

# Integration and Evaluation of SOA-based Higher Educational Administration System

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**Abstract:** In order to make the higher educational administration system to play a better role in the daily office, this paper, taking a university for example, proposed a SOA-based system integration model for the higher educational administration (by its very nature is a system provides a range of office service, through a variety of services combinations to achieve office automation), described a common system integration step of the higher educational administration. Finally, proposed a mathematical model which based on the fuzzy comprehensive evaluation method and AHP to evaluate effects of the system integration, Compared the evaluation before and after the SOA-based system integration, proved the necessity of the SOA-based educational systems integration.

**Keywords:** SOA, system integration, system evaluation, higher educational administration,

## I. Preface

The rapid development of information technology and the diversification of teaching in university make the information technology has become an important developing direction of today's universities. The daily office becomes more convenience because each department of the university has its own information system. However, due to the lack of an overall planning and unified information management standards, and information technology is a process of ongoing change, contradiction of the data exchange between information systems of various departments has become increasingly prominent. "Information Silo" appeared<sup>[1]</sup>. Accompanied by the deepening of reform in the universities, the higher educational administration system needs to have a capacity to adapt to changing demands of various routine offices. How to eliminate the "information silos" and at the same time improve the resilience of the entire system, so that office staffs relief from the complex resources and easily manage more resources? The information integration based on SOA (Service Oriented Architecture) could be a good solution to this problem.

## II. Overview of SOA

### What is SOA

SOA is a component model, it will link the different functional units (Services), and the interface is defined in a neutral way, independent of hardware platforms, operating

systems and programming languages, making such a system built on the various kinds of services can interact in a uniform and universal way<sup>[2]</sup>. Service is an application logic unit of a certain function deployed in the network, contains a set of operations (one or more) to provide access to the operate from outside, so that other software resources can use its functions. In the SOA architecture, Service is the core abstract methods, business is divided into a series of coarse-grained business services and business processes. Business services are relatively independent, self-contained and reusable, implementation by one or more distributed systems, while the business process is assemble of services. All functions of SOA are defined as services and all of the services are independent. The internal implementation of services is transparent for users so that they can call service through the service interface. For example, in the higher educational administration system, the enrollment management, teacher information management and the curriculum management are all services.

The key features of SOA are: it is coarse-grained, loosely coupled service architecture, Communication between services by simple and precise interfaces, and does not involve low-level programming interface and communication model.

### The Basic Structure of SOA

In a basic SOA architecture there are service providers (Service Provider), service requester (Service Requester) and the service registry (Service Registry), they interact by three basic operations: public, find and bind<sup>[3]</sup>. The architecture of SOA showed in Figure 1.

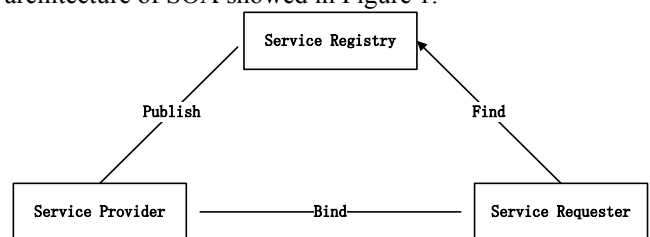


Figure 1 Architecture of SOA

- (1) Service Provider. Acceptance and implement request from the service requester, it will publish services and interface contract to the service registry so that service requester can find the services.
- (2) Service Requester. Bind and use services by find them from the service registry.

(3) Service Registry. Registry of service descriptions, contain a repository of available services. Here, service providers publish their services in service description and service requestor finds the service description they need. In static binding, service provider send describe to service requestor directly; in dynamic binding, service requester binds services they need by find.

Each entity in SOA plays one or more role of the three roles: service provider, service requester and service registry, in these roles using three kinds of operations: publish, find and bind.

(1) Publish: service providers need to publish service descriptions in order that the service requester can discover and call services.

(2) Find: service requester locate services they need in service registry by find.

(3) Bind: after find the service description they need, the service requester call services according to the information in it.

### Implementation Platform for SOA

There are many specific implementation of SOA: Web Services, Session Bean, JINI and so on. With the increasing emphasis on Web Service technology, it has become a major technology to build SOA<sup>[4]</sup>.

Web Services is a new generation of distributed computing architecture, with features of self-contained, self-descriptive and modular, you can publish, find and bind via web. Web Services using standard XML protocols and message formats to implement application services. Through the use of open Internet standards: WSDL (Web Services Description Language), UDDI (Universal Description, Discovery, and Integration) and SOAP (Simple Object Access Protocol), make the platform of Web Services, language, and publishers can be independent of each other, eliminate the access dependence problem in traditional distributed solutions (such as CORBA and DCOM). The model of Web Services-based SOA showed in Figure 2.

