White Paper

Reducing Time-to-Market through an Adaptive Service Generation Infrastructure

By

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Abstract

Most service-based business organizations recognize that time-to-market for service introduction and the cost structure for service delivery drive competitive position and profitability. This paper outlines a componentized approach to business service delivery called ***Adaptive Service Generation (ASG)****, which addresses the core issues of time-to-market, cost containment, and service customization. While considerable attention has recently been paid to the use of "agile" methods to decrease software development cycles, we take a broader view of the ability of businesses to deliver individualized services that respond rapidly to changing customer demands. In particular, we suggest the use of component approaches to build a capability, not simply for application generation, but more importantly, for service generation. The prescription for service enhancement is expressed in terms of a novel view of services called a "Service Component Architecture." This tool provides a hierarchical view of the service generation capabilities of the organization, the bottom layers of which contain the cross-enterprise technical infrastructure. The top layers define the business infrastructure for service generation. The Service Component Architecture depends in turn on the use of "adaptive service components," which are the flexible building blocks for rapid service deployment. With these elements, the business can create an environment for service delivery that responds to the service recipient's needs at or near the time the service is delivered. ASG provides the integrated business and technical view needed to leverage technologies like web services. Building on this foundation, ASG methods of service component accounting provide a natural way to prioritize investment in service development and a means to focus the resources that support service delivery. Opportunities for radical cost reduction follow from the reuse of service components across services, business units, geographies, and customer segments. The paper discusses the implications of ASG for application development, knowledge management, and a simplified service delivery infrastructure. We conclude with the definition of a sample pilot program for implementing the ASG model.*

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Purpose of the Adaptive Service Generation Approach

Many organizations, even those explicitly involved in product manufacturing and distribution, have come to understand the impact of services on their business. Competitive position depends on how well they can reduce the cost structure of service-delivery and the time required to introduce new service capabilities. Because customer needs and expectations for services vary from individual to individual and change rapidly over time, service organizations cannot assume that today's services will meet the needs of customers tomorrow. Yet most organizations introduce new service capabilities on a time-scale of months or years. Services that use automated means of delivery may have been defined long ago in response to a business environment whose time has come and gone.

Related to the need for rapid response is the need for increased responsiveness to the individualized needs of service recipients. Both service quality and market reach depend on the ability of a service to adapt to specific customer needs. Yet despite some efforts at "personalization," most websites treat one customer very much like the next. What if, on the other hand, the financial services company delivered services over the web in a way that took cognizance of the expertise, risk proclivity and life circumstances of the customer? What if customer support services delivered over the web mirrored the flexibility and service values of human-delivered services? The ability to respond with speed and specificity to the needs of customers can dramatically affect the size, loyalty and profitability of a customer base.

This paper provides an overview of the Adaptive Service Generation (ASG) approach. The ASG view suggests a substantial change in the way we can think about services and practical ways in which new technologies and techniques can be used to enhance the value and efficiency of service delivery. The aim is fourfold:

1) to reduce costs of service delivery,
2) to enhance the value of services produced by multiple business units,
3) to extend the reach of existing service capabilities, and
4) to compress the time needed to deploy new services.

For the purposes of this discussion, we find it useful to distinguish the term "service" from "business process." In our view, the special characteristic of service is the ability to respond interactively to the individual needs of the customer or service recipient. The role of the service recipient is key. Business processes, on the other hand, are normally focused on structured output as in a workflow. A process typically executes predefined rules that reflect the requirements of an abstract "user" rather than the needs of a specific customer. Where process focuses on output, the value of a service lies in how it may change the capabilities of the service recipient to meet a known objective. This is not to say that processes are not appropriate for structured business functions like check processing and logistics management. Equally valid, however, are the special requirements of customer-specific services. The demands of service delivery become ever more important as customers take increasing control of their relationships to the businesses that serve them. Moreover, while we use the term customer or service recipient, this view applies equally well to services involved in business-to-business relationships and those that support the technical infrastructure. This paper shows how the analysis of services in terms of service components can enable increased responsiveness of services to recipient needs within a constrained cost structure.

In addition to the adaptive nature of services, there is a huge opportunity to structure service delivery in terms of what we call a "Service Component Architecture." This tool defines how services are and can be delivered through reusable service components. The Service Component Architecture is the foundation for reducing the cost of service delivery through replication and adaptation of service components across business units.

We call our new approach, the "Adaptive Service Generation Framework", or simply, ASG. The new view of services asks the question: what are the features of the business and technical infrastructure for service development and deployment that may help radically reduce time-to-market? ASG lays out an approach to service engineering that consists of:

- Careful definitions of what we mean by services and their constituent elements.
- A set of tools and techniques that implement the engineering concepts of service components, service component architecture, and service adaptation.
- Methods for analyzing service delivery capabilities, prioritizing service components, designing and generating services.
- A set of technologies that support the rationalized approach to service engineering.
- Strategies for changing business operations to take advantage of ASG capabilities.
- A migration path for implementing the ASG framework.

Where does the ASG framework apply?

- The financial services company that aims to reduce costs through consolidation of the IT infrastructure.
- The public sector organization that aims to create a common set of services to support user access to multiple public agencies.
- The health services organization that seeks to integrate human-delivered services with web-delivered services.
- The transportation company that aims to deliver new services through a network of business partners.
- The commercial organization that seeks to add value to products through customized customer-focused services.

In essence, ASG rationalizes the process of service delivery by defining an engineered architecture based on reusable service components. These building blocks for services adapt to the needs of multiple business units, geographies and customer profiles.

Introduction

Recent trends in technology and changes in the business environment for service delivery force us to alter our understanding of services and how we deliver them. On the one hand, many business and public sector organizations are under extreme pressure to enhance the efficiency and quality of their service-delivery capabilities. No longer is it tolerable to allow the infrastructure that supports service delivery to evolve in an uncontrolled way among independent business units. The opportunities for infrastructure consolidation are too great and the need to reduce costs too important not to rationalize the way technologies are used to deliver needed services. Whether the focus is medical services, financial services or transportation, organizations have looked to information systems to add value and reduce costs of labor-intensive services. Those same businesses are now confronted with

escalating complexity of the those systems, especially in cases where business units need to be merged, supply chains integrated, and business relationships extended in unpredictable directions.

On the other hand, developments like web services and business trends such as service outsourcing make it possible to deliver services in new ways. Web services, customer profiling and other new technologies have the potential to change the manner in which people and businesses interact with information systems and with each other. This paper addresses the implications of these changes for service delivery and, in particular, the speed with which new services can be developed and deployed. Providing an integrated view of business services within a Service Component Architecture has powerful effects on how services are customized, how we manage the increasing complexity of services, and how we can radically reduce time-to-market for new and modified services.

When merging IT systems in multiple business units, for example, it is often assumed that the priorities are IT issues like application integration, data access and transaction integrity. But the real challenge is merging the services that represent the core value of the business. Consolidating services in a rational way requires a model of services in terms of reusable service components, what we call a "Service Component Architecture."

We maintain that the same discipline that has been applied to software systems design has been largely ignored in the case of services. There are good reasons for this. Professional services such as financial advising, medical diagnosis, and IT architecture have been regarded as too complex and too tied to the human service provider to be "engineered" or delivered by an automated system. On the other hand, software products, integrated circuits and other complex systems demand a careful and exact engineering discipline. Building systems from well-designed and tested building blocks reduces risk and complexity. No computer customer wants or needs to know the structure of the NOR gates in mega-device chips or the content of the software components that translate bits into boxes on the screen.

There is no reason, however, that methods of complexity encapsulation and component design cannot be applied to services. In fact, it may be that the evolution of service-delivery technology and the growing complexity of the service economy will demand a service engineering discipline just as the growing complexity of information systems demanded an information engineering discipline. This does not mean that all such services need to be automated. On the contrary, the concepts of service components and Service Component Architecture apply equally well to automated and human-delivered services.

