

教育领域中的一个服务应用： 基于 SOA 的学分银行系统^①

林慧苹 李伟平 吴 斯 (北京大学 软件与微电子学院 北京 102600)

A Service in Education: SOA-Based Credit Bank System

Huiping Lin, Weiping Li, Si Wu (School of Software and Microelectronics, Peking University, Beijing 102600)

Abstract: The paper presents a new service application in education area, namely credit bank. Credit bank is a service provided by authorized education organizations so that customers can save, manage and exchange education credits. The paper focus on establishing a service oriented information system to support the idea of credit bank. After introducing its concept, the paper studies the requirement of credit bank from both business and technical point of view. Then it presents a practical step-by-step guideline to identify services in the system. The guideline is applied to design credit bank information system (CBIS) as a case study. The contributions of the paper are: (i) It gives a new idea about how service can be used to benefit education; (ii) It presents a useful method for service identification in system design with case study.

Key words: service oriented architecture; credit bank; case study

Services are considered economic activities offered by one party to another, most commonly employing time-based performances to bring about desired results^[1]. Driven by an environment that includes global communications, business growth and technology innovation, the economic has migrated from agriculture and manufacturing to service industry. It now accounts for more than 50 percent of the labor force in many countries^[2]. Services have been applied in many areas such financial, manufacturing, communication, and so on.

This paper focuses on a service application in a specific business area - education. It is sponsored by an ongoing project that is to establish a credit bank system for China Central Radio &TV University (CCRTU). Credit bank is a service provided by authorized education

organizations so that customers can save, manage and exchange education credits. After introducing the concept of credit bank, the paper studies the requirement of credit bank from both business point of view and technical point of view. Then service oriented system design method is applied to build credit bank information system (CBIS). CBIS is provided by the CCRTU as a service to users. The contributions of the paper are: (i) It gives a new idea about how service can be used to benefit education; (ii) It presents a practical service identification method in system design with case study.

1 Concept of Credit Bank

Education is related to everyone's life. People go to

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schools, universities, training centers, distance learning centers, and so on to learn knowledge. When people go to college, university or distance learning centers, usually they earn credits. After they get enough required credits, they are qualified for a degree or certain certification.

This is the traditional way of getting a degree in China for decades. The shortages of such a system are that: (i) It does not count in all education forms; (ii) It does not provide enough support to flexible credit exchange; (iii) It does not help to encouraging lifelong education. Thus, recently ten years, the idea of credit bank is attracting more attentions.

Credit bank is a service provided by authorized education organizations so that customers can save, manage and exchange education credits. The driven force of credit bank is the need for lifelong education. With credit bank, all education experiences, such as elementary school, middle school, university, internet class, and various trainings courses, are evaluated by credits. People can register, accumulate and manage these credits as his personal education treasure. He can redeem credits for certification or degree. Or he can transfer credits from one organization to another, just like money exchange between countries. If we compare credit bank with financial bank, which is a financial institution whose primary activity is to act as a payment agent for customers and to borrow and lend money or to exchange money^[3], we would say that financial bank deals with the money, credit bank deals with the credit.

Table 1 Comparison of financial band and credit bank

	Bank	Credit Bank
Deal with	Money	Education Credit
Functions	Deposit	Credit Registration
	Withdraw	-
	Loan	Credit Loan
	Exchange	Credit Exchange
	-	Credit Redeem

The idea of credit bank has already been carried out in application. For example, South Korea has established credit bank system(CBS)in order to help adults get degrees outside traditional colleges^[4]. It provides more than 8000 standard and qualified courses from universities, colleges and lifelong education organizations. With

CBS, the high education rate grows from 33.2% 1990 to 80.5% now. In US, Excelsior College consolidates credits from a variety of sources: such as Credits from Excelsior College and other accredited colleges and universities, military training and experience, corporate training and so on^[5]. In china, Shanghai established a credit qualification program so that credits from certain education can be exchanged^[6].

There is no doubt that the idea of credit bank will benefit lifelong education. However, there still lacks of specific information system that can support the operation of credit bank. The paper is going to establish a credit bank information system for CCRTU to manage credits. CCRTU was established in 1979 and has 44 sub-organizations spread all over the country, with more than 160,000 graduates. By implementing CBIS, it hopes all the credit within CCRTU can be managed and exchanged.

2 Challenge and Requirements of CBIS

The challenge of implementing credit bank information system lies both in business and IT perspective. From business point of view, the biggest challenge is that the business requirements evolve gradually. Credit bank needs an extensive, standard credit authorization and exchanging mechanism with consideration of diverse education forms. However, in China the standard credit system is still developing.