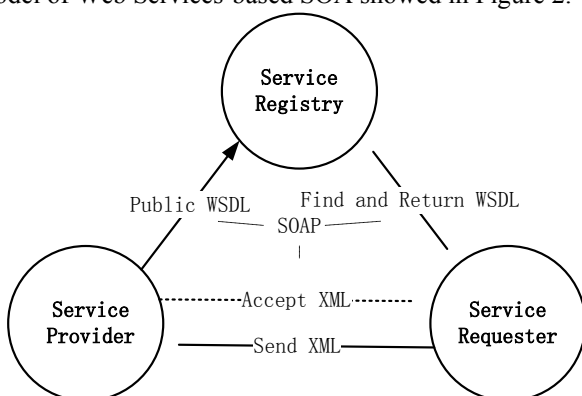


Figure 2 SOA model based on Web Services platform

### III. Integration of SOA-based Higher Educational Administration System

#### Analysis of Higher Educational Administration System

Taking a university, for example, the university has many independent systems such as expulsion management system, degree management system, doctoral application management system and course management system. According to the business they will do office staff choice the appropriate system. The phenomenon of data import and export between various systems often appear, as shown in Figure 3.

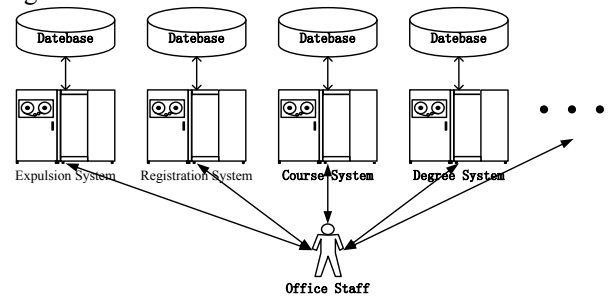


Figure 3 The original information system state of the university. When a new business needs arise, such as the candidates for admission, in which, first of all input student information and Entrance scores, then placement of students, registration of expulsion at last. We can see from the above process that this business involves in a number of existing systems such as expulsion management system and registration management system. The re-development of a "Student Enrollment System" means a waste of the original information resources and more management cost. The SOA-based Higher Educational Administration System has become an ideal solution.

SOA-based higher educational administration system, by its very nature is a system provides a range of office service, through a variety of services combinations to achieve office automation. In this system, every information system will be described as a service. All of the services can be simple and fast bind to complete the corresponding service request. The performance of the SOA-based higher educational administration system is that user submits their service request and the system provide the corresponding services service portfolio. The greatest advantages of this system are: office automation can be achieved through various service portfolio in order to respond flexibly to demand changes; maximize the integration of information resources by combining a variety of independent incompatible systems into standard Services and execute services integration through SOA bus.

#### System integration framework based on SOA

SOA-based systems integration framework consists of business data conversion layer, business logical service layer and business application layer. System integrate is build one or more business data adapters for each original database of

the original system based on business needs, each business data adapter acts as a data conversion interface, then according to business logic, combined these adapters into corresponding business logic services based on SOA framework, at last, compose these logic services into user oriented business application through business needs. As shown in Figure 4.

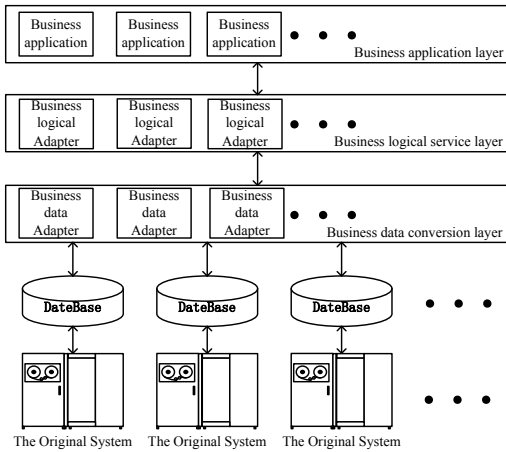


Figure 4 SOA-based system integration framework

In this way, without modifying the original system, not only maintain the normal operation of the original system, but also expansion of new applications without more cost. As long as modify or add the relevant business data adapter in business data conversion layer and provides the corresponding business services in business logical service layer, system can be extended or modified. So after the integration system will become more flexible and will provide a good environment for various departments to work together.

**Steps of System Integration**

The first step is business requirements analysis of higher educational system. This step not only requires a comprehensive consideration of the existing business needs, such as expulsion management system and degree management system, but also with due regard to requirements that might arise in the future, such as doctoral application management system.

