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Case Study: Duke University Health System Finds Excellent Productivity Using SOA

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Service-oriented architecture (SOA) can be an important tool in breaking the IT backlog for application integration, if used appropriately without being overzealous. Duke University Health System has found an appropriate, pragmatic approach to SOA and a demonstrated highly accelerated development of an integrated portal.

Key Findings

- SOA is an approach to application integration that supports improving, but not necessarily maximizing, the reuse of data and business logic.
- Web services is a set of standards and associated development tools that enable enterprise application developers to devote more time to solving the business application programs and less time to the mechanics of making interfaces work.
- Duke Health System has been able to exploit the SOA approach and Web services tooling to achieve rapid results creating stakeholder portals that represent a single user interface combining data and business logic from multiple, purchased and the self-developed back-end systems in only 14 weeks.
- SOA done well has a compounding effect: Investments in early projects help to reduce the cost of follow-on work.

Recommendations

- Employ the principles of SOA to consolidate data storage and business logic to the extent this is practical.
- When it is not practical to consolidate entirely on a single enterprise system, use the tools of Web services to create a homogeneous facade over what may be very heterogeneous applications and technology.
- When selecting new enterprise applications, investigate whether application vendors offer Web services interfaces to their clients; rate those that do higher in terms of the likelihood that the vendor can support clients' new business directions.
- When working with existing enterprise applications, investigate Web services offerings available from the vendors, and invest in the learning curve required to use these services for application integration.

WHAT YOU NEED TO KNOW

The SOA style of architecture and the associated Web services tools are important enablers for extending the functionality of existing legacy applications, whether they be custom-built or purchased from a vendor. It is practical to apply this architectural style and these tools in environments that were not originally created for SOA. When compared to the potential for SOA described by vendors, Duke's accomplishments seem routine. However, when compared to the healthcare industry track record of actual application integration projects involving products from different vendors, the experience validates the value of the technology approach.

CASE STUDY

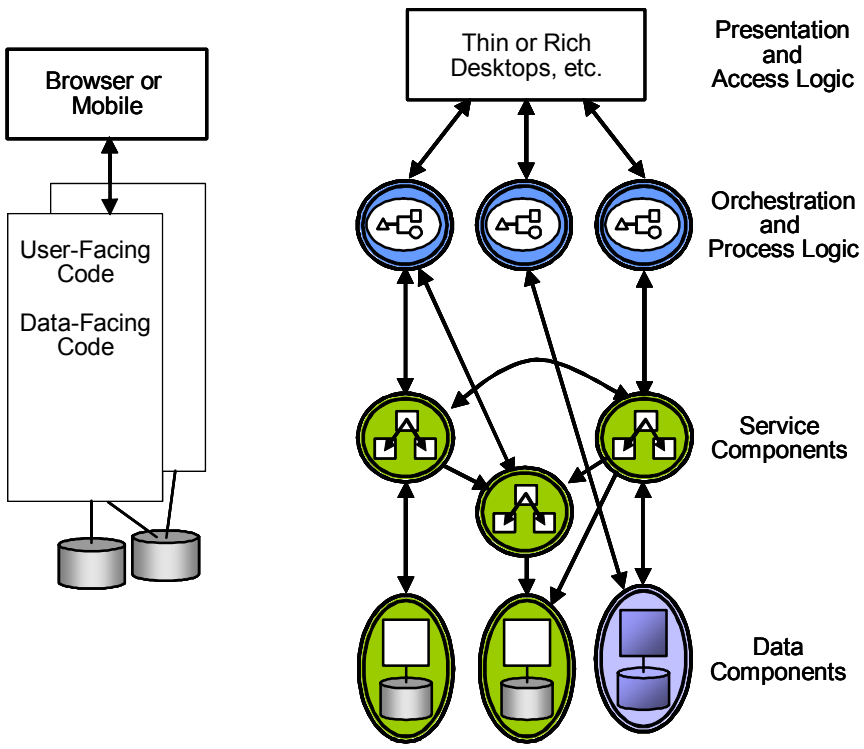
Introduction

An age-old story in IT is the application backlog. When applications were largely developed internally, it was a programming backlog. In recent years, however, most applications have been bought from vendors, and the IT backlog is for application integration. SOA can be an important tool in breaking the backlog if used appropriately without being overzealous. Duke Health System has used SOA pragmatically and demonstrated highly accelerated development of complex applications.

SOA Background

In general, SOA is an architecture style founded on modularity and layering (see Figure 1). The difference from the traditional, or monolithic, architectural style is that the data and the associated business logic are created in separate layers of programs that are shared by multiple applications. This means that the different applications don't have to repeat the business logic, and when the business logic changes, fewer resources are devoted to iterating through the applications repeating essentially the same change. Furthermore, this approach ensures that different applications don't represent the business logic differently and that when data is updated by one application the updates are available to other applications.

