



Research and Development of Vocational Education Service Management System Based on SAAS Model

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Abstract. With the rapid development of the Internet, a large number of vocational education software are emerging. Most vocational education and training institutions need to purchase or develop vocational education systems and deploy their own software and hardware environments, and there are some problems such as high software development cost, difficult maintenance and upgrading, etc. The vocational education system based on SaaS (Software-as-a-Service) mode changes educational software from traditional selling products into services. Training institutions only need to rent online educational services from software service providers, instead of purchasing a complete set of educational software at one time and maintaining the software system by themselves.

Keywords: SAAS mode · Vocational Education · Service management

1 Introduction

The full name of SaaS in English is “Software as a Service”, which means software as a service, focusing on services. In the traditional software market, software is bought and sold as “a product”. After purchasing a computer, users need to purchase corresponding software to use it according to their own business needs. Software providers also need to provide users with long-term after-sales maintenance and upgrading of software. In this special case, the software product is more suitable to be provided to users as a service, and the traditional C/S structure mode is transformed into a special C/S structure mode, namely B/S structure mode. SaaS model is a typical B/S structure model. The biggest difference between SaaS model and traditional software model is that customers don’t need to buy the whole software, but rent the software services of service providers instead. Software vendors deploy their software on their own servers and provide software application services to different customers through the network. According to their own needs, customers purchase and use the required software services from service providers, and pay fees to manufacturers according to the amount and length of service provided. In this mode, users don’t need to maintain the software, and manufacturers will have full authority to maintain and manage the software, which saves a lot of maintenance costs for customers. Nowadays, with the rapid development

of Internet technology, SaaS service mode has penetrated into all fields of computer industry. For example, Baidu and Google, our most commonly used search engines, are SaaS services.

2 Literature Review

The significant difference between SaaS technology and traditional software technology lies in the multi-tenant mode technology. As multiple tenants share an application instance, all data are stored in the database of SaaS server, so how to ensure the sharing and secure isolation of data among different tenants is a problem that SaaS service providers must consider. At present, there are three main schemes of SaaS multi-tenant database architecture: independent database, isolated data architecture of shared database and shared data architecture of shared database. Independent database means that one tenant corresponds to one database. This scheme has the highest level of data isolation and the best security, which can conveniently provide tenants with personalized needs. If the database fails, it is easier to recover the data. However, the disadvantage of this mode is that with the increase of tenants, the space occupied by the database will increase rapidly, resulting in very high deployment cost and maintenance cost. Therefore, this mode is only suitable for users such as banks and medical institutions who have very high requirements for data security and isolation. The independent database diagram is shown in Fig. 1 [1, 2].

The three modes have their own advantages and disadvantages. We compare the three modes in terms of sharing level, isolation level, security and cost, as shown in Table 1.

The tenants involved in this system are all training institutions in China, and the requirements for data security are not very high. Therefore, the cost factor of the current system will be the main factor in choosing data architecture. As can be seen from the table, the isolation level of shared database shared data architecture is the lowest. Although the backup and recovery of data of different tenants is the most complicated in this mode,



Fig. 1. Independent database diagram

Table 1. Comparison of three data structures

model	Sharing level	Isolation level	security
Independent database	low	high	high
Shared database, isolated data architecture	middle	middle	middle
Shared database, shared data architecture	high	low	low

this mode can support the largest number of tenants with the lowest cost, so this system chooses the mode of shared database and shared data architecture.

3 Methods

3.1 Analysis of Education and Training Market

In China, education has always been the focus of attention and attention. Good education can promote the rapid development of national productivity and enhance China's comprehensive national strength and international competitiveness. China advocates advocating science and deeply practicing Scientific Outlook on Development. Especially in recent years, the education and training industry has developed rapidly, involving academic education, primary and secondary education, IT education, foreign languages, finance, management, workplace and many other fields. As the saying goes, "It's never too late to learn." Nowadays, people are learning new knowledge all their lives, and human thirst for knowledge has greatly promoted the development of education and training market. The training market has been recognized as one of the most "financial picture" markets and a "sunrise industry". China has a huge population, forming a strong consumption potential. The training market has become the second largest market after food, and its market share is expected to reach 400 billion yuan. At present, the number of students in China accounts for 17% of the world, but the value of the whole education market is less than 3%. According to the World Bank's forecast, in the next 10–20 years, China will be the world's education and vocational training market with the greatest growth potential, with an estimated market size of 640 billion yuan by 2025 [3, 4].