The second step is business data adapter design of higher educational system. Under the current system database, collection various business needs, delete and modify the original redundant data, and then use SOAP, XML and other technology to build or re-use business data adapters. Every business data adapter is actually one service that is deployed in the database server of original system.

The third step is business logic service design of higher educational system. Business logic service design mainly based on business processes, build business logic services according to the corresponding data adapter, and deploy the services into the corresponding Web server, finally, apply these services for the construct of required business applications.

The fourth step is building the business logic services of higher educational system. That means build call relationship between logical services based on business applications as well as correlations in order to achieve all of the business processes.

Last step is business Logic Services integrate through SOA bus. Bus is used to integrate applications and services in a flexible infrastructure. All services in the bus are in the same position and little correlation between them, change one service will not affect other services, so deletions or changes service in bus will be very easy. After integration of the higher educational system by bus, various services of the system are able to communicate with each other. All requests for access services will be submitted to the service through the bus.

The ultimate realization of the framework showed in Figure 5.

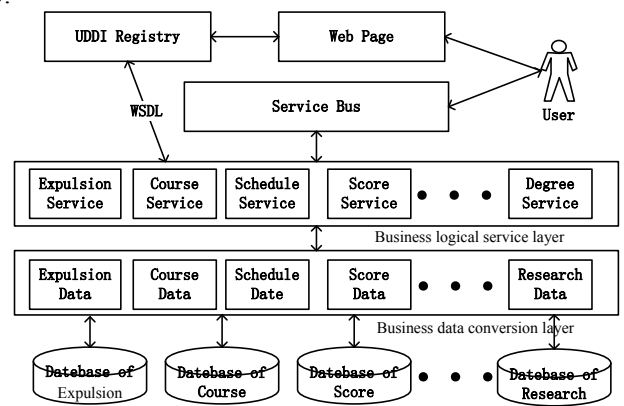


Figure 5 Framework of educational system Integration

**IV. Evaluation of SOA-based Higher Educational Administration System**

**Index System of evaluation**

According to the characteristics of higher educational administration system, combined with reference [5] [6], we propose a comprehensive evaluation index system from three aspect: value, technology and operational, and establish a model of hierarchy evaluation as showed in Figure 6.

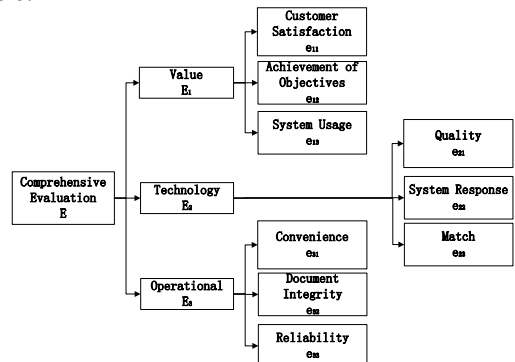


Figure 6 Evaluation framework of educational system

**Mathematical Model of Evaluation System**

Set up the set of higher educational system evaluation factors is set E, set E is divided into n sub-set according to the different attributes of the evaluation factors.  $E_1, E_2 \dots E_n$  satisfy

$$E = \bigcup_{i=1}^n E_i \tag{1}$$

And

$$E_i \cap E_j = \emptyset \tag{2}$$

Set up the evaluation set of the k sub-set is

$$E_k = (e_{k1}, e_{k2}, \dots, e_{kn}) \tag{3}$$

$e_{ki}$  means the evaluate factors taken into account;

$$i = 1, 2, 3, \dots, n \tag{4}$$

The discriminate set of the k sub-set is

$$V_k = (v_{k1}, v_{k2}, \dots, v_{kn}) \tag{5}$$

$v_{ki}$  means the judge results

$$j = 1, 2, 3, \dots, m \tag{6}$$

Fuzzy set on  $E_k$

$$M_k = (\mu_{k1}, \mu_{k2}, \dots, \mu_{kn}) \tag{7}$$

is called weight distribution

$\mu_{ki}$  is weight of evaluation factor  $e_{ki}$

Evaluation steps are as follows:

1. Determine the weights of every sub-set

There are several ways to determine the distribution of weights, the methods commonly used are: Delphi method, Judgment Matrix method and so on. In this paper, we use Delphi method to determine the weights of every sub-set.

2. Factor evaluation of sub-set  $E_k$

Definition: A fuzzy mapping from  $E_k$  to  $V_k$  is  $\underline{R}$ , called factor evaluation, any given  $u_{ki} \in E_k$  there will be

$$\underline{R}(u_{ki}) = (r_{i1}, r_{i2}, \dots, r_{im}) \in F(V) \tag{8}$$

$\underline{R}(u_{ki})$  is determined by experience and reasoning, can be find from fuzzy table (table 1).

