The State of SOA in Higher Education

This document was produced by the ITANA SOA Working Group.
See: https://spaces.internet2.edu/display/itana/SOA+Survey+2012

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Executive Summary

ITANA's 2012 survey on the state of SOA in higher education drew responses from 27 institutions, nearly all large research institutions in the top 100 of the AWRU ranking. We found a substantial level of SOA activity in these institutions, suggesting that SOA remains relevant both as a set of technologies and as an architecture.

Nearly all respondents reported an active SOA-related project, and most had implemented or are implementing a set of ERP web services, an ESB, a SOA suite, and/or a service registry. Most indicated an increase in understanding of SOA-related concepts and the skills to act on them, and progress on surrounding infrastructure such as identity management.

SOA can be approached in a more "tactical" mode (e.g., use of SOA technologies for integration), a more "strategic" mode (e.g., analysis of business process and capabilities to plan services), or both. Most respondents indicated that their drivers for SOA are tactical (e.g., integration of back-end systems), but some of the projects highlighted by respondents have a more strategic scope.

There appear to be several challenges around SOA for higher education. Many respondents reported little or no progress on IT governance and IT operations related to SOA. Few respondents indicated that their services are tied to known business requirements, or that they could demonstrate a return on their SOA investment. We also found limited response to industry-specific XML schemas such as PESC or IMS.

The survey suggests to us several questions for CFOs, COOs, and other leaders. What are your institution's SOA-related goals? Regarding strategic goals, what kinds of coordinated SOA efforts can be pursued, given your level of centralization in business processes, funding models, and IT? We believe this varies greatly by institution. Regarding more tactical goals, how are these supported by IT governance, operations, and SOA infrastructure? Finally, particularly in collaboration with other organizations, what SOA-related vertical standards are relevant to your institution?

SOA represents a different challenge for each institution. Large, decentralized universities with potentially the greatest need and potential for SOA often also face the greatest challenges in governance. We believe that the current context of disruptive changes, including mobile and cloud computing, is a good time to revisit your SOA strategy, and the full document suggests possible next steps based on the experience of other institutions.

Introduction

The Gartner 2008 Hype Cycle Report for Emerging Technologies showed Service Oriented Architecture (SOA) climbing out of the 'Trough of Disillusionment' and up the 'Slope of Enlightenment'. The 2008 economic meltdown precipitated an abrupt change in direction for many organizations, leading Gartner Analyst Anne Thomas Manes to publish her now famous call to action: "SOA is Dead: Long Live Services" in January 2009. This ironic comment was intended to convey that despite problems with ambitious large-scale SOA projects, the basic architectural concepts of SOA remain fundamentally important.

How are higher education institutions using SOA? Have institutions been able to use SOA strategically as part of a mature organization, or have they been using SOA-related technologies to solve tactical problems? Has their investment in SOA paid off? To answer these and related questions, in March and October 2012 ITANA surveyed universities about the state of SOA in higher education. Twenty-seven institutions in the US, UK, Canada, and Australia responded, two thirds of them fall within the ARWU top 100 ranked universities.

This document reviews the survey findings in key areas, with background, survey data, and forward-looking discussion. For more detailed survey results, see the Survey Data document at https://spaces.internet2.edu/display/itana/SOA+Survey+2012

Is SOA dead?

Background. Some observers consider SOA to be dead, either as a term, or in some of its original premises.[1] Institutions may be confronted with mixed messages around the goals of SOA, as well as overlap with cloud computing and related concepts. We believe that SOA remains an active architecture in higher education, although types of SOA-related activities vary widely by institution.

Survey data. Most respondents (82%) reported at least one important driver for SOA at their institution, ranging from integration needs (74%) to business agility (48%). Most institutions (85%) have implemented or are implementing SOA-related solutions, and many (70%) have implemented or are implementing an ESB, SOA suite, or service registry. Nearly all respondents were actively engaged in one or more SOA-related projects, ranging from large-scale multi-institution integrations to more modest technology proof-of-concepts. Integration via web services was a constant and dominant theme. Although this in itself is not SOA, it is one of the basic building blocks of SOA.

Anecdotal comments testify to the continued appeal of the SOA paradigm: for example,

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[1] E.g., David Rubinstein, *SOA (the term) is dead, but SOA (the architecture) lives on*, Software Development Times, http://sdt.bz/36566 (April 25, 2012)

We have recently implemented an Enterprise Architecture focus area within the CIO's office that will facilitate development of SOA service governance (among other tasks),

SOA is a good IT strategy which must have top-level support and investment in order to produce efficiencies and cost savings. Our entry into SOA early-on has helped lead to many successes. Looking back, the three most important considerations would be: campus-wide governance and understanding, consistent development and usage, and a well-supported service portfolio.

