



Lessons from Amazon.com for Health Care and Social Service Agencies

Introduction

Service-oriented architecture (SOA) is an approach to configuring software systems in large organizations and agencies so that efficiency is maximized while redundancy, errors, and unnecessary cost are minimized. It rests on the notion that common data resources can be systematically shared throughout the enterprise, obviating the need for multiple, uncoordinated versions of similar information or processes.

Health care organizations and social service agencies stand to reap substantial benefits from applying SOA strategies to their own systems. Compared to other service industries, they have been slow to seek benefits from SOA. These complex entities are likely to have numerous different computer systems operating in relative isolation from one another. Employees often use two or three applications at a time to get a task done, switching from one screen to another, copying down and re-keying member information, and repeating process steps already performed by other groups.

These systems generate unnecessary cost as a result of re-entering and maintaining the same data in many places, disruptions caused by conflicting information in different systems, and high costs of making even minor changes that affect multiple systems.

Challenges to System Integration

Large organizations continually look for ways to manage budgets and enhance services by speeding up transactions and simplifying the flow of

information. Typically, department heads with functional responsibility for areas like enrollment, eligibility determination, claims processing, and provider licensing purchase computer systems, often on a large scale, to reduce operating costs. Such solutions bring measurable benefits. The move from paper to electronic claims submission, for example, has drastically cut the cost of handling claims.

However, such narrowly focused computer systems frequently do not connect smoothly with other systems in large enterprises. For example, families enrolling in various programs like Medi-Cal, child welfare services, and food stamps are asked to repeatedly provide the same personal information. Changes in a participant's address, financial condition, and eligibility status might be updated in one program but not made available to renew the family's eligibility status for other programs. Such problems cause frustration and lost time to both the enterprise and the consumer. In the worst cases, needed health care benefits are denied to eligible individuals.

There are similar problems in clinical settings. When patients move from one health care setting to another, they must repeatedly provide their personal information and medical history. Doctors, likewise, must maintain their credentials with multiple agencies and programs. Case workers retrieving a summary of a patient's recent benefits and treatment may have to log in to several different computer systems to pull the information together. Such inefficiency undermines much of the benefit of automating these activities.

A related challenge stems from having conflicting and inaccurate information in different systems. For example, when a public hospital clinic updates a patient's address during a visit, the subsequent correspondence about benefits may continue to be sent to the old address that still appears in the county's records. A consumer may provide different forms of his or her name (a recently divorced woman using her maiden name, for example) resulting in the creation of two separate records. Because information about people, providers, and programs are spread out in file cabinets and computer systems across departments and agencies, it is not always clear which information is current and accurate. Untangling such cases drains resources from the system and frustrates consumers.

Along with administrative inefficiency and out-of-sync data, a third major problem is the difficulty and expense of altering computer systems to keep pace with the institution's changing needs. Even a small enhancement can require major software rework and disrupt the operations of related systems. Many organizations have "legacy systems" running decades-old software that is poorly documented and best left alone. On the other hand, the cost of building whole new systems or renovating existing ones may be prohibitively expensive. The result is an impasse that tends to keep new ideas and innovation on the shelf.

Components of SOA

Service-oriented architecture is emerging as a powerful tool to address these problems because it enables large enterprises to share information and activities across all units and entities. The approach begins with defining the following:

- **A collection of services.** Services are the processes and information that are frequently used across the enterprise and where creating a common resource would bring value to the organization. For example, a single source for patient identification information would provide a "current mailing address" service to

all of the other systems that require or update that information.

- **A matching collection of schemas.** Shared services can effectively communicate with each other when there is a common language. A schema defines a common format for sharing information—for example, the format for passing prescription information between systems.
- **A matching collection of policies.** Policies governing the operation of individual services, might include the rules for security, response time, and other aspects of service behavior. For example, policies would define the conditions under which the information can be released, the audit trails that must be maintained, and the protocols for updating the information. A single set of policies would be in effect for any system that touches the data.

Defined services, schemas, and policies are fundamental concepts behind the federal government's efforts to promote a national health information network.

Three Key Benefits

The implications of SOA for an enterprise the size of a state's health and human services agency are significant. With dozens of health and welfare departments at the state and local level—each with its own set of paper forms, workflow processes, and computer systems—the complexity is beyond what can be addressed by making each system run better. A service-oriented approach would look for those things that are common and shared by various agencies, such as services for program enrollment and provider accreditation. A payment disbursement service would create a single point for money flow. Each agency would provide a service that indicates a given person's eligibility status and recent activity.