3.2 Advantages of SaaS Vocational Education Services

Most online training institutions need to purchase a complete set of vocational education software at one time, or develop a set of education software by themselves. After obtaining the software, they also need to purchase and deploy the hardware environment by themselves, and they also need to recruit maintenance personnel to manage and maintain the education software. It takes a lot of costs from software development to successful online operation. Since SaaS educational software is available, training institutions no longer need to purchase software at one time, but rent corresponding software services from software providers as needed. After the service is purchased, training institutions can directly use the purchased service online as long as they have browser software, without installing and deploying other hardware environments. Software updates and maintenance are all handled by SaaS service providers. If users encounter problems during use, they only need to feed back the problems to the software service providers, instead of spending time and energy to solve them themselves. The software service providers will have professional maintenance personnel to deal with and solve the problems. In this way, the investment cost of users is greatly reduced, and users only need to pay the software rental fee, so the investment risk of users is much smaller than that of one-time purchase of software. SaaS service providers will provide professional security measures to avoid the leakage of user information.

3.3 Advantages of Software Vendors

SaaS-mode software service can provide users with software trial conveniently, so that users can directly experience the functions of software services, which reduces the sales cost of software. Software vendors can shift their focus from sales to marketing, and focus on various service functions of software. In the past, all the educational software purchased by the training institutions were deployed on their own servers. When the software vendors asked for help when encountering problems, the software vendors needed to send maintenance personnel to the site for maintenance. Moreover, each user's server hardware and software environment was different, and the problems encountered were also strange. This situation cost a lot of energy of the maintenance personnel, thus greatly increasing the maintenance cost of the software vendors. However, SaaS software is only deployed on the servers of software vendors, and the maintainers are familiar with their own servers. If they encounter problems, the maintainers can find out and solve them at the first time, which greatly reduces the maintenance cost [5, 6].

4 SaaS Software Features

SaaS software is different from traditional software in the following characteristics: Internet, multi-tenant and service.

(1) Internet features

SaaS service provides services to users through Internet browser or Web Services connection, so it has typical Internet characteristics. Therefore, SaaS service has higher requirements for network transmission quality, network speed and network security [7].

(2) Multi-tenant feature

SaaS service usually uses a set of system software to provide services for a large number of users (tenants), and many users use the service under each tenant. Different tenants have different requirements for SaaS services, which requires SaaS services to support data isolation and personalized configuration among different tenants, so as to ensure the data security of tenants and their personalized requirements for service functions, interfaces and processes. Multi-tenant feature is one of the most important core technologies of SaaS services, and the ability of personalized configuration under multi-tenant is one of the most important indicators to measure the quality of SaaS software.

(3) Service characteristics

SaaS model takes the Internet as the carrier, which changes software from commodity to service, and changes the form of purchasing software into the form of renting software services. SaaS model needs to consider the quality of software services, the number of service functions, service usage time, service cost and other issues, which are not considered by traditional software.

Table 2. Characteristics of four maturity models of SaaS

Maturity level	Configurable	High performance multi-tenant	extendable
first stage	no	no	no
second stage	yes	no	no
third stage	yes	yes	no
fourth stage	yes	yes	yes

4.1 SaaS Maturity Model

The three basic characteristics of SaaS are configurable, high-performance multi-tenant and scalable. According to whether SaaS applications have these three characteristics, we divide SaaS maturity models into four levels, and each level adds one of these three characteristics to the previous level, as shown in Table 2 [8].

4.2 SaaS Model Demand Analysis

There are thousands of training institutions in China. As a large-scale vocational education service platform, this platform will provide various vocational education services for these training institutions. Therefore, the system needs to ensure that the data of different institutions are isolated from each other and do not affect each other. After the database fails, it is convenient and quick to recover tenant data. Minimize the overhead of server resources and hardware costs.