In what follows, we will outline the elements of service engineering and the Adaptive Service Generation framework. This will show how service engineering can:

- Define priorities for investment in services.
- Integrate technologies such as web services and service customization into a capability for fast cycle service delivery.
- Reduce costs through service consolidation and customer-self-service.
- Improve competitive position by reducing the cycle time for generating the customized services that respond to the changing needs of service recipients.

Need for a New Approach – Service Challenges in a Web-Connected World

IT infrastructure and service consolidation – The challenge of producing an integrated infrastructure for merged business units.

Many businesses, from hospitals to financial services, face the need to consolidate their business operations and associated IT support functions. Often this is a result of mergers and acquisitions. The need to coordinate business operations across organizations has generated technical efforts in server consolidation, enterprise application integration, and workflow implementations. The fundamental need, however, is the integration of services across those business units and that depends on the type of service component analysis that is the foundation of ASG.

> ***The ASG response**: ASG focuses attention on replicable service components, which represent for both analysis and implementation the common features of service capabilities across business units. By structuring strategies for IT consolidation around the fundamental business capabilities of the service-based business, ASG provides a rational decision framework for merging business and IT operations. Because ASG addresses all layers of the service delivery architecture from strategy to platform, the framework provides an integrated path to improved service delivery capabilities for a networked set of business units.*

Customer support – The challenge of satisfying customer support demands in the face of increasingly complex products and services.

With costs escalating for delivery of internal services, many organizations have looked to the web to reduce the cost of customer service. Yet most surveys show that in the customer's eyes, the quality of customer service has declined. Customers wait in long queues to solve problems they never would have had a few years ago.

There are many explanations for the perceived decline in customer service. One of the most cogent relates to the increased complexity of products and services. This places increasing demands on customers and increased risk that the behavior of the product or service won't match customer expectations and skills. For Internet-based services, the rush to develop Internet applications has often produced a spaghetti-like mess of inconsistent interfaces, challenges to scalability, and increased demands on managing the evolution of the existing application environment. The obvious solution is to increase the quality of customer service and the expertise of the customer service representatives. But the obvious solution may be economically disastrous for the service provider. If the complexity of services and resulting customer demands increase exponentially, then it is hopeless to address the problem simply with more resources.

> ***The ASG response**: ASG recognizes that complexity must be managed through service engineering. This discipline amplifies the flexibility of the front-end systems to respond to changing customer needs. Service components, owned by multiple business units inside and outside the primary business organization, respond and adapt to the changing needs of the customer. This means that in real ways the customer is the designer of the service she receives, and this design occurs in realtime during the course of service delivery.*

Time-to-market – The challenge of reducing the time required for service generation and delivery.

If we were to identify one business measure that characterizes the capability of a service-based organization to meet its business goals, time-to-market for new and enhanced services rises to the top. The ability to reduce the cycle time for new services that respond to changing customer needs impacts other business issues such as revenue growth, service margins, and competitive position.

The importance of time-to-market derives from two features of most service-based business models: the time-value of new service features and the impact of time-to-market on the cost of service production. In a competitive environment, as companies adopt similar service capabilities, the value of a new service or enhancement declines rapidly. Reduced time-to-market can also drive down the cost of new service development. Ultimately, speed of deployment drives both the revenue and profit associated with a given service introduction.

> ***The ASG response****: Through the use of adaptive service components, and the infrastructure that supports deployment of these service capabilities, ASG radically reduces the time required to deliver newly designed services. ASG enables generation of new services from combinations of service components and adaptation of service components to changing recipient requirements.*

Service integration – The challenge of integrating human-delivered and machine-delivered services.

Service-based organizations often use automated delivery mechanisms to address only the most mechanical aspects of services, such as taking an order or providing information such as product features to customers. The fundamental problem is that human-delivered services are conceived, modeled and managed in a totally different way from automated services. One of the main causes for failure of automated systems to meet business goals is the need to provide the service value that customers expect from human delivered services. Changes in technology, such as customization and web services, can satisfy service requirements in new and valuable ways. But the delivery of service value in the automated environment depends on understanding the service content of the business model and what service elements can and should be delivered by automated mechanisms.

> ***The ASG response****: ASG provides a consistent approach to the modeling and deployment of services, whether they are delivered by people or over the web. With decomposition of services into adaptive service components, the determination of what services are to be delivered by automated means becomes an economic decision based on what delivery vehicle is appropriate for the identified service components under specific circumstances.*

Service content of products – The challenge of addressing the *service content* and *service value* of product-based business models.

The margins of many products depend on the “service content” of the product and the value of that content to the customer. The fact that lipstick may cost much more when delivered through a direct sales representative than through a discount retail store reflects the value of the relationship between the customer and the sales representative. Transferring such products to the web threatens margins through commoditization precisely because the service values are eliminated.

> ***The ASG response****: By modeling the service content of the direct sales business model, ASG can identify how service content affects product margins and what features of those services can be transferred to web channels.*

Service customization – The challenge of responding to individual needs of varying customers and deployment environments.

Recently accepted standards on web services and software support for adaptive components enable a substantially more robust approach to customization of automated services. More than simply enhancing the user experience, customization acts to manage the complexity of diverse deployment environments. As web applications are extended into foreign extranets, this ability to adapt and customize becomes essential rather than merely desirable. Accommodating customization at runtime changes the nature of the web-application development process. In a relatively short period of time, most large service organizations will move in the direction of rigorous service customization. As with other changes in business culture, organizations that begin the journey early will be in a better position than those that don't.

> ***The ASG response****: With "adaptive service components", ASG models the range of customized behaviors associated with replicable service elements. The attributes of the service recipients can be stored in an enterprise database providing a foundation for service customization.*

Collaborative commerce – The challenge of managing business functions that are the joint effort of multiple business partners.

The story of the Internet and B2B integration is symptomatic of the danger of assuming that business value emerges from the simple ability to connect one business entity to another. Many ERP efforts have stumbled without the help of the Internet. One of the reasons "collaborative-commerce" has not yet realized its promise is the need for replicating the flexibility and adaptability of supplier relationships within an automated process. This is not possible within traditional process models. This is not to say that the cure for the B2B new economy is improved modeling techniques. But rigid definitions of requirements for "workflows" across business units can easily fall of their own weight as business needs change.

> ***The ASG response****: Because ASG focuses on run-time adaptation of services, ASG service components can support the type of flexible response to changing business conditions that is difficult within traditional process models. Through use of technologies such as web services, the ASG infrastructure supports extranet implementations of adaptable service components and realtime changes in the automated behaviors of collaborative systems. This addresses the need to implement collaborative "business webs" that are adaptive both on the micro-scale of one-to-one relationships and the macro-scale of supply chain and collaborative product and service delivery strategies.*

Distributed IT Services – The challenge of enhancing the value of the IT organization to the business, while reducing operational costs of IT services.

IT organizations within a large company provide an increasingly complex set of services to a variety of business units and external customers. Like the need to reduce physical infrastructure costs, IT shops are under pressure to reduce the cost of IT support and improve the quality of IT services.

> ***The ASG response****: IT services are similar to those of other service-delivery organizations. The same methods of service engineering apply to this case. The use of service components for IT services can reduce costs and improve service levels by rationalizing IT service delivery. When addressing customer support or application development, the service components can be delivered by automated means or through structured staff delivery mechanisms. In either case, the engineered service components can adapt more easily to changing technical conditions and user requirements much more efficiently than* ad hoc *service delivery processes. Componentization of IT services complements the use of service components for IT infrastructure consolidation.*

Bottom line: ASG impacts competitive position.

Some companies may begin an ASG effort with the short-term objective of reducing infrastructure cost for service delivery. The surprise is that ASG makes reduced time-to-market a bi-product of that effort. Other organizations may focus on time-to-market and find that cost-reduction and improved customization capabilities are an unavoidable consequence. ASG enables winning on multiple fronts.

