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Proposal of Cloud Computing Platform for Enterprise Comprehensive Risk Management

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Abstract: The paper focuses on the studies of enterprise risk management information system. It integrates the risk management information and other business management information for enterprise risk management improvement. It also provides a comprehensive and accurate record of enterprise risk management. A data warehouse is useful for decision supporting and statistic of research. The cloud computing platform based on a database is designed for quick delivery of enterprise operational and administrative information for risk management department. For an enterprise, it is incapable of constructing an independent information system which results in high construction cost and waste of resources. In existing enterprise risk information system, the sharing of information and integration of management are limited in the internal of an enterprise. The proposal platform is based on cloud computing, which get the advantages of low cost, high resource utilization rate, high-efficiency of risk information processing, convenience for multiple level using and for the information interaction between the business management and the risk management, etc.

Key words: Cloud computing, risk management, information system

INTRODUCTION

In China, "Central enterprises comprehensive risk management guidelines" (The state owned assets supervision and Administration Reform (2006) 108 article) clearly states: "the enterprises should apply the information technology into every period of risk management to establish the risk management information system covering all aspects of the basic flow and internal control". Therefore, in terms of comprehensive risk management of state-owned enterprises, a management information platform is of high significance to adapt to its supervision and operation and enable to promote the risk management organization and speed up succulent response. Meanwhile it can also propel the continuous operation of comprehensive risk management system in favor of establishing a complete conception.

In recent years, cloud computing is wildly applied in the field of IT. It is forecasted that the global cloud computing will account for more than 30% of IT annual investment in 2013 (Leavitt, 2009). Therefore, users can get the application software and compute easily while surfing the Internet. Consequently, it will bring revolutionary changes and form a new trend for IT industry development.

Therefore, in this paper, it studies on comprehensive risk management information system framework of state-owned enterprises in application of cloud computing technology.

CLOUD COMPUTING SYSTEM

In recent years, cloud computing technology has been rapidly developing in information field (Leavitt, 2009; Armbrust *et al.*, 2009), which embodies a new concept for the design and implementation of distributed new management information system. Cloud computing is a super computing model through virtualization technology with the help of network carrier to provide infrastructure, platform, software and other services, integrating and coordinating massive distributed computing resources such as data, storage, computing application and so on (Wu *et al.*, 2009). In cloud computing pattern, users don't have to buy complex hardware equipment and software application, only need to rent service from "cloud computing" service provider, through which they can get the their wanted resources and services such as information storage and computing from the internet.

Michael Armbrust and the others from University of California at Berkeley define the cloud computing as: "cloud computing include what over the Internet is known as Software as a Service (SaaS) and the others applications of various service form and the hardware and software facilities for data center these services based on, that is to say cloud computing is just the combination of SaaS and computing utility. (Armbrust *et al.*, 2009) " While Rajkumar Buyya and the others from Melbourne University define the cloud computing system as: " the cloud is a parallel and

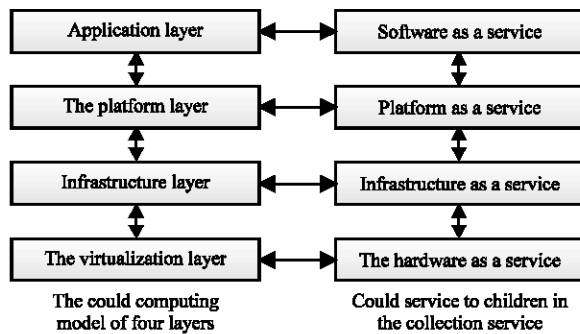


Fig. 1: Cloud computing system

distributed information processing system consisting of a collection of unified computing resources and interconnected virtual computer network, which is dynamically provided based on the service

level agreement (SLA) determined by service providers and users. In short, cloud computing is a computer information service system adaptable to the development of Internet. It's a parallel and distributed system by means of the internal connection and virtualization to represent one or more unified computing resource and it can realize the automatic configuration with "service" as the ultimate goal (Buyya *et al.*, 2008).

The IBM researchers give the definition of cloud computing from two aspects of broad sense and narrow sense. the narrow definition of cloud computing refers to providing users the services of network server, storage and others of cyber source level through the internet, namely Iaas, which is similar to the concept of PaaS, SaaS; But the general level of cloud computing includes each aspect of the service through the network, as shown in Fig. 1.

