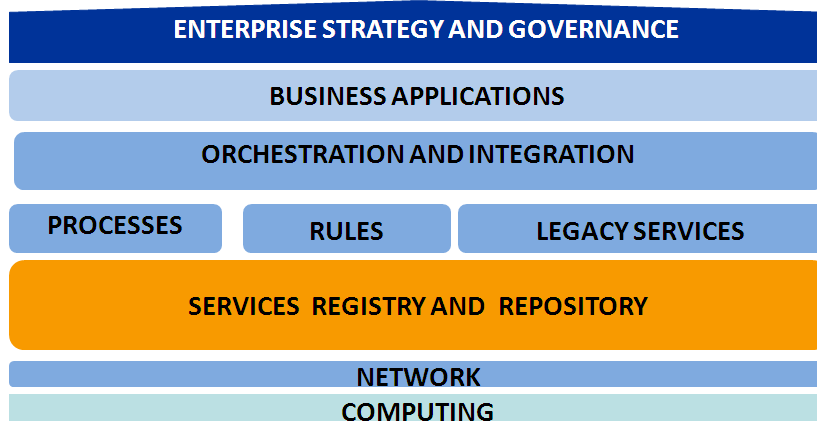


Figure 5. SOA Center of Excellence elements.

iPerspective

The iPerspective technology offers a suite of software tools to create and manage SOA services. The tools present this functionality with a point-and-click interface, eliminating the need to manually code the services, which is time-consuming and error-prone. iPerspective also allows services to be published or “deployed to the applications server” in groups called “releases.” These releases can be organized to reflect a meaningful construct within the SOA environment, such as versions, departments, or disciplines. Metadata stored in the iPerspective repository can also include rich data that enhances resilience as well as usability/visibility of the value provided by the services. iPerspective bundles an applications server, however it also allows for deployment of created services to a foreign applications server.

iPerspective also supports secure sharing by offering four levels of security. iPerspective offers its own default security module, or a foreign security package can be plugged in. Six levels of security available with iPerspective are:

- Table –table data within the data source
- Operation – operations that the web service user can issue through the web service
- Gateway – the way a data source is made available to web services
- Service – each web service
- Release –a collection of services
- Administration/Management – access to iPerspective itself

4. Business benefits

Four illustrations of real customer situations show the value of an agile approach to SOA that SOA-today, SOA CoE and iPerspective bring to our customers. The first illustration is an energy company that needed to improve *operational decision-making* capability through more time-responsive and better integrated data infrastructures. The second illustration involves the real-time integration of new data sources for more *efficient production*. The third presents Rolta’s use of SOA to enable faster, better executive and *financial decision-making*. The last example shows how using SOA to provide enterprise-wide consistency in taxonomy and ontology yields more *resilient* operations that can easily respond to perturbations and errors introduced into its operations.

Operational Decision-making

A large energy management firm had a number of disparate operational systems and the inability to harvest the information from each into a unified platform to develop consolidated

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information. As a result, a number of business units were operating without unified data, making decisions with the ability of understanding the impact to the business as a whole. Additionally, within each system, there was a lack of adequate reporting and analysis capabilities that also restricted the business users' access to accurate, timely information.

Rolta developed a solutions roadmap that captured the information goals of the company three to five years into the future. Out of the roadmap came a detailed list of prioritized projects that allowed this energy company to attain their reporting and analysis goals. Rolta then executed a series of projects, each being driven by Rolta's proven methodologies. With the scope and requirements in place, Rolta used iterative development to deliver on the requirements of the project.

The solution involved creating web services that allowed the customer's Energy Trading positions to be marked to market every day compared to once a month that had been the case. The affected positions totaled into the hundreds of millions of dollars. The solution allowed traders to take action with more information to either improve a trading position or minimize a trading loss. Real-time use of actionable, updated information saved the company 1% of trading dollars, which translates into a savings of \$3MM US to \$5MM US. This was a long-term and wide ranging effort that changed the way the entire organization used information.

Efficient Production

A major diesel engine manufacturer purchased iPerspective technology, under a previous brand of "Periscope," in December 2006. They are in the process of enhancing their assembly line application in order to reduce the amount of time an engine is at one of their assembly "stations".

All engines are custom ordered, so each engine can have a slightly different assembly procedure, depending on the options selected by the customer. The current application runs on a Stratus system and prints out a text-only version of the assembly instructions for each station. These instructions are used by the line workers to assemble the engine. iPerspective enabled enhancement of the application to include pictures with the assembly instructions. Providing a visual depiction of the instructions reduced the amount of time the assembly worker takes to interpret and perform the task.

Financial Decision-making

TUSC, a division of Rolta, is using iPerspective to improve financial decision-making. Upper level management sponsored this project to reduce the amount of manual work needed to provide financial information for decision-making. The specific objective was to make the business data more transparent available on-demand to all upper management and also to measure the time savings for the employee responsible for delivering the data.

Currently all financial information is created by manually running reports on the source systems and then consolidating the information into Microsoft Excel™ spreadsheets. Those excel spreadsheets are then emailed out to the appropriate parties within the organization. The SOA

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solution delivered, based on iPerspective, addresses a number of problems with the current system:

- Security – email is one of the least secure ways to distribute information, by building an application in a central location that has the appropriate security scheme, sensitive company information will be much more secure.
- Repetitive/Time consuming work – Currently one employee is responsible for creating all the excel spread sheets that get distributed to upper level management. Monthly, Weekly, and sometimes more frequently, she is required to manually pull information out of the source systems and transform it into a format that will be meaningful for the business executives. These tasks are repetitive and can be time consuming. The use of iPerspective completely eliminates her need to spend time creating these standard reports.
- Latent Data – because these reports were generated monthly or weekly, there is was no way to track current, real-time performance of the company. The weekly and monthly reports are important to see trending and overall performance, however there was no way to view current, up-to-date performance. The application continues to display historic data and also allows executives to see real-time data in the same place for important areas like sales.
- Versioning issues – To share information in the past, spread sheets had been distributed to multiple people on a regular basis, potentially causing some versioning issues and ultimately confusion. iPerspective's repository and release mechanisms offer a reliable place to look for this information.
- Summary - The current reports provide very detailed information, however, there hasn't been a good summary available that quickly and easily provides executives with overview information and insight into the business. The use of iPerspective provides this quick and easy identification of problem areas, as well as areas that are performing well.

Resiliency

California Institute of Technology (CalTech) recognized that they faced a human resources (HR) problem. They had identified a multitude of different ways that the same people were being described in different databases throughout the institute. Through a SOA-today engagement, CalTech used iPerspective to implement mechanisms for a common taxonomy and ontology around the HR databases. This solution enabled the institute to work toward resilient policy management for the people associated with CalTech.

5. Summary

SOA offers value to engineering firms by using iPerspective-generated services to deliver secure sharing of data sources with agility and resilience. This value reduces engineering service process risk by delivering improvements in communication, ability to change with changing conditions and recoverability in the event of extreme events or

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disasters. SOA-Today, a packaged consulting engagement from Rolta, can help organizations get started with SOA easily and with robust results, as shown by our case studies. Rolta's SOA Center of Excellence matures the initial SOA efforts, introducing new SOA elements that add more and more capability to manage enterprise risk. iPerspective provides a solid foundation for SOA-today and SOA CoE by empowering these offerings to gain fast access to business data in "business time." iPerspective delivers this value by quickly (by a factor of 10 in most instances) and automatically generating needed code, without requiring IT personnel to learn new development skills. Ultimately, as SOA reduces risk, engineering firms will compete more effectively on the basis of better delivery performance and greater operational control.