The changing business requires more flexible system. More concretely, the CBIS need to be:

- Extensible: Since education is dynamic and diverse, it leads to dynamically changed business requirements. That requires CBIS should update its functions, data format, and so on with rapid and low cost updates, when application domain or technological scenarios are changed.
- Interoperable: It means two types of interaction: (i) human-to-system, for example, human operations; (ii) applications-to-applications, for example, CBIS exchanges data with heterogeneous university applications.
- Open:Users of credit bank should be able to access the service even in presence of different technological

gaps and different internal system types and organizations.

- Flexible: It should provide flexible support for continuously changed education scenarios. For example, provide flexible credit transfer policy definition method.

- Secure: The credit bank users and partners should be able to exchange message or do transactions with guarantees of authenticity, integrity and secrecy.

- Accessible: The users can easily access the credit bank without limitation of location and time.

3 Service Identification

Service oriented architecture features separating functions into distinct, loosely coupled services and assembling according to business requirement^[7]. Since the idea of “building block” greatly improves software reusability, flexibility and extensibility, SOA is adopted in CBIS design and implementation.

In order to build a SOA, one needs to make key architectural decisions about each layer in SOA, such as operational systems, enterprise components, services, business process choreography, and presentation. IBM proposed Service Oriented Modeling and Architecture (SOMA) method, which consists of three general steps: identification, specification and realization of services, components and flows. In SOMA, service identification consists of a combination of top-down, bottom-up, and middle-out techniques of domain decomposition, existing asset analysis, and goal-service modeling.

Since the service identification is very important in service oriented system design, the paper presents a step-by-step guideline for service identification, as shown in Fig.1.

The Steps include:

- Business Requirement Analysis. It identifies all potential users of the system and develops use cases. Also it identifies system functions, including identify potential functions for future use.

- Use a top-down method to analyze business processes and identify services based on use cases. The top-down process is often referred to as domain decomposition, which consists of the decomposition of the business domain into its functional areas and

subsystems, including its flow or process decomposition into processes, sub-processes, and high-level business use cases. Every process is broken down to atomic activities and then an activity-function matrix is built. The atomic functions that are belonged to several processes will be identified as reusable service components that explore their interfaces.

- Build internal workflow model with service choreography language – BPEL to compose the service components as a compound service, which will be put into service repository and can be access by end-point users.

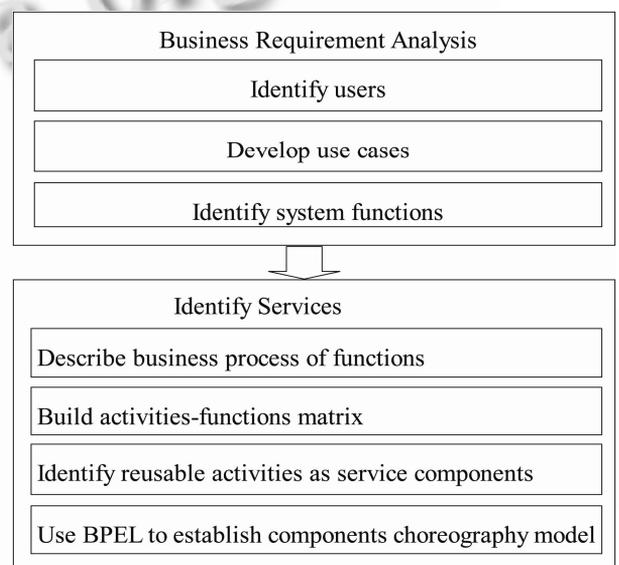


Fig.1 Steps of service-oriented system design

4 Case Study-CBIS

The method presented above is applied in the design of CBIS to identify services.

4.1 Identify users and use cases

The users of CBIS include:

- Individual users, who want to register and exchange the education credit with credit bank, such as students. One can register his credits and save them in his own account when the bank verifies that the credit is real and acceptable. Also students can apply for credit exchanging: redeem some of the credits for certain certification, or transfer credits of one college to another.

- Organization users, such as education organizations. The organization users are responsible for three

tasks: (i) provide enough information to credit bank so that its own credit is acceptable; (ii) deal with credit verification request from the bank; (iii) deal with credit transformation approval request from the bank.

- Bank clerk: just like clerks at financial bank counter, there should be clerks in the credit bank. Their main task is handling customer's online request. For example, when a student wants to deposit credits, the bank clerk will initiate a credit verification process to make sure the credit is qualified. When a student wants to transfer credits, the clerk helps him with credit exchange. If there is matching exchange rules in the system, the clerk will do it directly. Otherwise, the clerk will initiate an exchange approval process instance.

- System administrator: responsible for system background maintenance including credit exchanging rule maintenance, course maintenance, university information maintenance and so on.