As a new method of sharing computing resource, cloud computing can connect huge systems to provide a variety of computing services. At present, Amazon, Google, IBM, Microsoft, Sun and other companies put forward the cloud computing infrastructure or cloud computing platform, mainly including cluster management and control system (Cluster), large scale of distributed database (Big Table) (Chang *et al.*, 2006) Google File System (GFS) (Ghemawat *et al.*, 2003), distributed data concurrency control system (Chubby), distributed parallel computing system (MapRe-duce) and the work queue system (GWQ) (Dean and Ghemawat, 2004; Lammel, 2008) and other systems, which are independent but linked closely. Thus, the emergence and rapid development of cloud computing result from the development of virtualization technology and data intensive computing technology, but it also becomes the inevitable trend of Internet development and application and distributed

system on the other hand: It's realized by reading the specific data needed and carrying out the analysis in the mass data storage based on distributed data storage in order to provide users with efficient on-demand service.

PROBLEMS OF TRADITIONAL COMPREHENSIVE RISK MANAGEMENT IN STATE-OWNED ENTERPRISE

In traditional risk management, there are many problems for the comprehensive risk management in Chinese state owned enterprises, including.

Limitations of traditional means of supervision and information processing method:

In China, the state owned assets supervision and administration institution under the State Council shall perform the contributor's duties of supervision and administration on state-owned assets of enterprises. Therefore, for a large number of state-owned enterprises, the traditional supervision and information processing is difficult to dynamically detect and open out the risk situation completely, or limited to reflect comprehensive risk information. It's difficult for users to get hold of key information timely to make rational decisions.

Limited managerial staffs, enterprises' wide distribution and multilevel regulatory difficulties:

Whether the national regulatory authorities or the state-owned enterprise risk management are concerned, they both face the problem of limited managerial staffs. Consequently, the traditional inspection and audit supervision is difficult to achieve multi-level risk supervision between national regulators and enterprises, enterprise and its sub (Branch) company.

Interactive fusion between risk management and Business information:

In China, most of the state-owned enterprises have established office automation, production management, safety management and ERP system management information system to some degree, but due to various kinds of information systems built in different periods, the realization techniques and methods are different. Most of systems can't realize effective integration or collaboration, so the business information can not realize real-time interaction and fusion.

Disconnecting risk management and business process:

According to the COSO "enterprise risk management- integrated framework" and the SASAC "central enterprises comprehensive risk management guidelines", the implementation of state owned

enterprises' comprehensive risk management usually set up a special risk management institution to achieve risk control purpose through the implementation of risk control system. Therefore, risk management and business process is relatively independent and cannot fully reflect the risk control requirements in the business process.

CLOUD COMPUTING PLATFORM OF RISK MANAGEMENT FRAMEWORK

Enterprise comprehensive risk management integrated information system by cloud computing system can be divided into three layers on the basis of cloud computing framework in general, which shows as Fig. 2. The presentation and application layer forms the module of software as a Service (SaaS) and information sharing and integration with the various business systems constructs platform as a Service (PaaS).

Presentation layer: The information service platform on presentation layer could provide the users the overall situation of risk identification, risk assessment, risk strategy, risk control, risk management and evaluation and other comprehensive risk management elements via defining clients 'access interface in methods. Moreover, the user can also obtain the risk profile, early warning and other basic information service.

Risk profile: Risk profile information service platform will show users enterprises' overall risk distribution and

the relevant information in key area as well as the overall dynamic information of the overall risk change. Meanwhile, the risk distribution comparison for enterprise or the subordinate unit can be provided, too.

Risk early-warning: According to the risk degree, risk events frequency, duration of risk events and the specific warning model, the system can give early warning of risk changes and release real-time warning information through the platform.

Operation: Statistical analysis can be carried out on risk control within system, synthetically reflecting the overall evaluation result including the problem of system suitability, effectiveness and other aspects in the operation process of comprehensive risk management system. And it can provide users information query, retrieval service through this information platform.

System construction: System reflects the construction status of comprehensive risk management system in the enterprises or the subordinate construction company and facilitates the communication to promote system construction and.