Figure 1. Traditional Applications Versus SOA



Source: Gartner (October 2007)

When an enterprise is building an application or a series of applications on a common platform, SOA is widely used. However, in the real world of healthcare institutions, it has been a more difficult style to apply. This is because:

- Healthcare enterprises seldom build applications; their challenges are to extend the life of existing applications and integrate the hodgepodge of vendor and legacy applications.
- Integrating applications is particularly challenging because they run on a variety of technological platforms.

Fortunately, with SOA, the perfect is not the enemy of the good enough. Even though the enterprise may never approach SOA perfection, with a singular source of data and business logic, using the style in moderation is beneficial. A primary requirement for application integration is creating portals and other composite applications. In Figure 1, the SOA style and associated tools and standards make it possible to avoid adding even more unsynchronized data sources and duplicate business logic.

Increasingly, application integration products include extensive tooling for Web services, a set of standards that have been implemented widely enough to make it easier than it has been to integrate with applications on multiple technological platforms. Furthermore, healthcare application vendors are offering Web services interfaces to their products. Care delivery organizations that self-develop portals or other composite applications, or that contract with system integrators for this service, can find immediate benefit by using the SOA approach.

Furthermore, they will find there is a compounding effect — the more they use SOA, the more they find that new projects can be completed more quickly.

The Duke University Health System has used SOA principles for some time and had very rapid results introducing the tooling and technologies of Web services.

The Duke Environment

The Duke University Health System includes a flagship academic medical center, two community hospitals, 80 clinics in 60 locations and other special care settings. As with most healthcare systems that grow by acquisition, Duke supports its diverse care settings with a variety of healthcare applications, many provided by vendors and some self-developed. The important enterprise applications include GE Centricity Business Solutions (GECBS, previously known as FlowCast) for enterprise scheduling, faculty-practice billing, and enterprise billing presentment and cash collection; Cerner Laboratory; two copies of Siemens Invision; Meditech; McKesson Horizon Expert Orders; and the Duke Health Information System (DHIS), a mainframe-based, self-developed cluster of applications that include a patient registration and a clinical data repository. As part of previous application efforts, Duke acquired the Hyland Onbase workflow management system, which configures workflow steps that invoke Web services.

In 2006, Duke began a program to improve the patient experience. The goals were to support self-service over the Web and through kiosks, enabling patients to register, schedule appointments, view results, and pay bills with a simple, consistent, user-friendly interface.

The Challenge

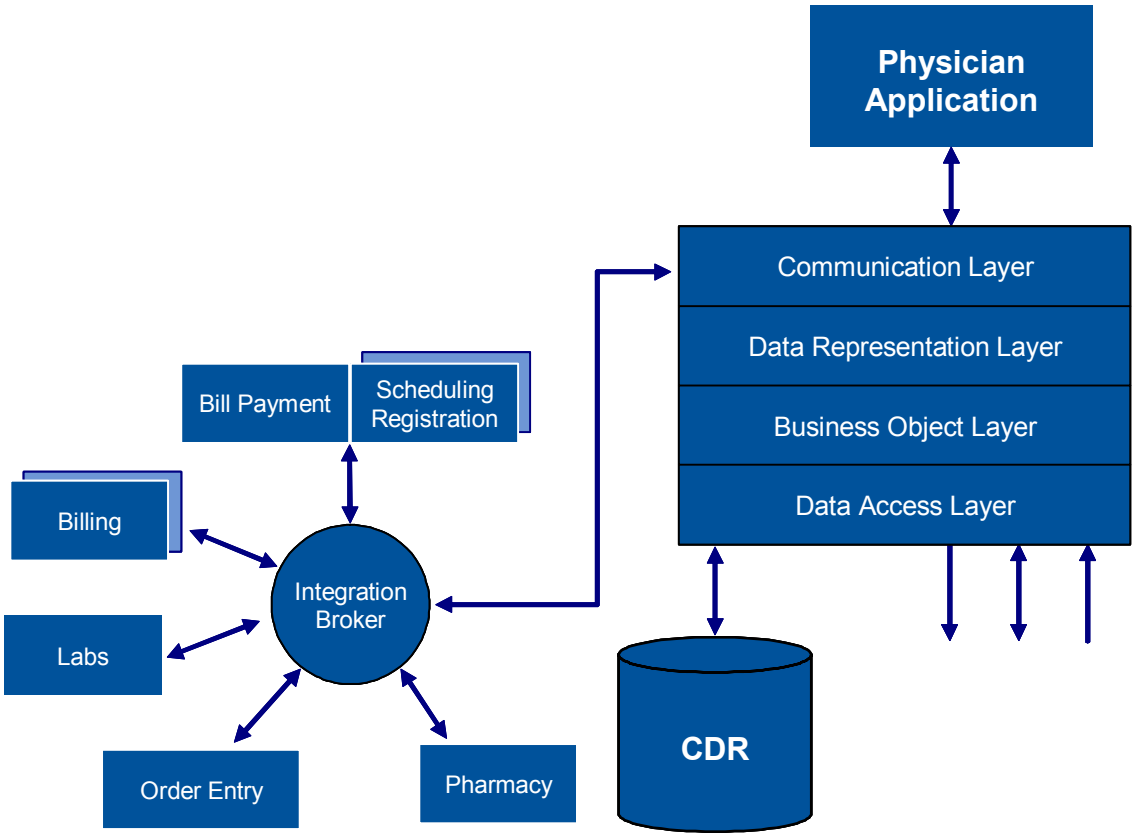
Duke University Health System had to provide the improved functionality quickly and, at the same time, achieve a consistent user interface. Arguably, the fastest approach would have been to leverage portal products available from the various vendors that supply applications to the health system. However, that approach would have led to a variety of user experiences involving different user interfaces, differences in the way data was represented and anomalies that arise from inconsistent application of user-initiated changes in the data across applications. On the other hand, self-development would require a substantial investment in special interfaces to these applications. It also requires the creation of a software framework for a portal with necessary security, identity management and other basic application capabilities.