We leverage our SOA infrastructure for nearly all system level integrations, regardless if they are web services related or not. Through the use of commercial adapters we are able to standardize the integration patterns for legacy integrations as well, which allows us to manage the vast majority of our system integrations though one standardized management interface.

Most respondents reported increased understanding of SOA-related concepts among their IT and business leaders (94%) and improved collaboration with business units to define goals (72%) over the past 5 years.

Discussion. In terms of project activity, SOA continues to be relevant for IT organizations. This may be because it addresses older and deeper concerns in software design (loose-coupling and reusability), or because of widespread use of SOA-related technologies (web services). But the survey also suggests a gradual increase in maturity that keeps SOA relevant as a framework for responding to business needs with IT solutions.

We suggest that some of the leadership challenges in this area are:
- Define what SOA means for your institution going forward, and how it relates to other trends such as cloud computing.
- Reaffirm your organization's core SOA goals and who is responsible for them across projects.

"Strategic" SOA or "tactical" SOA?

Background. Many drivers for SOA seem tactical rather than strategic. Technologists often see web services as the correct platform for back-end system integration, perhaps combined with some concept of an ESB or asynchronous messaging. These efforts can be quite successful and preferable to direct database integration or flat file transfers. However, without enterprise-wide governance around things like service-contract management, availability and master data management, these efforts remain essentially tactical for the IT organization rather than strategic.

SOA can also be strategic for an institution. It provides a design model that encompasses both business architecture and software architecture, connecting institutional goals and capabilities to services and their implementation.

Survey data. When asked about drivers for SOA, respondents were more likely to cite tactical concerns. Most commonly cited (by 74% of respondents) was the need for enterprise integration of back-end administrative systems and ERPs, while only about half cited the importance of executive leadership decisions (56%), or a need for greater agility in responding to changing business requirements (48%).

Similarly, regarding changes over the past five years, most respondents indicated increased use of web services provided by vendors (94%) as well as projects that have increased the portfolio of available services (76%). Relatively few respondents agreed that currently, services are tied to known business requirements (33%), have improved responsiveness to changing needs (24%), or have resulted in real cost savings (24%).

Respondents also indicated challenges in strategic management of SOA within their IT organizations. Over the past five years, 44% indicated no improvement and none indicated major strides in the governance of services as they are proposed, developed, and changed. 44% indicated no improvement in the operational management of services (SLAs, change management). Only 6% agreed that SOA is currently supported by a strong IT governance and change management framework, and none strongly agreed.

> **Examples:** Projects at the University of Washington provide evidence of the success of a tactical and pragmatic approach where there is a supportive and forward-looking IT culture.
> 1. The Supplier Registration Form (SuRF) integrates workflow (Kuali Enterprise Workflow) and legacy systems through RESTful api's to allow vendors doing business with the university to self-register.
> 2. MyPlan creates new functionality to students by allowing them to create a multi-year learning plan. It integrates a new curricular hub (Kuali Student CDM), degree audit, legacy student academic records and on-line advising via web services.
>
> In both cases new functionality and value has been created through service orientation but without any explicit SOA governance mechanisms.
>
> An example of a more top-down approach is the University of Toronto's Student Contact Information project using IBM WebSphere: "We purchased IBM's WebSphere Message Broker and established an SOA governance structure. We're in the process of building an "Integration Team" that will operate the ESB and develop message flows and services, and help the divisions build services too."

A review of the projects described by the respondents suggests that they have been most successful where there is a well-defined business problem to be solved, combined with a good level of maturity in SOA-related infrastructure and skills.

Discussion. The survey suggests a preponderance of tactical approaches. This appears to be true both for IT organizations (which often struggle with the governance and operational aspects of SOA) and for institutions (which often have not seen gains in transparency or efficacy of services).

Some institutions have taken more long-term, strategic approaches to SOA. The anecdotal responses suggest that this is more likely when an institution has reached greater maturity in IT governance and in collaboration between IT and business units, in some cases through an enterprise architecture program. We can speculate that institutions that are more decentralized, especially if they have decentralized IT, have greater governance challenges to overcome and are likely to use SOA in a more tactical way.