The multiple impacts of ASG act to enhance competitive position. Customization, realtime adaptability of services, and reduced time-to-market differentiate the service delivery organization from its competitors. The ASG capabilities broaden revenue channels for existing services and also create new service-based revenue streams.

The Basics of Adaptive Service Generation

The ASG approach provides an analytical framework for applying web services and related technologies to improving the service-delivery infrastructure. ASG methods apply well-understood concepts of component-based systems engineering to service delivery. In so doing, the ASG approach addresses the conflict between rigid procedural definitions of business process and the behavioral, object-oriented approach to systems design. The result is a view of service design that pays explicit attention to the manner in which services "discover" and implement user requirements at runtime. This view moves the software design process one step farther away from the waterfall model in which requirements are specified in advance. The new services model enables application behaviors to be generated as a realtime response to individual customer needs.

The ASG approach is based on the following observations.

- **Services lie at the core of business-value generating capabilities.** The quality of services and the ability to respond to the current individualized needs of customer defines the quality of the relationship with the customer and its value in terms of loyalty and long-term profitability.
- **The focus on services reflects an ongoing change in business and IT culture from delivery of goods to delivery of customer value through services.** Many business, even some involved with service delivery, are still structured on a product-delivery model. That is, the relationship with the customer is structured on product delivered and payment received. In the services view advocated here, the opportunity is to enhance service value through interactivity and adaptation to the specific current needs of the customer. As we shall see, the ability to address customer needs at runtime enhances service value (and profitability), and also reduces time-to-market.

- **In service-based organizations, efforts to improve competitive position and reduce cost of service delivery depend on improving all layers of service delivery architecture.** Much of the IT organization is typically involved in supporting service delivery functions. The benefits of an engineering view of service delivery can only be realized through an integrated picture of the business service capabilities and the technical service capabilities that support service deployment.

What is a "Service"?

If we want to improve our capability to engineer services, the first order of business is to understand what we mean by service. The temptation is simply to equate service with process. There are well-accepted definitions of business process. For example, according to foundational work on business process engineering of Hammer and Champy, a process is a "collection of activities that takes one or more kinds of input and creates an output that is of value to the customer." Rather than thinking about service in terms of an input-output model, we find it more useful to work from the dictionary definition of service as "an act of helpful activity." Building on this colloquial description, the concept of service can be distinguished from process in a number of ways. While process, defined as an activity with inputs and outputs, takes little account of external circumstances, for service, context is crucial. A service focuses on the recipient rather than the business function. In particular, whether provided by a doctor, teacher, or automated system, a service provides something of value to a recipient via an *interactive* course of action. The existence of the recipient is hugely important in determining the behavior of the service provider. Taking this into account, we propose the following definition.

> *A "service" is an interactive activity with a recipient that adapts to the recipient's needs and delivers a capability that enables the recipient to accomplish an objective or gain something of value.*

Note that the emphasis is shifted from delivering an output or product to changing the capabilities of the recipient of the service. Educational and training services are a clear example of how a service changes the capabilities of the recipient. The value of other types of services can also be defined in relation to changing recipient capabilities. Customer support enhances the capability of the recipient to use a product as intended. Legal and medical services enable recipients to make decisions on courses of action. Information technology services enable recipients to apply technologies to meet business goals.

Within this definition, a service has the following properties:

- a mechanism for discovering attributes of its environment, specifically, attributes of the recipient.
- interactive behaviors that progressively change the capabilities of the service recipient.
- a feedback mechanism for indicating the quality and effectiveness of those changes.
- a means for using the attributes of the recipient to select appropriate service delivery behaviors.
- a means for adapting the mode of interaction with the recipient to the attributes (needs) of the recipient.
- a means for communicating with and building on capabilities of other service providers (collaboration).

- access to skills and other knowledge resources that provide value to recipient.

This definition conforms to the common understanding of service as an activity that serves the needs of the recipient. For example, if we are obtaining a service from a professional service provider such as an insurance broker, financial advisor or doctor, we expect that the service provider will base recommendations, procedures, and manner (mode of interaction) on his or her knowledge of the recipient. In fact, in great measure the value of the service depends on the confidence the service recipient has in the service provider. The ability to respond to the special needs of the recipient fosters that confidence.

How well does this definition translate into the automated context? The answer is very well if we apply the right modeling techniques and pursue a consistent application of systems engineering to the services domain. That is the purpose of the Service Component Architecture, which produces an integrated view automated and non-automated services.

What is a "Service Component"?

Just as software engineering uses components to manage the complexity of system design, ASG uses service components to design and construct services. A service component retains well-accepted component attributes of modularization and the use of interface protocols to manage system interactions. Just as software systems or product designs can be efficiently built and modified with reusable component parts, service components are used to generate services through combination and adaptation of individual component behaviors.[1]

The service component is both the unit of analysis and the unit of implementation. To be in a position to improve service delivery processes, it is necessary to model services in terms of reusable building blocks. These describe how services are now delivered and how they can be delivered with an improved delivery infrastructure. The service components (and the related Service Component Architecture) identify properties of service delivery that are reusable across business units and recipient groups.

As an example, customer registration is a service component that records information on new customers. Registration can be treated as a narrowly defined activity in which simple identification information on a new customer is recorded in a registration database. Registration can also be treated as a service, or service component, which establishes an interactive relationship with the customer and obtains more detailed information on customer preferences and characteristics. Registration is a component that applies to many services and to many business units from sales to customer support. The registration component makes use of resources common to multiple service components such as existing customer data to ensure that new registrants have not been previously registered.

Another example is customer support triage, in which an initial customer contact is directed to an appropriate support path. The particular response will depend on information derived from the current customer interaction, customer profile data, customer support knowledge bases, customer support resource availability and other conditions. These and other service components are reusable as components because of their applicability across multiple services, wherever and however those services may be delivered. The issue from

[1] Our view of component builds on commonly accepted concepts like the definition in the UML specification, which defines component as "a physical, replaceable part of a system that packages implementation and provides the realization of a set of interfaces. A component represents a physical piece of a system's implementation, including software code (source, binary or executable) or equivalents, such as scripts or command files."

a service delivery point of view is what kind of infrastructure is required to support service delivery.

The decomposition of services into service components enables the business to identify service capabilities and support reusability of service capabilities that are delivered in different business contexts. The service component may apply to varying services, business units, geographies, customer segments, business-partner relationships.

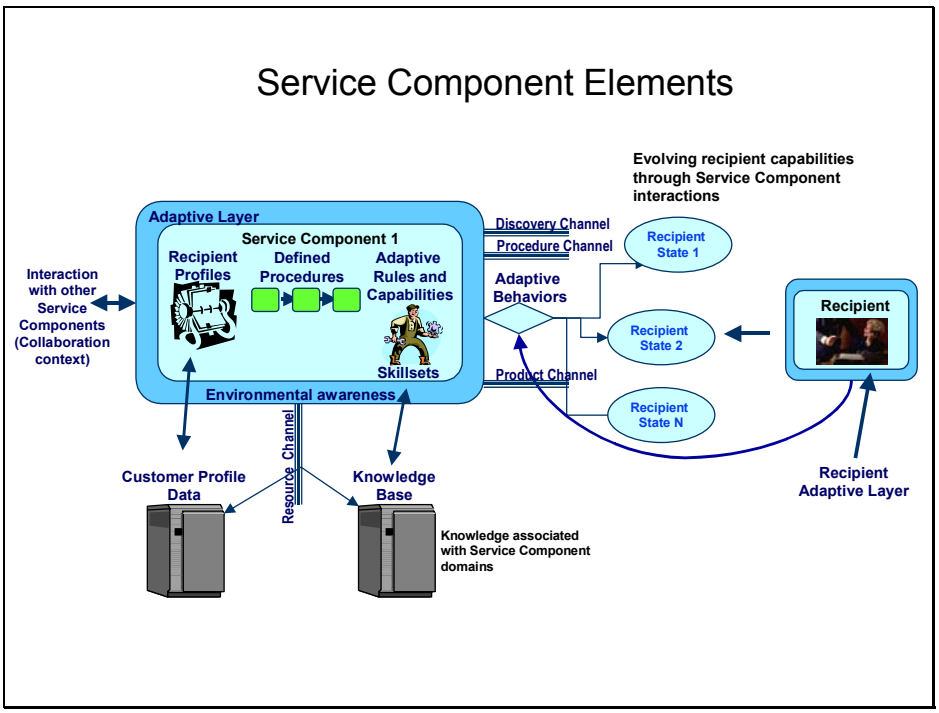
The implementation of business service components depends on technical service components that support service deployment. Web services are an important example of technology used to deploy service components, but not the only one. Service components may be delivered by human beings, existing systems, third party outsourcing and other options. The initial modeling of services in terms of service components is carried out independent of a particular technical implementation. Why? Implementation of service components should be a business decision that reflects available options and objectives. Factors affecting deployment include how the service components can be built on existing systems, how the service component contributes to revenue, what role people play in delivering interactive service value, and availability of third-party outsourcing.