Table 1 Table of Fuzzy sets

	1	2	3	4	5	6	7
best	0	0	0	0	0	0.33	0.67
better	0	0	0	0	0.25	0.50	0.25
well	0	0	0	0.25	0.50	0.25	0
general	0	0	0.25	0.50	0.25	0	0
bad	0	0.25	0.50	0.25	0	0	0
worse	0.25	0.50	0.25	0	0	0	0
worst	0.67	0.33	0	0	0	0	0

3. Determine transformation matrix in sub-set  $E_k$

Transformation matrix of the comprehensive evaluation is a matrix tie up all the fuzzy mapping  $\underline{R}$  above

$$\underline{R} = (r_{ij}) \tag{9}$$

4. Comprehensive evaluation in sub-set  $E_k$

$$\underline{N}_k = \underline{M}_k \cdot \underline{R} \tag{10}$$

$\underline{N}_k$  is the vector of comprehensive evaluation.

5. Calculate comprehensive evaluation value  $W_k$  in sub-set  $E_k$

$$W_k = \underline{N}_k \cdot C \tag{11}$$

$C$  is the vector of grade

$$C = (1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7)^T$$

6. Repeat steps 2-5, calculate all the comprehensive evaluation value of sub-set.

7. Determine  $w_i$ , weight of every sub-set of evaluation set E

Delphi method will be used again to determine weight of every sub-set of evaluation set E.

8. Calculate the comprehensive evaluation W of the information system evaluated

$$W = \sum_{i=1}^n w_i W_i \tag{12}$$

**Evaluation Before and After the System Integration**

Use the evaluation model above, after compare the evaluation before and after the system integration based on SOA. Here is the user evaluation information we obtain through the questionnaire, as shown in Table 2.

Table 2 The evaluation of system

	$e_{11}$	$e_{12}$	$e_{13}$	$e_{21}$	$e_{22}$	$e_{23}$	$e_{31}$	$e_{32}$	$e_{33}$
Before	well	well	general	well	well	general	bad	general	well
After	better	better	well	well	well	well	best	better	well

Table 3 shows the weight of all evaluation factors derived from the Delphi method.

Table 3 The weights of evaluation factors

$E_1$ (0.68)	$e_{11}$ (0.25)	$e_{12}$ (0.62)	$e_{13}$ (0.13)
$E_2$ (0.15)	$e_{21}$ (0.76)	$e_{22}$ (0.14)	$e_{23}$ (0.10)
$E_3$ (0.17)	$e_{31}$ (0.24)	$e_{32}$ (0.24)	$e_{33}$ (0.52)

After calculated according to the steps of evaluation model, Table 4 shows the comprehensive evaluation results before and after the system integration.

Table 4 Evaluation results

	$E_1$	$E_2$	$E_3$	E
Before the Integration	4.87	4.9	4.04	4.73
After the Integration	5.87	4.86	5.64	5.68

Thus we can see, after the integration of SOA-based higher educational administration system, the higher educational administration systems significantly improved.

## V. Conclusions

SOA is now being widely used in business, government, hospital and library and so on. SOA brings the flexibility of IT infrastructure, making it a powerful vitality, and it will be the future direction of development of IT infrastructure. By the integration of SOA-based higher educational administration system of one university and compared the evaluation before and after the SOA-based system integration, we find that SOA-based higher educational administration system is more effective and preferred.

## References

- [1] Chunzi Li, Weizhi Hu. Design and Research of the Platform of College Application Integration based on SOA [J]. China Education Information, 2007, (09):51-53
- [2] Junjie Chen, Xiaojun Yuan. SOA and System Integration [J]. Chinese high-tech enterprise, 2008, (02):23-24
- [3] Chuanxiang Tang. Design and Application of E-government System Architecture based on SOA [J]. Journal of Xi'an Electronic Science and Technology University, 2006:35-46
- [4] Bieberstein N , Bose S , Fiammante M. Service-Oriented Architecture(SOA) Compass-Business Value, Planning and Enterprise Roadmap [M]. 2008
- [5] Ying Li. Quality Evaluation Index and Architectural Research of Management Information System [J]. Journal of Hebei University, 2009, (2):66-68
- [6] Dongqiang Guo. Quantitative model of Information System Evaluation [J]. China Management Science, 2000, (11):96-102
- [7] Yongyi Chen. mathematical model of Comprehensive Evaluation [J]. Fuzzy Mathematics, 1983, (1):61-69

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