Approach

Duke chose to purchase a series of IBM WebSphere products that included prepackaged security and user management along with the capability to build and manage SOA interfaces based on Web services technology. The work to install and configure the tools, and integrate with existing applications was jointly done by IBM Global Services and Duke IT personnel.

Figure 2 illustrates the Duke University Health System IT environment before the project began. It is characterized by a traditional Health Level Seven (HL7) messaging approach to database synchronization. Duke had previously built its own clinical data repository (CDR). The CDR has been effective at aggregating data from disjointed clinical applications.

Figure 2. Duke IT Environment Before the Portal

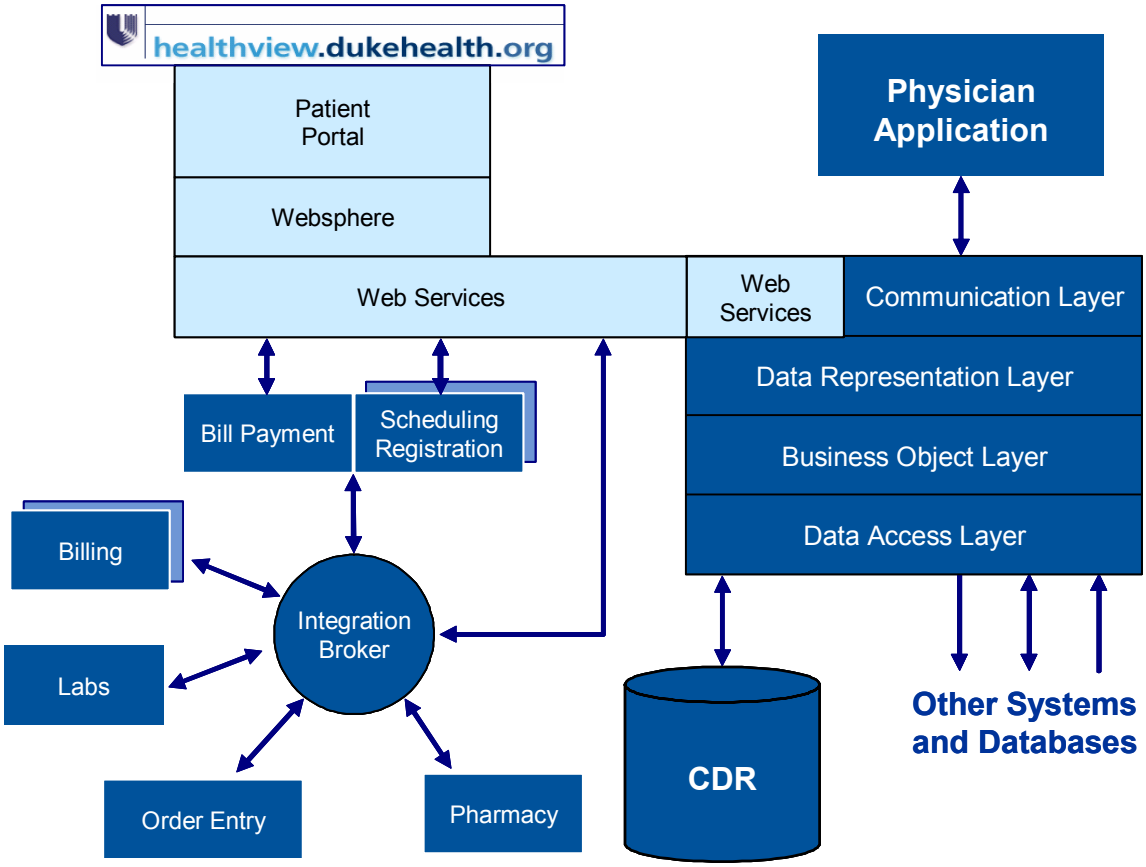


Source: Gartner (October 2007)