4.3 Security Requirements

- (1) The system must control the access rights of each function.
- (2) The system should provide corresponding mechanisms to enable tenants to authenticate users within their own data and authorize users’ functions as needed.
- (3) Provide a mechanism to allow the administrator of each tenant to create, manage and delete user account numbers for that tenant.
- (4) To ensure the normal operation of the application, it is necessary to prevent virus invasion, set up a firewall, and ensure the confidentiality and integrity of data transmitted by the network.
- (5) Ensure that users’ business can continue to operate in the event of an accident in SaaS system.

4.4 Scalability Requirements

- (1) Scalable scale: When the number of tenant users of the system increases greatly, the system should be able to conveniently add tenant information and customize services for new tenants. The system should be able to conveniently improve the concurrent processing capacity and carrying capacity of the system from aspects of software performance optimization and hardware quantity increase.
- (2) Extensible functions: The system should be able to easily develop and expand new functional modules without modifying the original code [9, 10].

5 Conclusion

The key of SaaS mode lies in the multi-tenant mode. The tenants of this system are various education and training institutions or universities, and each institution has its own independent course portal. At the bottom of the system design, each institution rents the same set of software system instances and shares a database system, but it seems to user Mi that each tenant uses independent software that does not interfere with each other.

1. Combined with the multi-tenant and configurable characteristics of SaaS mode, the business process of SaaS mode is studied, and the system functional requirements analysis, SaaS mode requirements analysis and other requirements analysis are completed.
2. Combining the two characteristics of SaaS mode, the online education service platform architecture of SaaS mode is designed and completed. The SaaS multi-tenant data isolation model is studied, and the key technologies of SaaS multi-tenant model are designed. This paper studies the data configurable technology of SaaS, and designs and realizes the function configurable of SaaS with RBAC (Role-based Access Control) technology. The functions of each module of the system are designed, and the system includes four subsystems: portal website, teacher training, student learning and background management.

References

1. Dziembek, D. . (2020). Project management support systems in the saas model in the activity of virtual organizations. *Informatyka Ekonomiczna*, 2020(4), 93-110.
2. Sun, Y. , Dang, C. , & Feng, G. . (2022). Saas or not: optimal versioning strategy of releasing enterprise software. *Industrial management & data systems*13(3), 122.
3. Kumar, P. , Gupta, G. P. , & Tripathi, R. . (2020). An ensemble learning and fog-cloud architecture-driven cyber-attack detection framework for iomt networks. *Computer Communications*, 166(15 January 2021), 110–124.
4. MNDDL Guillén, Morales-Rocha, V. , & LFF Martínez. (2020). A systematic review of security threats and countermeasures in saas. *Journal of Computer Security*, 28(5), 1-19.
5. Nordam, T. , Litzler, E. , Skancke, J. , Singsaas, I. , & Johansen, I. . (2020). Modelling of oil thickness in the presence of an ice edge. *Marine Pollution Bulletin*, 13(1)56, 111229.
6. Cui, G. , He, Q. , Xia, X. , Lai, P. , & Yang, Y. . (2020). Interference-aware saas user allocation game for edge computing. *IEEE Transactions on Cloud Computing*, PP(99), 1–1.
7. Orji, J. C. , Gana, C. S. , Ezema, V. S. , Okenyi, E. C. , Ugwuanyi, C. S. , & Ngwoke, A. N. , et al. (2020). Assessment of the efficacy of creativity-based instructional model on scientific attitude in basic science and technology among pupils. *Global Journal of Health Science*, 1(2).56.
8. Yisihak, H. S. . (2021). Leader’s role and its effect on organizational change: the case of federal technical and vocational education and training institute. *IJERT-International Journal of Engineering Research & Technology*,06(2)42.
9. Al, R. . (2021). Social learning management system (slms) for technical vocational education and training (tveter) program with filtered foul words. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, 12(3), 5290-5296.

10. J Sánchez-Prieto, Trujillo-Torres, J. M. , M Gómez-García, & G Gómez-García. (2021). Incident factors in the sustainable development of digital teaching competence in dual vocational education and training teachers. *European Journal of Investigation in Health Psychology and Education*, 11(3), 758-769.

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