Application layer: The application layer reflects the main functions of the comprehensive risk management platform. According to the elements in the process of comprehensive risk management, the comprehensive risk management platform should be rooted in the process of

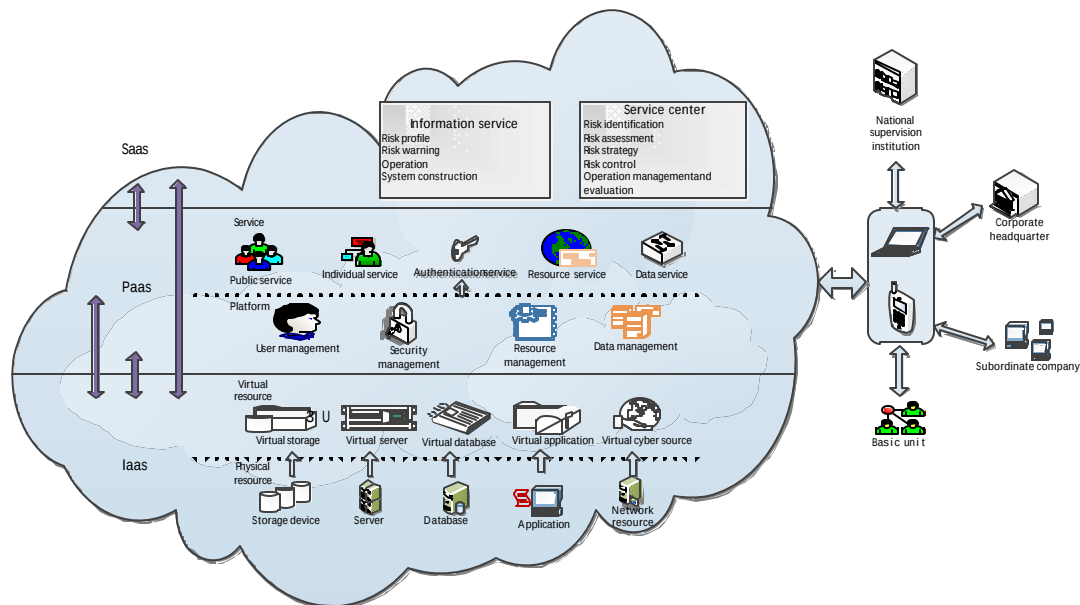


Fig. 2: Enterprise risk management information platform based on cloud computing

business management, including risk identification, risk assessment, risk response and control, risk management evaluation and the function of operation monitoring and evaluation.

Risk identification: Risk identification can deal with the description of risk source, function scope, the events and consequences and other information. Thus, complete risk inventories of enterprises can be built, which will promote the form of risk source databases and provide the basic information for the follow-up risk management.

Risk evaluation: Risk assessment can realize the evaluation of the risk source condition, the influence of potential consequences of risk source on the degree of goal achievement and the residual risk information after taking some measures. According to the different business units, the functional module would be embedded in one or more corresponding risk assessment models.

Risk response and control: This function module can provide the knowledge base for risk response strategy and offer an implementation tool to streamline and standardize the risk control process. Risk management department identifies the coping methods such as avoidance, reduction, sharing and tolerance, etc on the basis of assessment results, in the form of standard workflow to ensure full implementation of the policies and procedures.

Evaluation of the risk management: This function module automatically generates scores on risk management system implementation check and control and produces ranking and rating information. Thus, on one hand the user could understand the degree of meeting requirements in each stage of enterprises' risk management implementation procedure in order to improve the whole working level. On the other hand, users could also master necessary information with regard to the compliance of effective risk management system to enterprise risk actuality for system continuous improvement.

System operating evaluation: According to the relevant data of the comprehensive risk management, the users should deal with the overall situation of risk management objectives, tasks and the safety performance, the condition of risk control and occurrence, the assessment results of risk management, the previous tracking measures and effects of evaluation, the possible reason of affecting the change of risk management system and the final improvement suggestions and resolutions.

Platform layer (PaaS): PaaS is actually a software development platform as a service provided to the user. In other words, it can be used as the application of SaaS model. In the view of service providers or users, there are two kinds of perspectives about the PaaS. For one thing, Cloud provider can deliver a platform through the integration of OS, middleware and application software, or a development environment; while PaaS users will have a package service through API for interaction with the platform. No matter what kind of views, PaaS provides the intermediate platform for enterprise development and customization, including database and application server to realize business management and risk management completion on the same information platform for basic information interaction. And the utilization rate of resources on the Web platform can be improved at the same time.