Duke had also built a physician application that uses data from the CDR. This work was done using the principles of SOA. The physician application accesses the CDR through business objects located within the CDR. Because this application was constructed in 1996, the SOA accesses were built using COM objects. (Web services were not conceived until 2001.) Nonetheless, because the layers were structured using the SOA style, adaptation was easy.

Figure 3 illustrates the environment after the project. Duke was able to quickly adapt the existing SOA communications layer to Web services. This approach used to the same architecture that was developed for the physician application and leveraged it for the portal with rather minor adaptations of the technology.

Figure 3. Additions to the Duke IT Environment for the Portal



Source: Gartner (October 2007)

The prevalence of vendor-supplied Web services interfaces also accelerated other application integration chores. Duke also was able to connect quickly to:

- Bill payment, registration and scheduling GECBS, because GE offers HealthObjects SOA interfaces (see Note 1)
- Credit card collections using Cybersource, because it offers Web Services
- Hyland Onbase, for a workflow application that enabled the patient administration staff to ensure follow-up on online requests, because it, too, offers and consumes Web services

Results

In 14 weeks from contract to first availability, Duke offered:

- Authorizing and authenticating patients
- Updating demographics
- Viewing detailed bills
- Paying bills

- Requesting a payment plan
- Requesting an appointment

Duke has not chosen to advertise the facility initially, other than to offer the URL to patients who are on the phone, waiting on hold. On that basis alone, the portal became popular with consumers. During the first six months, Duke collected $600,000 in online payments. At the same time, collections from other sources were not greatly reduced. It appears that a substantial portion of the $600,000 represents money that previously went uncollected.

In another 12 weeks, it offered:

- Viewing past and future appointments
- The ability for parents to act on behalf of their children

It has since added viewing lab reports, radiology reports and allergy information. The total programming time for viewing lab results was less than a week, because it was exploiting the previously built services.

These additional functions are to be implemented for at least pilot use before year-end 2007:

- Online viewing of lab results
- Rapid check-in
- E-mail reminders
- A kiosk pilot

Plans include a referring physician portal, the ability for patients to book appointments, disease management and a personal health record.

Even though this project touches many applications, the IT staff finds itself able to add the functionality faster than the users can absorb it. This is a reversal of the typical condition in healthcare organizations, where IT development bandwidth is the rate-limiting step in improving user processes. Furthermore, the ability to take the project in small bites and implement rapidly helped to minimize the danger of IT building an application that did not meet user needs.

Critical Success Factors

- Using SOA, Duke saved time and effort by leveraging prepackaged portal functionality, including rapid application development tools, a complete framework for managing user access and Web services support.
- Using Web services as the universal adapter for legacy custom-built and vendor-provided applications and the new portal technology reduced the programming complexity.
- Technology was used to hide IT complexity. The approach of creating a single portal across multiple applications enabled Duke users, consumers and eventually referring physicians to see a single user interface and a consistent view of the data and business logic, even though they are accessing information from multiple applications sold by different vendors and running in widely varying environments.

Lessons Learned

- According to Duke, "WebSphere is not a tool, it's a way of life." In other words, there is a substantial learning curve and change in the skill set required to achieve the productivity gains associated with SOA and the product. Duke addressed this by using contract labor for a substantial part of the initial project and including a knowledge-transfer program afterward.
- A Web-services-based approach to portal development can provide accelerated delivery of function on the initial project and compounded improvements in follow-on projects. Replacing human customer service people with Web functionality requires rethinking the function. For example, appointment clerks can perform triage to select the appropriate type of pediatrics appointment among 40 possibilities; however, the appointment templates must be substantially simplified for self-booking. This is why Duke deferred self-booking until after the consumers and Duke's business staff were able to use the portal and understand the differences.

RECOMMENDED READING

"Magic Quadrant for Horizontal Portal Products, 2007"

"Healthcare Payers Are Reaping the Benefits of BPM"

Note 1
HealthObjects SOA

Duke used the Java implementation of the HealthObjects SOA rather than Web services. However, it was easily adapted because the Java objects are architected in the SOA style.

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