Service Component Elements

While we will not go into detail on modeling methods here, we can identify a number of important features of service components. Naturally, the properties of service components correspond in many ways to the properties of services. To address the adaptive requirements of a service in relation to the recipient, a service component:

- Acquires custom information about the recipient
- Selects service behaviors appropriate to recipient
- Adapts manner of interaction to recipient profile
- Assesses changes in recipient capabilities
- Applies a skill-set and knowledge resource in delivering the service.

Additional features of service components are shown in the diagram below. Based on information on the current needs of the recipient, the service component exhibits behaviors that aim to change the recipient's capabilities in ways that are of value to the recipient. This change in the state of the recipient becomes part of the customer profile and interaction history. Knowledge of recipient preferences and behaviors in turn influences subsequent delivery of services. In this way, service components adapt to the current needs of recipients and the deployment environment. These adaptations, standardized for multiple service components, may adjust to language, recipient expertise, business customs and rules, and other factors that vary depending on where, when, how, and to whom the service is to be delivered.



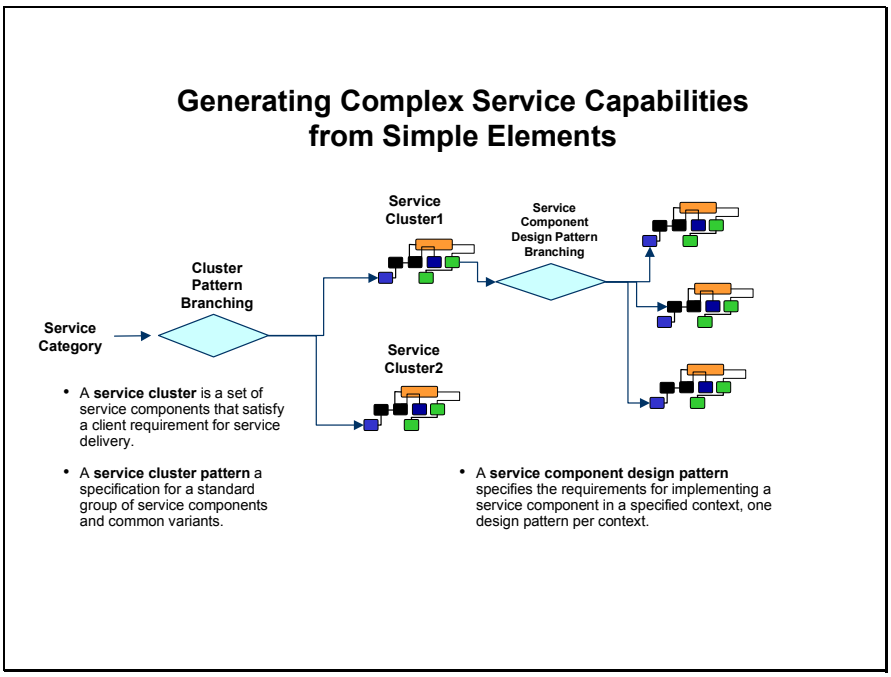
The customer or recipient profile is an example of the common resources on which service components depend. Other resources include related knowledge bases, skillsets, existing IT assets, and other service components.

Service Component Adaptation and Collaboration

Just as a few thousand genes can produce an infinitely complex variety of life depending on how they are expressed in a specific living environment, service components can adapt and combine to deliver a wide variety of service capabilities. As illustrated below, service components provide for service adaptation in two ways. First, service components may be combined in various ways to form what we call a "service cluster." Second, the constituents of the service clusters, the service components, adapt to variations in recipient needs.

This service cluster may be generated at runtime via technologies like web services to satisfy a particular user requirement. The service cluster can also support collaboration among multiple businesses or multiple agencies within one organization. Combinations of service components may also be defined in terms of standard clusters or what we call "cluster patterns." These provide for repeatable ways to meet a class of service requirements.

Service component adaptation extends the range of service variability. Service components can be designed to respond interactively to the particular needs of service recipients. They are the "front line" of adaptation. As with service clusters, patterns may be associated with adaptive behaviors. A good example is adaptation of services to multiple geographical environments. Globalization requirements can be met through adaptations in relation to language and local business practices. This is an example of another type of reuse. Adaptation for globalization can be applied to multiple service components.



The ability to generate service variations with service clusters built from adaptive service components goes a long way toward rationalizing service delivery. Service components and clusters can be reused and tailored in repeatable ways.

Service Component Architecture

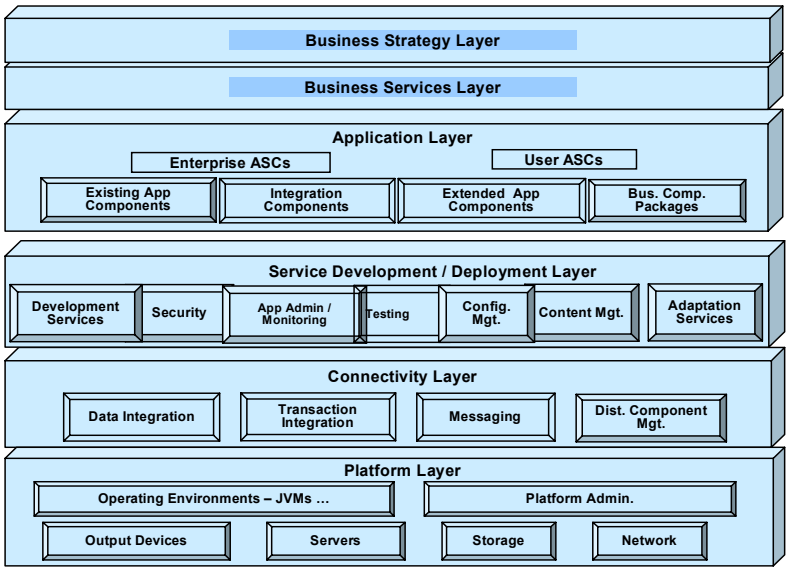
The Service Component Architecture is a multi-layered view of the service delivery capabilities of the business organization. The Service Component Architecture can offer both an “as-is” and “to-be” view of service delivery capabilities. When applied to the current state of service delivery operations, the service components can be used to characterize service delivery processes in relation to common elements among multiple business units. But the service components are not simply business functions. As noted before, service components contain (or reference) adaptive behaviors that address multiple deployment contexts. As important are links to capabilities of the existing IT infrastructure. IT assets, including applications and infrastructure services that support application deployment, can also be described in terms of service component features. In fact, it is a useful premise to describe the IT infrastructure and organization in terms of a set of services or service components that support business operations, including business services that are delivered to customers. These technical service components include capabilities like web-service deployment, configuration management, application monitoring, testing, connectivity architecture, storage management, and network management. Like replication of business service components across business units, technical service components can be implemented within the reusable, adaptive framework that ASG recommends.

