An innovative method for data and software integration in SaaS

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ARTICLE INFO

Keywords:
SaaS
Cloud computing
Data integration
Software integration
Master table introduction

ABSTRACT

Recently the main trend in providing software services has been shifting from an ASP (application service provider)-oriented to a SaaS (software as a service). ASP is a software service model in which the service is provided on a one by one basis according its ownership, while SaaS is a software service model in which the service is provided virtually on a one by one basis, but physically all at once. In a SaaS environment, all users can access the system via Internet without any software installation—examples include Google and Amazon. Now, more companies are shifting their business software service from ASP to SaaS. However effecting the transition of the existing software and data from ASP to SaaS is not an easy task. First, we have to solve the problem of the integration of data for different forms of software, because each data set consists of different data types. Second, the software integration must support a user customizing interface for various users on the Web. Almost all users want customized services, but those require high costs. In this paper we propose a novel method for transferring the existing business software to integrated software that can be used in the SaaS environment. We use a master table and master code to implement the integrated system. The master table is based on the project master table, and other user information tables are connected to collect the necessary information. All information about the project is stored in each column of the project master table. The master table can integrate various software databases. By using this novel methodology, the existing ASP-based software and data can be effectively transferred to the SaaS environment.

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1. Introduction

Modern society is an information-oriented society, wherein smart ideas and talent are important, beyond the resource- and labor-oriented industrial society. In the past, businesses made profits only from product sales, and advertised for maximized profits or tried to reduce costs within the scope of traditional ways. However, this type of profit-seeking business had limitations, and businesses started to find a new way to achieve their desired results at a low cost. Businesses tried to change their business processes, adopted the ideas of their employees, and collected ideas even from outside.

The results of such efforts first appeared in the advertising industry. In the earlier period of the industry, celebrities appeared in advertisements and promoted products. Diverse kinds of advertisements appeared with unique and exciting ideas, and people were interested in them [1].

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The low-cost and high-efficiency principle was also applied to in-house business processes. Instead of a traditional system of document approval, the ideas of employees were collected and managed, and an electronic approval system was introduced to change the in-house business culture [2].

Using enormous capital, large enterprises introduced the business management system that suited for them. The system was exclusively developed for each enterprise, to manage its tasks, results, and service evaluations. Therefore, it could not be applied to other enterprises. Because of its very high cost, small and medium-sized enterprises could not afford to construct their own systems. To address this problem, the software as a service (SaaS) type of business support system was developed. The SaaS method allows the user to use the software provided by the developer via the Internet for a monthly charge. This method eliminates the need for users to establish a system by themselves or purchase the specific software. The SaaS system does not require a higher cost for an initial installation, and can be directly customized by the user. Therefore, the user can select his/her desired software and use it. Because this system was developed in compliance with Web standards, it also can be used by different users. This is a very efficient software distribution method [3].

In this study, we propose a novel method for integrating existing softwares in the SaaS environment. This method can be applied to all the commercial softwares, and we illustrate business software integration using the proposed method. The integrated software is service-oriented through Internet access, where the customers only pay for the service that they want to use. This paper is organized as follows. We first discuss cloud computing, ASP and SaaS, with several service-oriented methods such as IaaS and PasS being treated in detail, in Section 2. After that, we propose a master table method for organizing the SaaS service. Section 4 explains the simulation results and is followed by a conclusion in Section 5.

2. Related studies on SaaS

2.1. The definition of SaaS

SaaS is a software distribution model in which customers can acquire services on demand by ordering and receiving various kinds of software application services via the Internet. Compared with traditional service models, SaaS has very many advantages such as investment reduction, performance improvement, time saving, easier collaboration, global accessibility, etc. A well-designed SaaS application must have three features, namely multi-tenant efficiency, scalability and configurability, even though not all existing SaaS applications support all of these features. SaaS markets all over the world will continuously increase until 2013 according to Gartner’s report [4].

There are many industry practices for SaaS management and operation platforms [5]. HP provides operation solutions focusing on the SaaS service operation itself, such as reliability, scalability, and security. Salesforce.com provides platform sharing customer relationship management services via a Web-based programming tool for SaaS. Google AppEngine provides platform developers with a flexible programming template and a powerful data access mechanism. OpSource.com also provides SaaS hosting services for users with enterprise-class clouding services [6].