On the clinical care side, an SOA framework would ease the efforts for hospitals, doctors, and other providers to securely and easily exchange patient data. An emergency

room physician could access patient information not only from that hospital's system, but from those in other facilities, and learn quickly about the patient's recent heart surgery, medications, and allergies. This would minimize redundant diagnostic tests and reduce the chance of medical errors.

Such an SOA implementation at the state level would result in:

1. **Fewer redundant processes, data entry activities, and paperwork.** Any change to a provider's or consumer's information would be reflected across all of the programs. When one agency hands off a case to another, well-defined services would handle the transfer of information as smoothly as Amazon hands off a package to FedEx. There would be no need for printouts, mailed case files, or phone calls. The result would be better service at lower cost.
2. **Consistent information across the state and among agencies.** Improving the way state programs share information would give administrators a more complete and accurate top-level view of operations. Rather than focusing on the costs of a single activity, such as Medicaid enrollment, the state could look more broadly at enrollment and retention rates across a population or region.
3. **Better responsiveness to change.** SOA steers enterprises to think in terms of small blocks that can be assembled to solve problems, then reassembled to meet changing needs. The technology behind the shared services allows for new capabilities—support for Real ID cards for example—without having to replace whole systems. The result is faster organizational response to policy changes and new initiatives.

Online Retailers as a Model

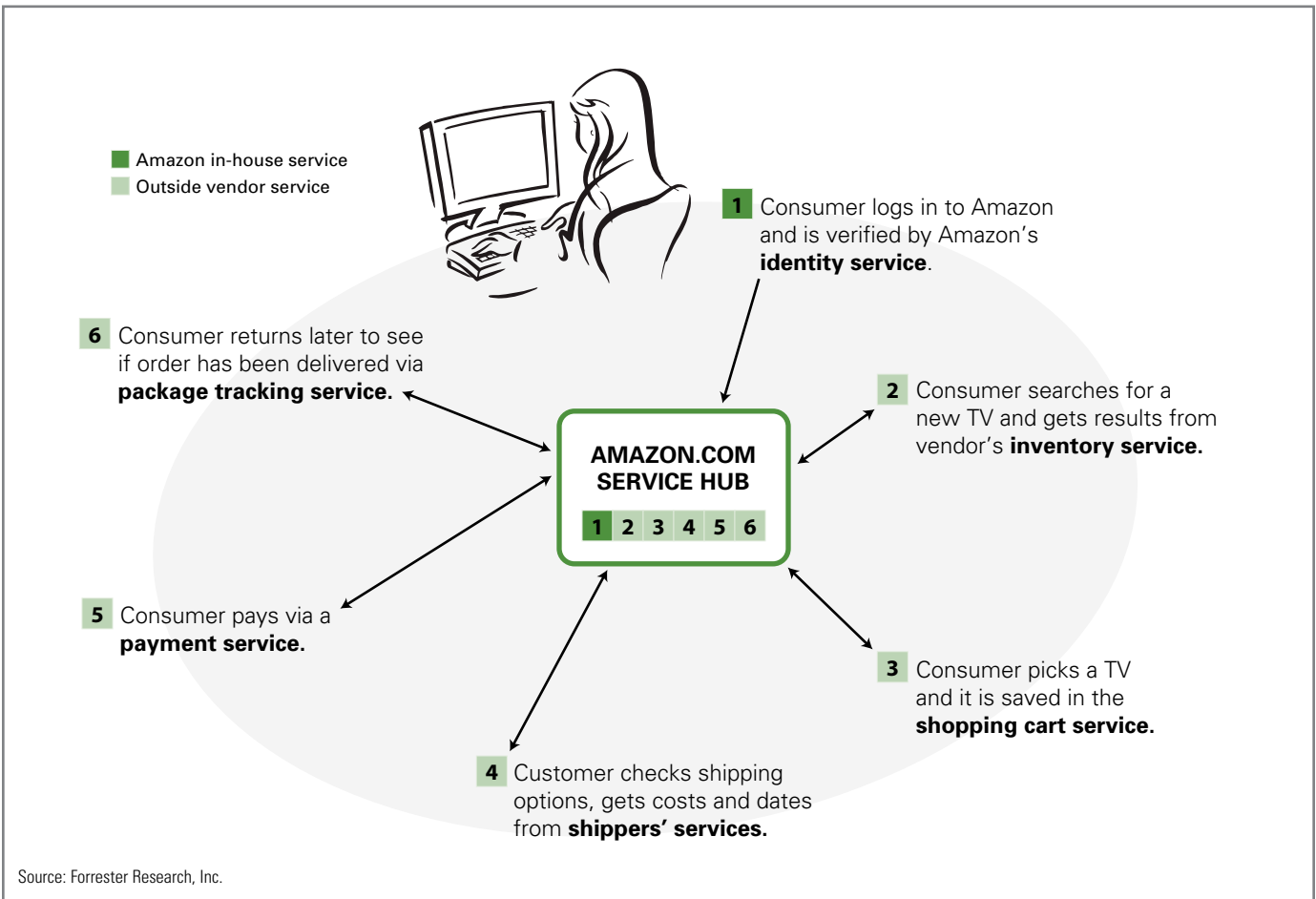
Such benefits have spurred the adoption of SOA principles at retail sites like Amazon.com, which provides a good model for understanding the concept. (See Figure 1 on the following page.) Amazon collaborates with other businesses—suppliers, shippers, and credit card firms—to create a seamless experience for its customers. As they browse through Amazon's offerings, they are looking not only at Amazon's own inventory but also products available from its many partners, such as Target, Macy's, and FAO Schwarz.