Although our survey didn't ask about funding models, our conversations with respondents suggest that this can also affect the type of SOA activity. In principle, numerous units around a university could offer services as part of a university-wide SOA, but in practice, decentralized units may not be able to do so in a sustainable or coordinated way. An institution with more centralized business processes and IT services may be in a better position to maintain a suite of services that provide re-use and agility.

We suggest that some of the leadership challenges in this area are:
- Define what kinds of strategic and tactical SOA goals can be sustained by your institution, given funding models, level of governance, and degree of centralization.
- Define the SOA-related strategic goals for your IT organization, and ensure that they are incorporated in IT governance.
- Define the SOA-related strategic goals for your institution, and ensure that these are incorporated in business-IT partnerships and projects.

Vertical standards

Background: The term "vertical standards" is used to mean standards that are industry specific. As an industry, Higher Education is concerned with Learning and Research. A number of standards have developed in these domains. We can distinguish between 3 different kinds of contracts:
1. Schemas developed by standards bodies such as PESC and IMS
2. Service contracts developed to allow interoperability with software products. This category is subdivided into:

a. Service contracts for commercial products such as PeopleSoft and Ellucian (still often referred to as SunGuard SCT)[2]
b. Service contracts for open source products like Sakai, CAS and Kuali Foundation software

The key issue that separates these approaches is *governance.* Standards bodies like PESC and IMS are communities of practice that include non-commercial and commercial partners. The processes around contract governance and publication are quite formal. This can be described as a community governance process.

At the other extreme, service contracts that serve as api's for commercial products are the intellectual property of the company and are designed primarily for integration with that company's products. Here governance resides with the commercial vendor. Although there is usually an ecosystem of user groups around large commercial offerings, these user groups are not involved in the design and management of service contracts.

The service contracts of open source products do not suffer from the restrictions of commercial products. The governance process is community based. At the same time, community and open source service contracts tend not to exhibit the formality around publication and governance that is characteristic of the standards bodies. Further, like the api's of commercial products, they have the advantage of being connected to working software.

Of course there is interplay between these different levels. For example:
1. The PESC standard has been adopted by Ellucian (formerly Sunguard SCT) for some of its modules[3]
2. In 2010 there was a Letter of Intent between Kuali Student and PESC to further align their efforts[4]

Survey data: With these distinctions in mind, what did the SOA survey reveal? On the face of it, explicit adoption of standards developed by standards bodies seems to be surprisingly low:
● IMS Global Learning Tools Interoperability (22% have implemented or are implementing)
● IMS Global Learning Infrastructure Services (22% have implemented or are implementing)
● PESC College Transcript (11% have implemented or are implementing)

There did not appear to be any implementers of the PESC Admissions standard or the High School transcript (though UBC is part of a Canada wide MOU to use the High School transcripts).

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[2] The combination of Datatel and SunGard Higher Education in a new company called Ellucian was announced in March 2012
[3] See: http://www.ellucian.com/News/Ellucian-Helps-Shape-and-Drive-Standards-with-Role-on-PESC-Board-of-Directors/
[4] See: http://www.pesc.org/interior.php?page_id=213

Examples: There were several examples of successful integrations using vendor supplied service contracts (especially the PeopleSoft Integration Broker). Very prominent among these is the University of California system Path project (UCPATH) which involves integrating payroll HRIS across ten campuses and five medical centers.[5]

A good example of establishing a set of contracts at the institutional level is the University of Wisconsin-Madison curricular hub. A standard set of service contracts to access curricular data are centrally maintained thus helping ensure a consistent use of that data across the institution.[6]

The University of Washington MyPlan also uses a standard set of contracts around a curricular hub. In this case the service contracts are part of a community source project and are published on that project's wiki.[7]

Discussion: One issue that may account for the apparently slow progress of standards is the problem of local variations. Often individual institutions do not describe learning objects and learning results in a way that corresponds *exactly* to a given schema. There are basically three ways of handling this problem:
1. xsd:any. Allow any local extensions to the standard schema
2. Create a schema that attempts to include as many concrete variations as possible and then allow users to select those portions that apply to them. This is essentially the PESC approach
3. Provide a simple abstract schema that can be configured in different ways. This is essentially the Kuali Student approach

As mentioned above, the PESC schemas take the second approach in that they attempt to be all inclusive. The advantage of this is that you will typically find what you need. The downside is that the schemas can be difficult to work with.