The SaaS application framework may have the following structures [7]. First is the service transport layer which guarantees accurate information. The schedule layer supports the user in choosing the services required and wraps them. The service technology layer provides API or Web service applications through the SaaS platform. The application and services layer provides API and a special Web service for the upper formation transfer implemented by a package to meet the needs of the market demand. Finally, the data and services management layer uses three ways to manage multiple-user data, such as independent databases, shared databases and isolation data schema.

2.2. Software engineering and SaaS

SaaS is an extended version of a software service with a new provision method. Therefore the methodology of software engineering is also extended accordingly. Software engineering is the systematic approach to the development, operation, and maintenance of software by applying the analysis, design, assessment, implementation, testing, maintenance, and reengineering of software step by step, that is, the application of engineering to software. In the 1968 NATO Software Engineering Conference, most researchers agreed that they suffer under the bottleneck of software development, and so the term software engineering first appeared. In the ICSE2006 keynote address “A View of 20th and 21st Century Software Engineering”, software engineering is defined as “the application of science and mathematics by which the properties of software are made useful to people”.

One of traditional software methodologies is model-based system architecting and software engineering (MBASE), which integrates the process model, product model, and success model of a software system. Others are the constructive cost model (COCOMO), the spiral model of a software process, and the W (“win–win”) approach to software management [8]. With the rapid development of Internet technology, software engineering is adopting SaaS through cloud computing. The ultimate goal with scalability, flexibility, reusability, and reliability is cost effectiveness. Therefore, in order to make any software development both effective and efficient, software development methodologies are still among the primary concerns.
2.3. Cloud computing and SaaS

The basic concept behind cloud computing is that the computing resource is connected to the network environment, so that users can access the resource whenever and wherever it is needed. That is, even if users do not have a hardware device, they can use the desired computing resource anytime and anywhere if the Internet is available.

Cloud computing has a very different concept to existing business processes. Under traditional environments, users must purchase the systems and lots of software. Under the cloud computing environment, however, users just need an Internet-enabled terminal to handle and store all tasks on the network, without constructing a system or purchasing software programs. Users only pay a fee to use the system, wherein the hardware and software are integrated somewhere else [9].

Cloud computing supports large-scale computing resources and enables virtualization, on-demand computing, dynamic deployment and flexible scalability. Benefits of cloud computing are there being no initial cost of purchasing software or hardware, freedom from maintenance/updates, accessibility through the Internet, high availability, and pay-per-use pricing. The enabling technologies of cloud computing include service-oriented architecture (SOA), a component-based approach, workflow integrating services, and virtualization of lower-level functionalities and underlying hardware [10].

There are four hierarchical layers in cloud computing [11]. The top layer is SaaS (software as a service), delivering the conventional software functionality as a service. The following layer is PaaS (platform as a service) and the third layer IaaS (infrastructure as a service). The bottom layer is the IT foundation including servers, network devices, storage devices, databases, and other physical resources. The cloud computing is classified into four kinds of offerings, which are cloud computing serving as the data center, cloud computing in the form of distributed computing, cloud computing in the developed form of a utility grid, and cloud computing serving as software as a service [12].

However, there are some critical technical problems in cloud computing, such as providing pre-specified scalability even at peak time, providing availability of services and data sets, engineering services with high commonality, and adapting partially matched services. These problems must be addressed from the consumers’ viewpoint.

SaaS is an on-demand-type cloud-computing-based service, wherein the operator provides software via the Internet and the user selectively uses the required software. The user can reduce his/her cost by paying only a small monthly fee instead of purchasing expensive software, with the complex management under the operator’s charge. Representative examples include Google Docs, Microsoft Office Live, and IBM Lotus.

2.4. ASP and SaaS

The application service provider (ASP) refers to the service or operator that has a business application installed on the host server and charges a fee to the user. The ASP server can be placed in the premises of the service operator or in the business (independent type). In the first stage of the ASP service, its service scope is limited to the use of software. The service has recently been being developed, however, to become a form of concept in which even hardware is outsourced. ASP is not provided for non-business purposes. It offers only business software, for which the user is charged a monthly fee [13].