Customers don't have to log in to each of these retailers' sites and repeatedly enter shipping and payment information. Those data are collected just once, then provided as a service to the retail partners as needed. The retailers (Amazon calls them storefronts) each have their own inventory service with information about product availability, description, and shipping weight. VISA and MasterCard provide credit card payment services. Finally, FedEx, UPS, and the U.S. Postal Service calculate shipping costs, estimate delivery times, and track packages. The information that the Amazon customer gets is always correct because it comes from the vendor's own database, not from a duplicated version that would quickly be outdated.

Financial transactions, satellite maps, news feeds, traffic conditions, and in-store inventories from a wide variety of sources are all put together like building blocks into applications that can be accessed on the customer's laptop or even a mobile phone. Such seamlessness is highly efficient and highly valued by customers.

Because retail sites like Amazon are built on services, these same services can be used over and over again by Amazon on new projects and even by other companies looking to build their own retail sites. Such *reuse* is central to the value of SOA as a cost-saver and a lever for innovation. Amazon has made a business out of sharing the services that it built—customer profiles, shopping carts, product

Figure 1. Online Retailers, Like Amazon.com, Use Shared Services to Deliver Customer Experience



catalogs, and more. Amazon lets other firms build their own specialty retail application more quickly and cheaply without having to reinvent things that are already available through Amazon. Every innovation that the company puts into its shared services is enjoyed by the businesses that draw from those services.

It is important to emphasize that shared services include the people and processes supporting that service. For example, a customer service “service” would route an inquiry to a support person and may even initiate a phone call back to the customer. Likewise, a service that validates and credentials a physician may include processes to verify documents and degrees.

There are many other examples in the consumer world. Google’s online map can be used as a “service” for other

entities that want to overlay their own information—from real estate listings to databases of good parking spots. In the corporate arena, firms use shared services to make global manufacturing supply chains more efficient, to add new services to wireless communication networks, and to improve the customer experience in the hospitality industry. In a 2008 Forrester Research survey of nearly 300 IT decisionmakers at North American and European enterprises, half of the respondents indicated that their firms were actively using SOA; among these, half were committed to SOA at a strategic enterprise level. Federal agencies including the IRS, NASA, FTC, and EPA have implemented SOA-based programs, as have many state-level agencies.