With the Service Component Architecture in place, it is possible to view requirements such as infrastructure consolidation from a service-driven viewpoint. Both business and technical infrastructure requirements can be analyzed in terms of replicable service components. This has implications for all levels of the Service Component Architecture.

- **Business Strategy** - The new ASG capabilities change the calculation of what is possible for cost and quality of service delivery. Business strategy and plans must adjust to new capabilities for service deployment such as run-time response to customer requirements, improved service customization, and rapid

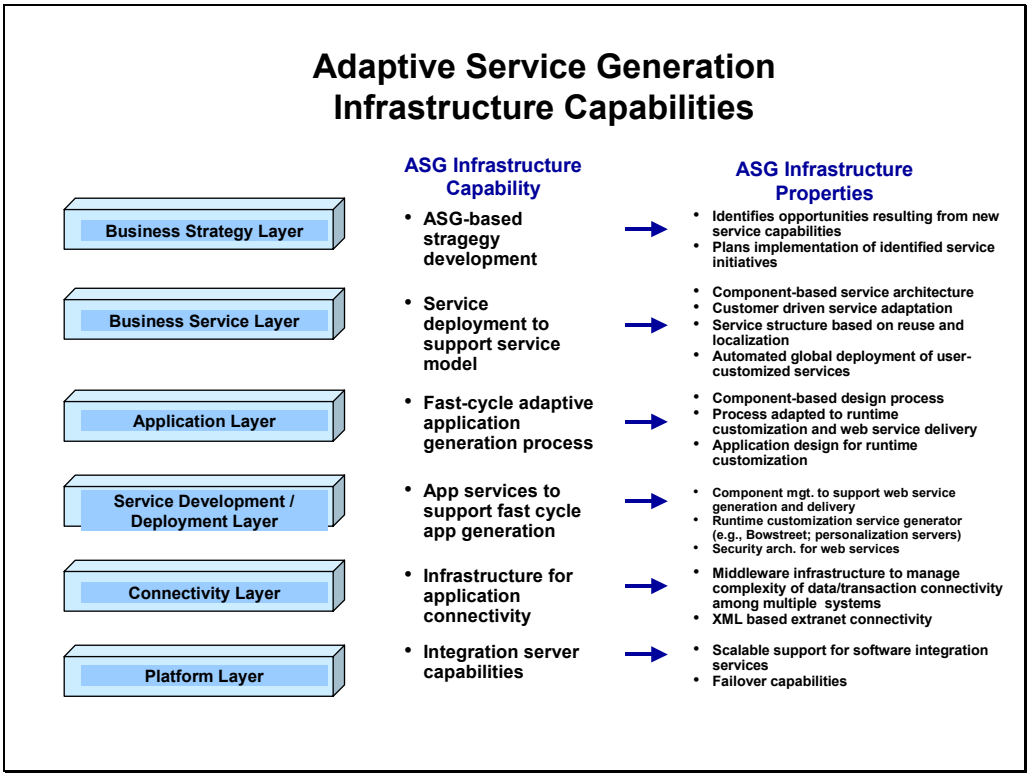
deployment of services to multiple business units. While competition normally occurs at the service cluster level, individual service components can by themselves affect competitive position (see later discussion of service component prioritization).

Service Component Architecture Layers



- **Business Services –** ASG affects business services and processes in fundamental ways. With services structured in terms of service components, service deployment becomes a matter of combining components into appropriate service clusters. Service quality management and improvement strategies can then be attached to replicable components.
- **Application –** It has been common practice to tie application development to business processes. Similarly, deployment of business services is often tied to IT applications. In the ASG environment, applications may consist of standard application program components. They may also involve web services and application generation packages or frameworks.
- **Service Development / Deployment –** This layer contains service components that support the application layer, including specialized requirements of rapid service development and deployment. These components support runtime customization of services and web-service deployment in addition to standard services like configuration management and application monitoring.
- **Connectivity –** Because service deployment often involves multiple business units, systems and geographies, connectivity among service components and the systems that support them is critical. Like other distributed application infrastructure issues, service components place special demands on the technical infrastructure especially for situations involving high-volume transaction management. ASG connectivity layer capabilities may involve XML-based linkages among extranet systems, supported by emerging standards for web services.

- **Platform –** The platform layer required to support distributed service components involves existing systems as well as new scalable platforms. Because service components are replicated among business units, ASG offers the prospect of deploying a consolidated infrastructure to support the common set of replicable service components. (See related discussion of infrastructure consolidation.) The distributed components also impose special requirements for service component deployment such as support for distributed service directories, common repositories for customer profile data and network resources.

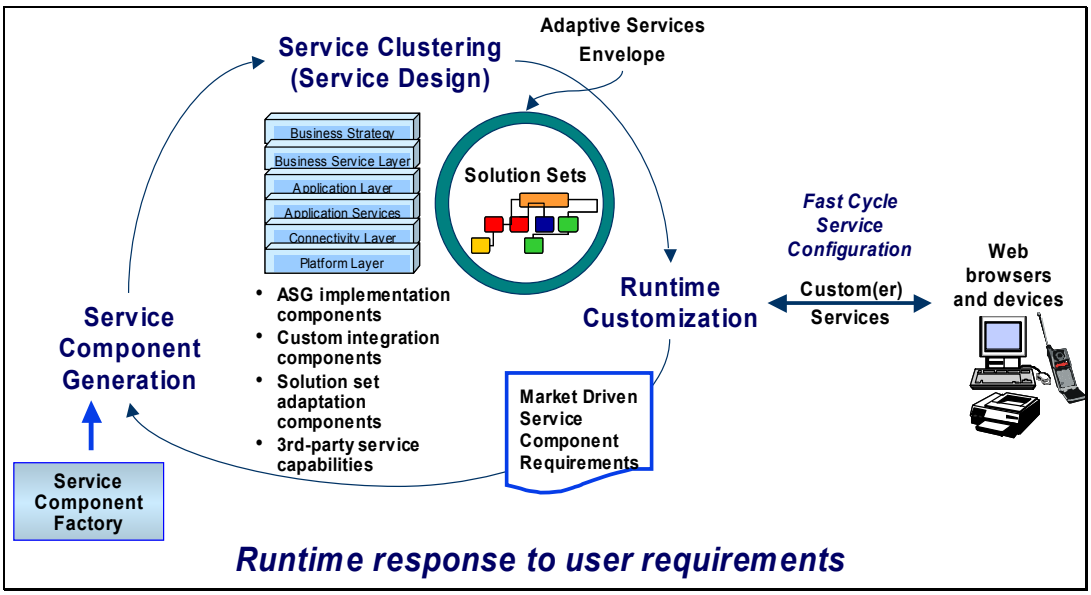


Infrastructure consolidation is one product of the Service Component Architecture. Another is the capability to understand the service delivery requirements in relation to the six layers of the Service Component Architecture. A high-level picture of some of these requirements is given in the previous chart. The important point to emphasize here is that rapid service delivery is a capability that affects business and technology operations at all levels of the the Service Component Architecture. The ASG framework offers a way of understanding what needs to be done from both a business and technical standpoint.

ASG Operational View – Role of the Service Component Factory

The implementation of accelerated service delivery depends on a number of changes in the process of service delivery. The overall process is shown below.

1. Services are delivered through a combination of adaptive service components. These service clusters represent typical groupings of service components that satisfy a class of user requirements. The recipient interacts with the service components via direct communication, telephone, web browsers or other devices. Service components may be implemented in human or automated form. Risk analysis for financial services, for example, may be delivered by a financial advisor, an automated web service, or both.