One issue that emerged on several occasions was that of size and complexity. Two institutions had abandoned efforts to implement a standard, citing complexity and inflexibility as issues. In the words of one respondent: "where the standard is somewhat easy to understand and limited in scope and usage, it's uptake is more broad. IMS Basic LTI is a good example - it is a standards based approach to solve a fairly common, fairly well understood challenge, and not surprisingly it leads in adoption. The more heavyweight and all-purpose the standard tries to be, covering a broad subject/service area with lots of interpretation required, the more complex the information model for the service becomes. Local variability is one factor in the "all purpose" vein, but so is the technical complexity in the standard itself. IMS LIS is a prime example. Without a skilled information architect who can navigate the data model of the standard, I

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[5] See http://ucpath.ucsc.edu/about/index.html

[6] The XML schemas and java api's are published on the project wiki: http://ucpath.ucsc.edu/about/index.html

[7] See https://wiki.kuali.org/display/STUDENTDOC/Course+Service+1.0

question how many institutions can even understand the challenge the LIS standard purports to solve. "

Is there room for convergence between these different approaches? Conceptually, one can imagine a set of simple, abstract and final definitions (like the Kuali Student Learning Unit) that are extended in more specific schemas like PESC and IMS. Whether this is feasible or worthwhile is another question. What does seem to be obvious is that the industry would be better served by more clarity and coherence around standards.

Technology standards

Background: Although SOA is obviously not the same as web-services, it is hard to imagine SOA without web-services. Web services alone provide the requisite loose-coupling at the technology layer. All SOA projects are using either SOAP, REST or JSON. Unlike the vertical, industry standards where there are still issues around adoption, there is clear uptake around core technology standards.

Survey data: Some highlights from the survey:
- SOAP and REST have become ubiquitous (as opposed to older remote object technologies like CORBA and DCOM)
- Java XML binding technologies are standard for those doing Java web services
- Among the WS* standards, SAML and WS-Security saw the greatest adoption

Discussion: REST vs SOAP? Respondents were split evenly between these two. Vociferous arguments between technologies in this area often mask underlying similarities. In both technologies the schema for the data payload has to be clearly articulated, published and managed. SOAP has well established mechanisms for handling authentication and reliability. These same issues have to be handled in REST. In reality, a lot of SOAP based applications are just doing "puts" and "gets". What does all this mean? Basically, the SOAP vs REST argument is not a fundamental technology inflection point. The really important issue from a strategic SOA perspective is getting institutional agreement around core data entities and how to publish and govern these.

SOA technology infrastructure

Background: There are a number of technology capabilities that are typically associated with SOA infrastructure. These include a service bus, business process management, messaging and, often, rules engine technology. There are two approaches to building out these capabilities:
1. One is to invest in individual products for each capability. The most obvious product in this space is an ESB.
2. The other approach is to invest in a comprehensive SOA suite that integrates these capabilities into one product.

Foremost in the latter category are Oracle SOA suite and IBM websphere. The Oracle SOA suite includes a service bus, a BPEL engine, a business rules engine, an event processor a B2B integration package and monitoring services. Although an application server is not part of the suite, IBM WebSphere occupies a very similar space and includes an application server, a business process manager, a messaging service and a rules engine (based on ILOG JRules).

Interestingly, the community product Kuali Rice has many of these same capabilities: business process management (Kuali Enterprise Workflow), business rules management (Kuali Rules Management System) and a bus (Kuali Service Bus). Although it is not a self-styled SOA suite, it is used in this way by adopters.

Survey data: The survey revealed investigations, experiments and some production systems in both the individual product category (especially around ESB's) and in the integrated SOA suite category. However, there do not appear to have been any obvious, stellar success stories in either category.

- ERP web services (59% have implemented or are implementing)
- An ESB (56% have implemented or are implementing)
- A SOA suite (44% have implemented or are implementing)
- A service registry (19% have implemented or are implementing)

Of the commercial offerings, Oracle SOA suite had the most uptake. If we are prepared to regard Kuali Rice as roughly analogous, then it provides an interesting alternative with adoption by 40% of the respondents.

> **Examples:** The following are illustrative of the kinds of efforts in this domain:
> - The University of Toronto has implemented a pilot around Student Contact Information using IBM WebSphere ("a small (100-150msg/sec) enterprise implementation").
> - University of Wisconsin-Madison has a well ESB evaluation project to provide a better understanding of the relative merits of the alternative SOA stacks.