4.2 System function analysis

The credit bank provides customers with services to deposit and exchange education credit, just like bank to deal with money. CBIS has three major functions, namely user administration, credit management and service configuration, as shown in Fig.2. User administration is responsible for users' management, authority management and security management. Since CBIS is going to be provided as a service to users, a large number of users are involved. Role-based user and user authority management is used to guarantee effective user administration. Credit management is responsible for key credit bank business such as credit registration, confirmation, transformation, exchange, and credit certification. Service configuration is very important. It provides userdependent settings such as rule-based credit transformation configuration, common curriculum settings, and organization user configuration.

4.3 Service identification

Since there is no legacy system within CBIS, the topdown method is mainly used to identify services and service components. Let's focus on credit management. There are five basic functions such as credit registration, credit confirmation, credit transformation, credit exchange, and credit certification. These functions are treated as candidate services. Then, activity-based swim line

diagram is used to describe processes of each function. For example, for credit exchange function, one of its processes can be described in Fig.3. Describing business process is a practical method to decompose functions. When all process descriptions are obtained, an activity-function matrix is build to find reusable components, which will be identified as service components. In credit exchange process, the activities such as "log in", "credit inquiry" and "course inquiry" are identified as service components. These service components are services at small granularity, which will be used by inner workflow model to compose user-accessible services. Also through top-down analysis, it is found there are many human tasks in CBIS such as approval, decision making. Thus, a special service component, named human task service, is identified. It is response for passing the task sheet to the right person, wait for him to complete the task and then give feedback to the system. Thus, the service "credit exchange" is composed of four service components such as "log in", "credit inquiry", "course inquiry" and "human task", as shown in Fig. 4.

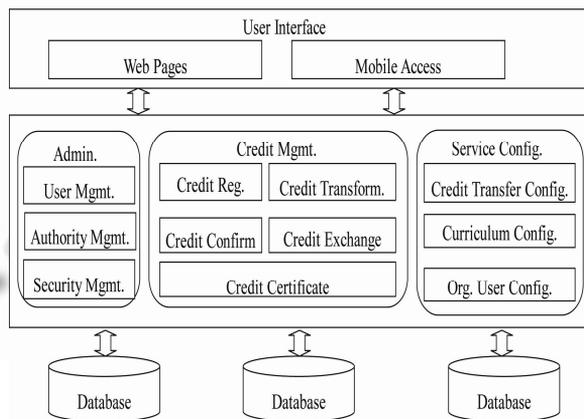


Fig.2 Components of credit bank system

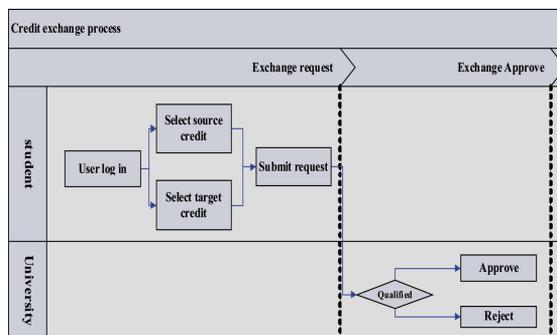


Fig.3 One process of credit exchange

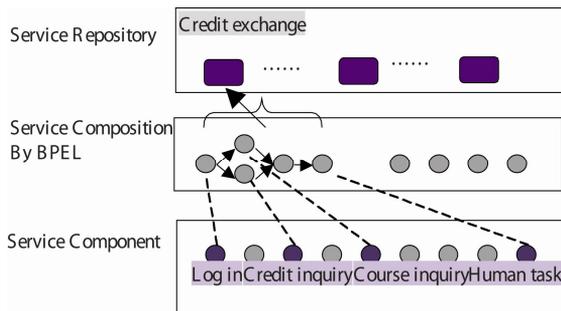


Fig.4 Service compositions in credit exchange service

4.4 System implementation

CBIS takes the popular service oriented architecture aiming to build a system with high flexibility and reusability. The services are implemented in Java EE technology. To improve the performance of the system, both web services and Plain Old Java Objects (POJOs) are used in this system. For some simple services we take POJO to fulfill the basic functions. For the services which can be further composited into the composited services both web services and the BPEL language are taken, in which BPEL describe the workflow as well as the relationships among the web services.

5 Conclusions

This paper focuses on a service application in education. It is going to establish a credit bank information system for China Central Radio &TV University (CCRTU) to save, manage and exchange the credits. The

paper introduces the concept of credit bank and studies the requirement of credit bank from both business and technical point of view and technical point of view. Service oriented architecture is applied to build credit bank information system (CBIS) in order to provide flexibility and extensibility. Since service identification is crucial in system design, a step-by-step guideline is presented and used in design of CBIS. The contributions of the paper are: (i) It gives an idea about how service technology can support credit bank; (ii) It use CBIS as a case study to discuss the practical service identification method.

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