2. Service components are built to adapt to the needs of the service recipient, which may be a technical adaptation such as whether the user is on a cellphone or PC browser. Or it may be a "business adaptation" such as the manner in which a financial advisor would take into account a customer's risk profile--family status, retirement age, etc.– in making investment recommendations.
3. Service component adaptations and clustering can be determined in response to current user circumstances. Service delivery is a product of a "service application framework" that generates the application and service features at or near runtime. These can be implemented with web services, personalization servers and other component adaptation methods.
4. Sources of service components are indicated in the center of the diagram. The Service Component Architecture defines the set of available service components. These may include custom solution sets or third-party packaged solutions supporting functions like CRM or e-commerce. The Adaptive Services Envelope indicates the capability to extend and customize the solution sets with adaptive service components that address opportunities to develop additional revenue streams via related services.
5. The cycle involving service delivery, component generation and clustering indicates the continuous evolution of the service generation capability. The process of service delivery exposes new recipient requirements. Service components adapt to recipient requirements at runtime and are also modified via component modification processes based on newly discovered requirements. The modified components then add to the service delivery resources of the service provider.

The capability for producing new or modified components resides in what we call the "Service Component Factory." The use of the word factory does not imply that service components are constructed by the factory itself or that the factory is located in a particular physical space. As we have previously stated, the decision to buy, make, or outsource the service requirements is based on economic factors. The factory does, however, create a standard enterprise-wide mechanism to identify, evaluate, prioritize and procure new service capabilities. The factory may also include a capability for designing software that implements the required service components and collaborates with third parties for producing service components

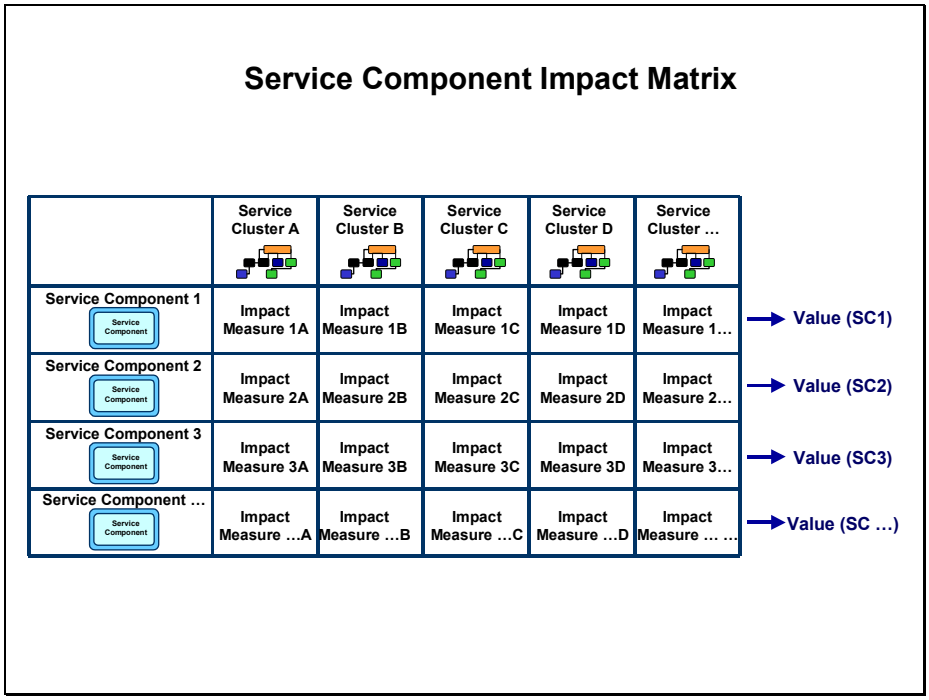
The factory is a service that produces service components. Like other services, it is modeled with a set of service components that adapt to enterprise needs. This is an example of how service components can themselves generate service components. The Service Component Factory is a systematic application of that capability.

Implications of the ASG Approach

Some of the business and technical implications of the ASG approach are addressed in the section on Service Component Architecture. There are a number of additional consequences of the ASG approach.

Ability to Prioritize Investment in Service Infrastructure

If the ASG approach seems daunting in its scope, one piece of good news is that a key advantage of the ASG framework is enabling the organization to prioritize effort. One important product of the ASG analysis is prioritization of the service components themselves. This can be accomplished because service values like revenue, profitability, and security impact can be attached to individual service components. A picture of how this is done – one of many analytical tools – is given in the illustration below.

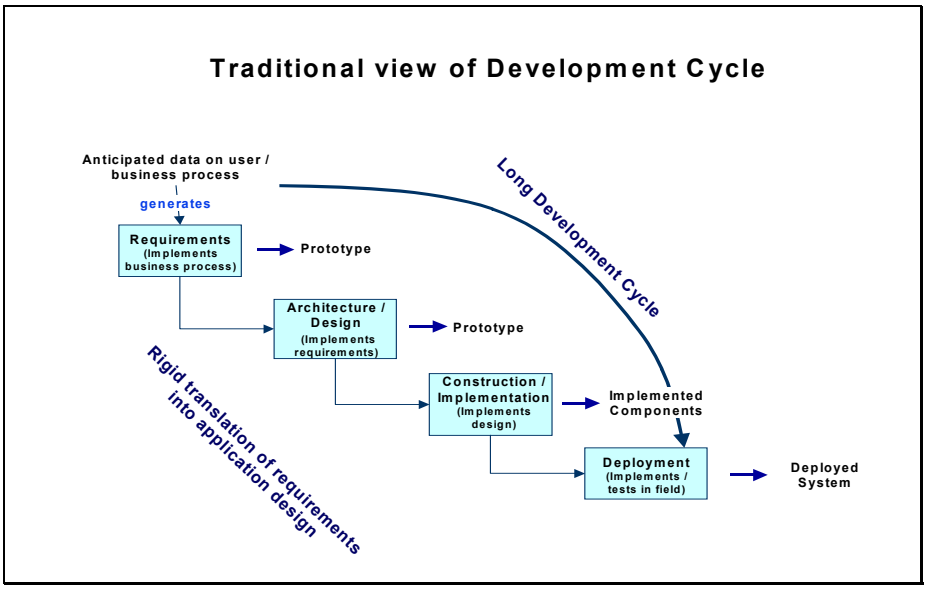


Service components can be weighted in relation to individual services which are themselves associated with measures such as revenue streams. Valuation of the service component is then obtained by summing over the contributions from the each of the services. Carrying through the analysis systematically permits establishing priorities for business investment in relation to ASG implementations, as well as for other strategies such as infrastructure consolidation.

Changes in Software Development Process

The traditional view of software development is often described by a “waterfall” process like the one in the diagram. This view of application development, with a characteristically long interval between determination of requirements and application deployment, has come under considerable attack in recent years. Pressures of the Internet economy on quick

development cycles and recent trends like extreme programming and agile methodologies have attempted to short-circuit the rigidities of traditional complex development approaches.[2] The agile methods emphasize testing limited functional domains of an application. This reduces risk and focuses development on user needs.



In spite of these improvements in software management, the basic relationship between requirements and implementation has not disappeared. Business processes remain rigidly defined in relation to inputs, activities and outputs. In our view, however, a rigid procedural definition of application requirements cannot adequately address the behavioral requirements of service delivery. The tight relationship between requirements and application design is, however, deeply embedded in the culture of software production and will not be easy to escape. Nevertheless, the shift to runtime service adaptation is necessary if applications are to be responsive to the existing needs of customers.

Instead of a serial translation of requirements into application design and implementation, the ASG approach views the application as a framework for customized service delivery. The user, through existing profiles and the discovery process, becomes the generator of requirements. Clusters of services that meet user requirements are created as a result of customer action or ongoing discovery of customer needs. This shift in view is consistent with object-oriented and component-based approaches in that object-oriented systems attempt to mirror the complexity of real-world structures.

Traditional, existing applications are an important part of this delivery capability. The existing systems can be used as a resource in service generation. Because of the focus on reusability of existing system capabilities and reusable service components, custom application development is minimized even while customization of service capabilities is enhanced.