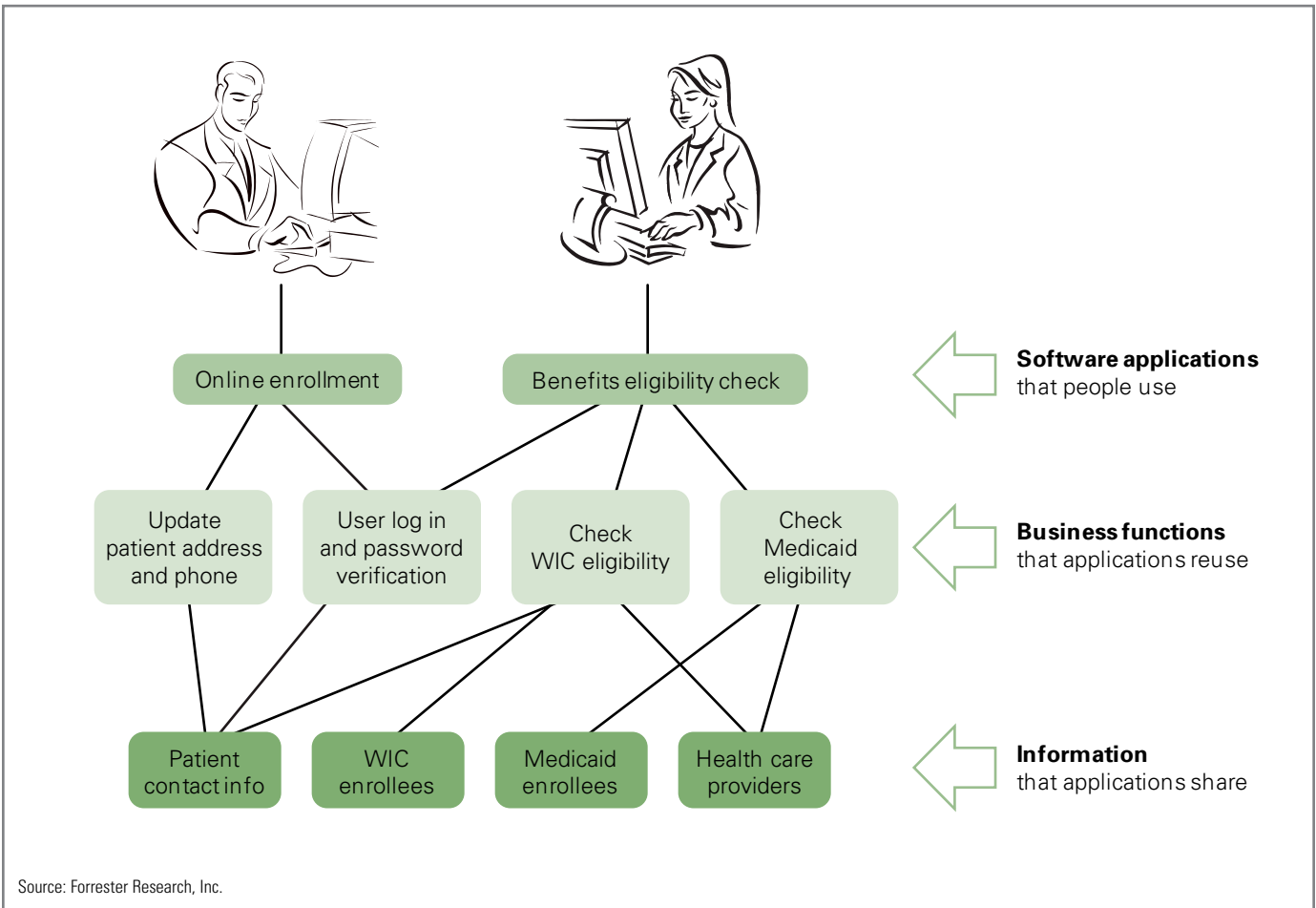
SOA in Health Care

There are significant opportunities to benefit from SOA in health care organizations, and also many challenges. The use of computers in clinical settings is still inconsistent at best. For example, while many hospitals have systems for their pharmacy, diagnostics lab, and emergency room, fewer than 4 percent enable physicians to enter orders or update records electronically. And barely 15 percent of clinics and physician practices in a typical community use an electronic health record (EHR). Most rely on handwritten charts and paper printouts. In large institutions with electronic records, a single patient's personal health information is likely spread across a dozen or more systems. Complicated scenarios are typical in health care, where a single patient may interact with many providers, and a single provider may interact with

many entities. Preventable medical errors due to gaps in communication are frequent.

An SOA approach would begin with identifying areas of redundancy among the administrative processes. Shared services might include a single "master record" for basic patient information, employment status, or government insurance program participation. Other elements might include program eligibility checking and income verification. Rather than trying to build all of the possible shared services into one large system, each shared service would be managed by the entity most closely responsible for the process and then offered, electronically, to other systems that need it. (See Figure 2.)