Discussion: Integrated infrastructure suites like IBM websphere, Oracle SOA suite and JBoss Enterprise SOA Platform are worth careful analysis because they reveal the various abstract technology capabilities that are needed for a complete SOA infrastructure. Whether or not these capabilities need to be implemented as part of a suite remains an open question.

Where next?

SOA continues to provide a compelling paradigm that integrates IT strategy, tactical IT needs and business strategy. The 2012 ITANA SOA survey revealed a rich and heterogeneous set of efforts in this domain.

Based on experiences at other institutions, SOA-related activities you might consider include:

1. Find out how SOA is tied in to your IT governance.
   a. Is there adequate governance of proposed and existing services?
   b. If not, what would it take to establish a some governance before the size of the service portfolio becomes difficult to manage?
2. Find out how SOA is tied in to your institution's business goals.
   a. Between your business units and IT organization, is there a good understanding of which business capabilities are supported by which current and future services?
   b. If not, what would it take to align services with business requirements and start to assess the value of services based on business needs?
3. Find out what SOA-related infrastructure is in place, such as an ESB or SOA suite.
   a. Have these solutions reached an enterprise production level?
   b. If not, what further work would be appropriate to create an infrastructure suitable for your institution's needs?
4. Find out how SOA activities are being related to disruptive changes such as mobile and cloud computing.
   a. Are the skills, plans, and intra-institutional collaborations in place to put in place foundational services and take best advantage of cloud services?
   b. If not, who would need to collaborate to get there?
5. Find out what SOA-related projects are going on currently -- for example, a major integration project using SOA infrastructure.
   a. Are these projects designed to provide re-usable services and infrastructure beyond the scope of the immediate project?
   b. If not, which projects could be steered to contribute building blokcs for your long-term SOA strategy and enterprise architecture?
6. Find out how SOA-related vertical standards are being used.
   a. Are SOA proejcts taking advantage of available standards, particularly in data exhanges with other institutions and other organizations?
   b. If not, which standards could be beneficial? Are there standards bodies or projects that it would be beneficial to be working with, such as the CIFER project?

Purpose (not included in final document)
- Audience:
  - CIOs
  - COOs, CTOs, other business leaders working closely with IT
  - Enterprise architect, business architect, or IT architect
- Core question: What should I be doing about SOA? Based on:
  - What other institutions are doing
  - What other institutions are experiencing as successes and failures
  - Potential future benefits
- Sources:
  - Quantitative survey results
  - Anecdotal survey results (especially projects)
  - General knowledge of SOA, standards, and products

Structure of each section
- Background - Context for understanding the data
- Survey data - Direct observations
- Discussion - Including recommendations (if you believe X, you should be doing Y)

Outline (not included in final document)
[Brackets indicate additional points not yet fully fleshed out in the text]

- Introduction
  - Some have questioned the role of SOA
  - ITANA investigated the state of SOA in higher education today
  - We're providing background, data analysis, and discussion/recommendations
    - For raw data, see …
- Is SOA dead? [Piet]
  - [Convince me that something important is going on with SOA]
  - Most institutions are using and continuing to invest in SOA-related solutions
  - Most institutions have active SOA-related projects
- Strategic SOA and tactical SOA [Piet]
  - [Drivers, change in maturity, current maturity]
  - [SOA potentially encompasses a range of concerns, from strategic to tactical, from business to IT; we are interested in all aspects]
  - SOA at most institutions is driven by tactical needs such as back-end integration
  - Relatively fewer IT organizations handle SOA strategically, for example in terms of governance or service management
  - Relatively fewer institutions handle SOA strategically, for example in terms of business architecture or master data management

Strategic, business-driven	Strategic, IT-driven
● Probably not	● Maybe some
Tactical, business-driven	Tactical, IT-driven
● Maybe more than you think	● Most activity

- Vertical standards [Leo]
  - Vertical standards provide opportunities for inter-institutional communication and collaboration using SOA
  - Most institutions appear not to be actively working with open standards
- Technology standards [Leo]
  - [The results here show successful tactical work going on]
  - SOAP and REST are both widely used
  - [The activity in this area needs to be tied back to strategic goals]
- SOA suites [Leo]
  - [Relatively low adoption of any single SOA suite, no apparent dominant product]
  - There is a tension between commercial interests in retaining customers and the interoperability and agility provided (in the ideal case) by SOA
- Where next?
  - [Restate major conclusions from prior sections]
  - SOA continues to be a compelling model
  - Leadership should give attention to strategic SOA concerns including governance, vertical standards, and business architecture