Knowledge Management and Service Enhancement

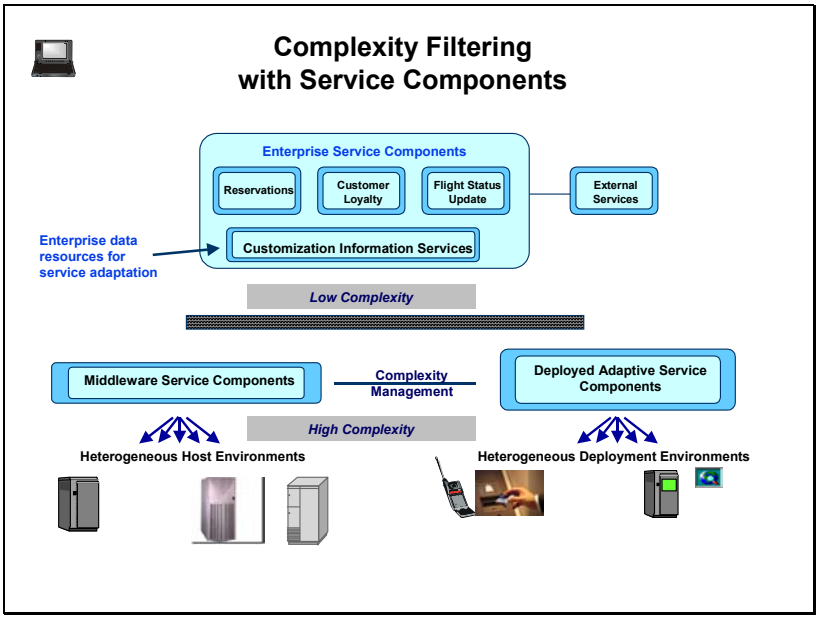
An important issue many organizations are now addressing is the use of knowledge and training to improve business capabilities. Many knowledge management efforts have failed due to an inability to connect knowledge resources to essential business operations. The

[2] This theme was introduced at least as early as 1988 with Tom Gilb's *Principles of Software Engineering Management.*

use of componentized services, however, provides a natural way to organize knowledge in relation to what matters to the business. If service capabilities are the locus of business operations and competitive position, then the prioritized structure of service components in the Service Component Architecture offers a desirable taxonomy for organizing knowledge, experience and skills.

Service-value is in part a function of the knowledge and skills the service provider offers to the service recipient. The organization of knowledge and training in relation to replicable service components provides a way of focusing these resources in a way that benefits the multiple ways in which the service component is applied. Service components become the reference points for measures used to track service quality and business reach. As we have noted, measures of business impact like revenue and profitability can be attached to service components. Measures of the use and effectiveness of service components can be used to target improvement efforts on those service components that offer the greatest opportunity for business impact. Change is effected where change can do the most good. Because service components affect multiple services and multiple business units, change in a single core component can have a far-reaching effect on business operations, business reach, and customer loyalty.

Management of Complexity for Services and IT Infrastructure



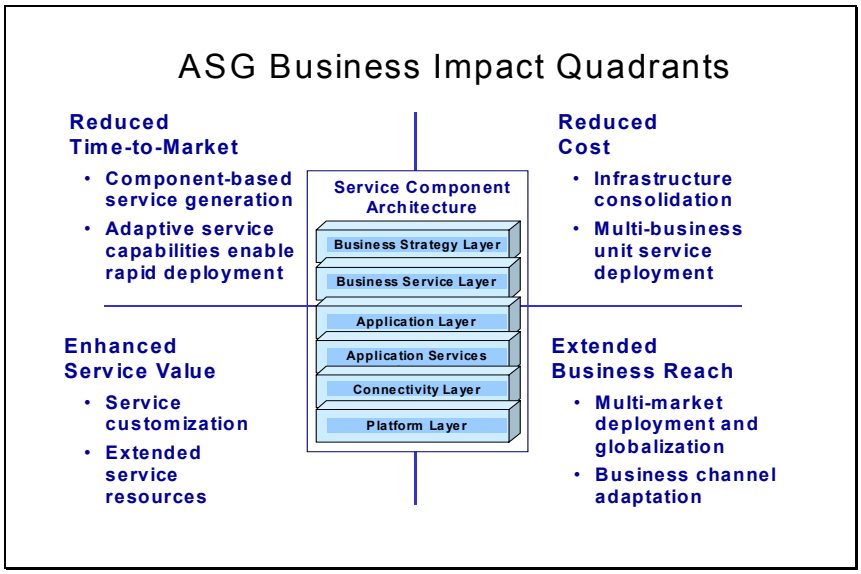
One of the great challenges for IT organizations is managing the escalating complexity of information systems related to distributed service delivery. The problem derives from the proliferating set of IT data resources, applications and other system assets produced by development history, acquisitions and extended business relationships. On the business side there is growing complexity of services in a diverse set of deployment environments. Adaptive service components can help manage this complexity by allowing service component adaptations to filter variations in both deployment and backend environments. This generalizes well-known techniques of using adaptors to connect to multiple information system resources. On the deployment side, service components can incorporate replicable ways of adjusting to variances in customer environments. The ASG approach escalates the level of complexity that can be handled with a given set of financial and staff resources.

Impact on Competitive Strategy

The implementation of the adaptive service technologies significantly alters the competitive landscape. The ability to reduce the time-scale and cost of service adaptation to multiple customer and geographic environments changes the operative business model for the service-based organization. From an opportunity standpoint, companies that implement ASG capabilities have the ability to expand both the content and reach of services offered to customers. The new component capabilities enable different types of partnerships in service delivery and more flexible use of multiple marketing channels. On the threat side, ASG-like capabilities can enable competitors to move more quickly and effectively in the marketplace. Potential commoditization of service capabilities escalates the importance of identifying service components that offer unique competitive advantages. Such components can be used to counter initiatives of competitive service providers as well as enhance the market power and profitability of core services.

Benefits of Service Component Engineering

Perhaps the most important value of the ASG approach is the definition of a path for realizing short-term business benefits as the organization moves toward the rapid-response service delivery model envisaged by ASG. With disciplined application of the Service Component Architecture and the use of adaptive service components, ASG methods identify unrealized opportunities for reuse and adaptation that benefit both the cost and revenue dimensions of the business. The effects can be expressed in relation to the business impact quadrants of reduced cost, reduced time-to-market, enhanced service value and extended business reach.



Reduced cost

- ASG addresses cost savings that can result from service-based infrastructure consolidation. By identifying the relationship between replicable service components and the required supporting infrastructure, ASG identifies how infrastructure redundancies can be eliminated.
- Because time-to-market is a strong indicator of the cost of service development, shortened cycles for service introduction has a dramatic impact on costs related to service development.

- By replicating a common set of service-delivery capabilities in multiple deployment environments, ASG reduces deployment costs (and time).

Extended business reach

- Service components enable systematic adaptation to market variations. By integrating customer profile data into service delivery processes, service components efficiently extend the reach of services.
- A special case of market adaptation is globalization. ASG greases the wheels for global or multi-regional service deployment by standardizing the process of adapting core service components to local needs.
- Service components support delivery of services through extranets and business partners by adapting service deployment to the individual circumstances of multiple marketing channels.

Enhanced service capability

- Adaptive service components provide a basis for enhanced customization of services and rapid response to changing customer needs.
- ASG identifies opportunities for customer self-service, which transfers internal customer support functions to customer-initiated services.

Reduced time-to-market

- Through component-based service engineering, ASG reduces the time required to design and modify services.
- The Service Component Factory enables efficient procurement and/or production of required service capabilities.