One of ASP’s advantages is that it can reduce the risk of system construction in the first stage. Wrong system construction may lead to loss of the initial investment and sales, and generally involves a very high cost. ASP reduces this risk. Another of ASP’s advantages is that it can ensure the support of skilled professionals during the software implementation stage, eliminating the need to have in-house professionals. The service operator performs additional system maintenance, so the user can concentrate on his/her business [14].

SaaS is an improved form of ASP. It is similar to ASP in that it provides software as a service, but it differs from ASP in many ways. The greatest difference between ASP and SaaS is in the number of users of the provided software. With the SaaS method, the service provider can easily have many users of one service, so each user can use many different services at a low cost. This method is advantageous to both parties [15].

Currently several companies are using SaaS platforms to provide software services. Salesforce.com is an cloud computing platform enterprise which provides Force.com where the user can customize CRM applications or implement other applications (see Fig. 1). When users use Force.com services, they do not need to purchase any server or software for development [16].

2.5. Other service-oriented systems

In addition to SaaS, there are other service types such as platform as a service (PaaS), which provides a software development environment for users, and infrastructure as a service (IaaS), which provides a server infrastructure as a service. PaaS provides a service by using a cloud infrastructure and applications. It also provides users with business development and an operating environment. By using cloud platforms, the developers can use cloud services or program applications and run them in it after building their own cloud platform. PaaS may be called Cloud 9 or an on-demand platform.

IaaS is a basic level of cloud computing service. It provides a platform virtualization environment as a service by converting computer infrastructure resources along with network devices and storage devices into a virtual pool of resources. The enterprises traditionally install resources such as servers and data-center spaces in their sites; however, these resources can be paid for as a fully outsourced service according to the amount of resources used.
Representative examples of PaaS include Microsoft Azure, Amazon Checkout, and Google AppEngine. These systems provide a software development environment and a development language as a service. Examples of IaaS include Amazon Cloudfront, SimpleDB, and Microsoft LiveMesh. These systems provide a complete computer system as a service [17].

3. Data and software integration using a master table

To provide the software via the Internet in the SaaS method, multiple software programs must be managed properly [18], and the data created from the various uses of the software must be stored separately. Each user should be able to select the software that he/she needs to use in the SaaS method.

In this paper, we propose an innovative method for integrating existing software and data by using a master table. The overall structure for this method is depicted in Fig. 2.

3.1. An overview of the proposed system

All softwares provided are managed by an integrated software management system (ISMS). This ISMS integrates heterogeneous softwares that are transparent to users. The ISMS accepts users’ requests and assigns appropriate services according to their needs. The ISMS consults the master table and grants necessary services.

The master table is a set of tables that stores the information about users, softwares and sessions. It consists of the main master table and various user information tables for different tasks. The user information table maintains software data...
information which can be created or modified according to the needs of the user and the usage of software. The combination of the main master table and user information tables constructs the master table. One of user information tables is the software authority information (SAI) table. ISMS consults the SAI table as regards granting access permits to users. The SAI table stores information about user authority for software usage, such as valid periods. All users are allowed to use software only through permission from the SAI table.

The master table facilitates the management of integrated heterogeneous software efficiently. The system in Fig. 2 shows some software programs being granted appropriately. First a user requests the required software from the ISMS, and then the ISMS will block or permit it on the basis of the specified user status. The master table stores and provides all necessary information for the ISMS.

3.2. Software and data integration using the master table

In this section we explain how users can access the needed software through the Internet. With the master table, there is no need to construct an individual database for software, and the data can be processed and stored as an integrated system. That is, diverse kinds of software programs and user data can be stored in one database. All data are stored in one master table.

There are three steps in using the proposed system. First, every user must register their information, such as a basic user attribute and the registered software. This information is stored in the SAI table and only registered users are allowed to access this system. Second, every user accesses the system through ISMS. This permits the users to access software if they are registered in the SAI table. The SAI table contains information about the user name and needed software. If unregistered users try to access software, ISMS will block it. A trial on unregistered software will also be blocked. Finally, when users finish their usage of the software, all generated information is stored in the master table.