Figure 2. Two Administrative Applications Share Common Services and Information



These services could be combined as needed into user applications, such as a Web site that allows people to check their status and eligibility in a number of public health programs.

There are many possible ways to configure SOA solutions. In one scenario, an eligibility worker could quickly view all of the programs someone is enrolled in, reasons for denials in other programs, and even scan for other available forms of support. Because information is easily shared, patterns of abuse (the same person applying for various programs under slightly different names or addresses) would be detected quickly. Information about program usage and long-term outcomes could be aggregated and analyzed to learn what is working and what is not.

A “clinical summary” service could be created to present a patient’s most important medical conditions, current medications, and allergies. A “health risk event” service could send a message to county health agencies when records include diagnoses related to particular communicable diseases. A “patient record locator” service could include a directory of providers that have records for each patient in a region, allowing physicians to access a more complete patient health record. All of these services would share not only common ways of connecting with each other, but also agreed-upon policies for security, reporting, and performance.

With these service agreements in place, isolated clinical practices would become a loosely knit federation of coordinated caregivers. A doctor could see recent changes to the patient’s behavioral medications, an emergency room encounter, a change in primary residence, and the current diabetes treatment plan. The provider would also have access to the patient’s eligibility and enrollment status in appropriate programs.

SOA Governance

At its core, SOA is a governance-driven undertaking more than a technology-driven one. It requires a high level of executive commitment because it involves a fundamental restructuring of who does what within the enterprise. SOA governance provides the framework for departments and teams throughout the organization to work together collaboratively. Governance discourages a “do your own thing” attitude and instead makes it easy for individual teams to participate in a way that promotes the creation of broadly sharable services.

For example, when a patient provides updated address information upon admission to the hospital, the admissions system would submit the new information to a service that makes it available to all of the other systems in the organization. For this to work properly, the admissions system must capture not only the address information it requires, but also any address information that other departments will need. The data must be in a format that all of the user departments can use. SOA governance provides the process and discipline for each department or agency to participate cooperatively in defining and using this information. It also prohibits unauthorized use and ensures that proper identity verification and authentication policies are observed.

Incremental Approach

Organizations that have successfully moved toward SOA have uniformly taken an incremental approach. Rather than attempting to recast their entire business as a collection of services, they focused first on one or two key business processes, or even a subset of a process, creating services that were initially used in a limited context and expanding their use over time. Every successful organization stresses the need for broad and constant communication so that everyone understands the SOA vision and his or her own role in bringing it to life.

The most common approach is to identify areas that are most troublesome and start there. In a hospital

that could mean starting with services that simplify the sharing of patient information—or a subset of patient information—across departments. State agencies might focus on consistent services for program enrollment and eligibility verification in order to reduce administrative costs and improve customer service. Starting with measurable outcomes and benefits—then working backward to identify the services needed to achieve them—ensures the best return on investment.

Typically, an organization creates five to ten services during the first 12 to 18 months and then broadens its SOA efforts over time. Some insurance and financial service organizations that have been at this for five or more years have successfully aligned themselves around SOA. Similar projects are underway in state and federal government institutions around the world as well as in health care provider systems like Partners HealthCare in Boston, Duke University Health System, Intermountain Healthcare, and Kaiser Permanente.

Conclusion

Service-oriented architecture compels organizational and technical leaders to take a fresh look at the way the enterprise performs its most common and critical tasks. In an increasingly interconnected world, organizations that put the discipline in place to optimize the use of their vital shared services will be positioned to work closely with other institutions such as state agencies, outside contractors, and providers.

In health care, the mandate for better collaboration and patient information sharing will require a shared services approach. By 2015 well over half of providers will have replaced their paper medical records systems with electronic ones, enabling them to share clinical records through services defined and certified by industry and government bodies. A federal effort to bridge regional health information exchanges into a national health information network would make medical records truly mobile and allow entities like the National Institutes

of Health or offerings like Microsoft's HealthVault and Google Health to aggregate data into a single research repository. Privacy and security safeguards will be a paramount concern, but the drive to capture, share, manage, and benefit from this information will prevail. By 2020, the five-year detailed anonymized medical history of over 200 million Americans could be a powerful tool for the rapid improvement and fundamental transformation of medicine.

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