Areas of Application

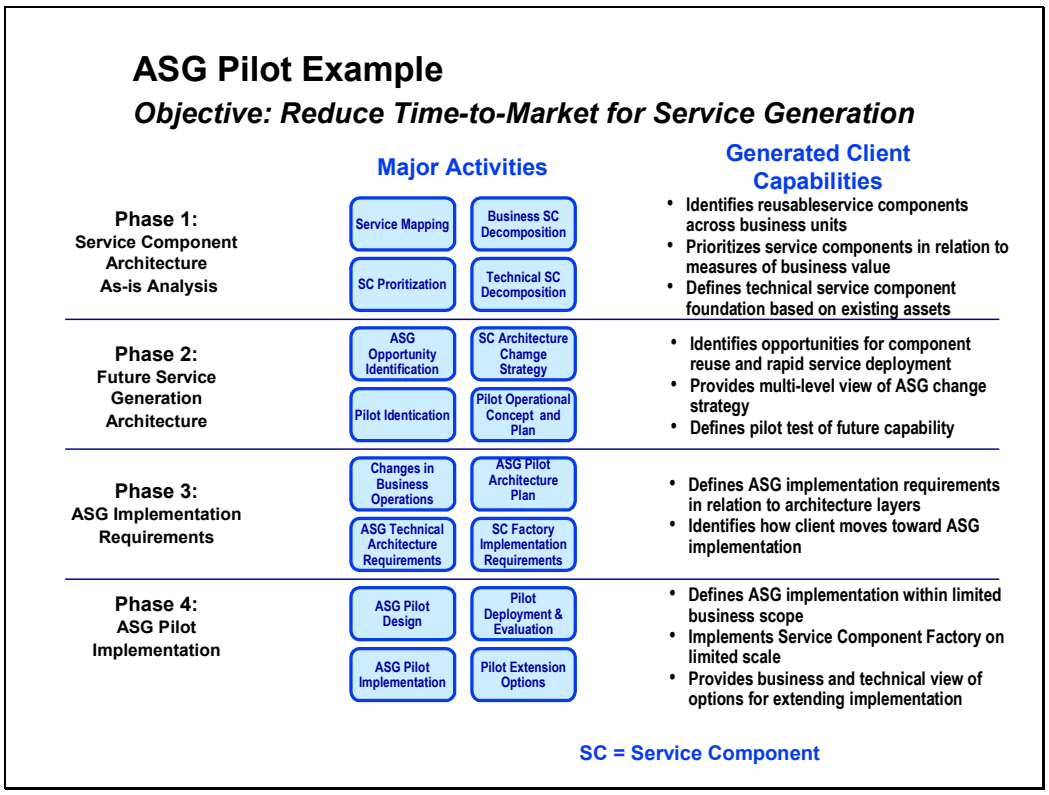
The ASG approach to service component engineering can be applied to a wide variety of business problems. We have already given a number of examples, including:

- **Infrastructure consolidation** – the use of ASG to reduce cost through consolidating the IT infrastructure to support deployment of common service components across business units.
- **Organization of IT services** – the use of service components to define and implement IT services that are adaptable across a range of business organizations.
- **Globalization of services to multi-country environments** – the use of service component adaptation to implement service deployment in relation to variances in language, business rules and other features of the local environment.
- **Enhanced customer service capabilities** – the use of adaptive service components to model and implement improved customer interactions through integration of customer profiles into interactive service-delivery behaviors.

Each of these applications makes use of the basic techniques of ASG – Service Component Architecture development, service component adaptation, and Service Component Factory capabilities.

ASG Pilot Implementation

While the ultimate scope of ASG is to change service-delivery capabilities on an enterprise-wide basis, initial steps can be taken on a relatively small scale. By limiting the scope in terms of business domain and technical objectives, ASG can be implemented in the form of a pilot that demonstrates feasibility and value in a short period of time. The pilot should also focus on a particular service-delivery objective. The chart provides one example of a pilot, which in this case focuses on reducing time-to-market for service implementation.



The pilot is carried out in four overlapping phases that aim to establish a specific set of capabilities in relation to service generation. As a demonstration of time-to-market reduction, the pilot defines a Service Component Architecture for the targeted business area as well as a limited form of Service Component Factory that enables rapid generation of adaptive service capabilities. Depending on client needs, such a pilot can be combined with related initiatives such as e-portal development and specific service enhancements. The general process of pilot implementation described here can also apply to other ASG objectives, such as multi-regional service extension (globalization) and infrastructure consolidation.

Phase 1 of the pilot develops a view of the current service-delivery architecture. The first step in this process is to map the existing services within the defined scope of the project. This map can then be used to define service components with consistent naming conventions across business units. The phase also uses a number of tools such as the service component value impact matrix. This technique associates business value with identified service components. This enables service components to be prioritized in relation to business impact and will justify narrowing the focus of the service-delivery strategies for subsequent phases. The result is an “as-is” picture of the Service Component Architecture.

Phase 2 addresses future service generation capabilities. Building on the as-is service architecture, the phase identifies opportunities for improved service generation capabilities. These may include service replication among multiple business units or capabilities to generate new service variants based on existing or procured service components. The phase also identifies desired changes in service capabilities in relation to the different layers of the Service Component Architecture.

Phase 3 details the requirements for implementing ASG capabilities within the defined scope. Based on the definition of existing service delivery resources from Phase 1 and the Phase 2 future Service Component Architecture, Phase 3 defines what features of an ASG infrastructure are required for the pilot implementation and the plan for meeting the near-term requirements.

Phase 4 implements the pilot infrastructure within the business and technical scope defined in the previous phases. This would include a limited implementation of Service Component Factory and other service generation capabilities. The implementation will build as much as possible on existing service development and delivery resources. Finally, the phase evaluates the pilot program and identifies options for extending the pilot to a broader business and technical domain. The implications of the pilot for related ASG efforts, such as service replication and infrastructure consolidation, will also be identified.

ASG Implementation Services

In this paper we have given only a high-level picture of the ASG approach. Implementation of ASG capabilities for a client may involve a number of services designed to address ASG requirements. ASG implementation services can, of course, be structured on the same model as other services. In other words, the services that implement ASG capabilities can be delivered by means of defined service components. We call this category of service component ASG enabling components. These components pertain to each of the layers of the Service Component Architecture. Like other service components, ASG enabling components and service clusters can be adapted to the specific needs of the client organization.

Next Steps

It is, of course, the client who determines whether the initial focus is one of infrastructure consolidation, cross-business unit service replication, time-to-market reduction, or another service related objective. Because of the range of possibilities in scoping an ASG effort, an initial assessment of ASG options is a desirable first step. Such an assessment would serve several purposes:

- Identify major objectives and business domain of the initial ASG effort
- Identify the team involved in ASG Pilot Program;
- Educate potential participants in the ASG Pilot on the overall approach and relevant methods;
- Determine relationships of ASG implementation to other initiatives;
- Coordinate ASG initiatives with related programs.

Because ASG addresses core business and technical functions of service delivery organizations, it should be expected that an ASG Pilot brings unanticipated issues to the surface. The good news is that ASG enabling service components and methods can adapt to changes in customer needs on a fast-cycle model. In this way, the implementation of ASG is itself an exercise in service adaptation.

Concluding Remarks

Fundamentally ASG is a business and technology strategy for rationalizing service delivery capabilities. Rationalization means

- Building services with components that have an appropriate level of granularity.
- Incorporating interactive, responsive features into the service components (service relationships with the service recipient).
- Using the Service Component Architecture to simplify the technical infrastructure that supports service delivery.
- Prioritizing investment based on contribution of service components to competitive position and revenue generation.
- Organizing knowledge and staff resources in relation to service components.
- Implementing service development and expansion strategies that take advantage of the new capabilities for responsive services.

In practice the ASG approach enables reuse of experience, technology and knowledge across services, business units, geographies and customer groups. While the use of component methods for service delivery may seem simple in concept, the implementation will occur through a concerted, long-term, enterprise-wide effort. The implementation of the future Service Component Architecture changes the conditions under which the service-based business operates. This evolution enables and requires a redefinition of the available business possibilities and a parallel change in the business culture of the services organization.