Fig. 3 shows the master table contents in detail. All data are separately stored in corresponding sub-tables in the master table. Each user information table has different attributes for different users. The main master table has basic information attributes for the software, for example, column name, leader ID, starting date etc. The user information table has attributes for the software other than those in the main master table. The attributes of the user information table could be flexibly modified by the system administrator to meet the software requirement conditions. If the software requires other information that does not exist in the master table, the administrator can create another table to store it in. After this, the newly created table will be a part of the user information table. Any software usage can be customized according to the user’s needs.

The master table also uses the concept of codes. The codes consist of the master code (higher property) and the sub-code (lower property). These are used in cases wherein alternatives are needed or to define specific data such as the department and company. For example, the name of the master code could be ‘university name of local area’, and the sub-code’s names could be ‘Sejong University’, ‘Governor’s State University’, ‘Bradley University’ and so on. The user selects one of these codes to register the data. The master code and sub-code are stored in their own list.

With the combination and modification of tables, the master table enables the combined storage of different kinds and properties of data. This is data integration software that is well suited for SaaS. For the simulation of the proposed methods, data from four heterogeneous software programs were stored in an integrated database using the master table and we explain how this can be implemented in the next section.
4. Business software integration using the proposed method

4.1. The proposed integrated business model

In this section, we apply the proposed method to four existing softwares based on a Web portal site. The pre-existing systems are individually installed as four different softwares at the host site, namely Proposal System, Quality Circle System, 6 Sigma System, and Town Meeting System, according to the user’s request. These systems are optimized for the companies that employ the softwares. Even though these systems are properly customized and well functioned, the cost of purchasing as well as paying the fees for maintenance and upgrades is not a trivial one. The system requires consistent staff time and expense later. As a result, most small and medium-sized business companies want to have a total composite system in which the functionality can justify the cost of system maintenance. In this portal site, the administrator can specify the functions that the user can use, according to the user’s demands. This site can provide different functions to different users. If a user who does not register for a specific function tries to access this function, the access is blocked with a warning message. The creative innovation business service system was applied using an Internet portal. The user can select and use the required functions.

All users have to register their projects on the Web site, and the intermediate management and approval of the person in charge are also performed on the Web. The online approval and business process require less time and are more efficient than those in the existing methods. In addition, the business contents can be easily shared by team members, and the current business status can be easily identified. The following three sections will discuss the implementation of existing business software in detail.

4.2. An integrated database using the master table

In order to integrate four different modules, we employ the concept of a master table in which one row accommodates information for a single project regardless of discrepancies. The stored information is in a textual format. The master table is connected to the necessary information. The master table is a set of tables that are used to store and manage the project data created from the four modules. Each line in the table has all the data on one project, and the data can be expanded by linkage into other tables.

The project master table, or the main master table’s name, which is that of the most basic table, has 75 items, including the project code, project name, project identification, methodology, end date, start date, department/team manager IDs and leader ID. Each line consists of the project data in the textual format. The items in the horizontal direction constitute a line in the project master table.

Some items can be represented in codes according to the user’s definition. When there is a request for the code data, the data are extracted with reference to the table that has the code list.

4.3. Integrated business software

Existing software programs integrated in a Web portal site are shown in Fig. 4. To provide these modules in a service, an integrated database was constructed in a master table. There are two different pictures in Fig. 4 that show different screens for different services. Four modules for business were constructed such that they could be operated on the Web. However, other services were not allowed to use the 6 Sigma function. That is why the picture in Fig. 4 does not show 6 Sigma on the screen.
5. Conclusions

In this paper we propose a novel method for integrating existing software into a SaaS environment. We use a master table and master code to solve the associated problems. The master table is based on the project master table, and other user information tables are connected in order to organize user information. All information about the project is stored in each row of the project’s master table. The master table can integrate various software databases. By using this novel method, the existing ASP-based software and data can be effectively transferred to the SaaS environment.

It is expected that SaaS will provide a new software distribution stage because users can select and use the required functions on paying only a small monthly fee instead of purchasing the software at a high cost. The master table methodology could be a core technology in solving database problems that may occur in software integration.

Acknowledgments

This research was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (No. 2011-0027263). This research was also supported by the Ministry of the Knowledge Economy (MKE), Korea, under the Information Technology Research Center (ITRC) support program, supervised by the National IT Industry Promotion Agency (NIPA, 2012-H0301-12-3006).

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