For example, the Web remote service data as a service (Data-as-a-Service), can be realized by the visualization of API and PaaS platform such as 800app can even mix and match the other platform for personalized applications, users do not need programming and on the same system platform they can realize the operation online immediately including office automation, supply chain management and risk management etc. Definitely it also includes information interactive in two-way and software services and provides users public service, personalized service, authentication service, resource service and data service. Thus, the user or manufacturer can easily develop and run their software solutions on a cloud platform without any cost and complexity of buying and managing the underlying hardware and software layers and the application can better realize the architecture of enterprise application based on SOA.

Infrastructure layer: Infrastructure as a service is called IaaS (Infrastructure as a Service). In the most basic cloud-service model, supplier will offer computers physical or virtual machines and other resources on demand from their large pools installed in data centers to all levels of users for data processing, storage, networks and so on and it can get working load calculation application from the application components to the computing applications of high performance, optimizing the allocation of resources. Cloud users can install operating-system and their application software on provided infrastructure. they can choose the operating system, control the storage space and the deployed applications and get the limited network components including the fire wall, the load balancer etc. IaaS is divided into the public model and the private model. Under the public model, infrastructures are shared by

multi users, such as the use of public server pool in the infrastructure cloud. While under the private mode, a group of public or private server pool of the enterprise data center is used. The combination of the two models is conducive to completing the development of comprehensive risk management application more quickly and improving the efficiency of development and testing.

FEATURES OF CLOUD COMPUTING PLATFORM FOR COMPREHENSIVE RISK MANAGEMENT

The cloud computing platform of comprehensive risk management is an information solution program with the characteristics of distributed processing and generalized cloud computing and the advantages of concentrating on the construction, resource saving, centralized deployment, in favor of multistage application.

Advantages of cost, utilization rate and the low risk of infrastructures: The cloud service provider has a huge infrastructure group, so the enterprise data center can use the public cloud to deal with the overflow of load peak, the growth of business data, the work load peak to reduce the economic risk; In addition, the infrastructure, the platform and the application program are all released and the only expense is determined by the service period and storage space and the cloud service provider's cost amortization and economies of scale make the user's consumption costs to a minimum.

Central deployment to facilitate the overall information construction of comprehensive risk management for multiple users: In view of cloud services characteristics, national supervision institution can lease and deploy each cloud service comprehensive risk management system required through the cloud computing platform. Every state-owned enterprise (Group) develops its own comprehensive risk management application software on the same platform and reported to the national supervision institution according to the unified data standard. Thus it is convenient to realize the applications from different levels of enterprises to the national supervision institutions.

Shorten the operation time and response time; improve the efficiency of risk information processing: To cope with the analysis and response to the risk data of comprehensive risk management in various fields for multi users, cloud computing platform can use 10,000 servers in the 1/10000 time that a single server is required to

complete a computational task, it greatly shortens the runtime of the system and corresponding response to high requirements of users. The application can be any CPU intensive task to the virtual machine process, thereby optimizing response time.

In favor of the information interaction between the business management and the risk management, improving the level of risk management: The cloud computing platform of comprehensive risk management can adequately realize the information interaction and integration between risk management and business management in different business management. For one thing, it can achieve the integrated processing and utilization of business information in various fields, avoiding data sharing difficulties and the low degree of information coordination among different information systems; on the other hand, it also helps to fully implement the risk management in business activities.

Comprehensive examination and analysis to promote the overall efficiency and effectiveness of comprehensive risk management: By means of the cloud computing platform of comprehensive risk management, the users can carry out the comparison between the data from the service platform system and that from the risk management standard library, then obtain the risk early warning and control assessment automatically and send the related information to the user terminal of the enterprises and the national supervision institutions at first time, so that the risk information and assessment can be responded without any space limitation, even for mutual response. At the same time, the statistical analysis and evaluation results of all levels can be reached for promoting independent dynamic mechanism formation in the process of enterprise comprehensive risk management.

CONCLUSION

The enterprise risk management information platform is constructed based on the four layers cloud computing structure. It provides a tool for information processing and flow controlling in enterprise risk management, which includes risk identification, risk evaluation, risk response and control, the evaluation of the risk management, etc.. Especially, the cloud computing platform provides conveniently interactive information process between enterprise operation and risk management for various administering authorities, which will save great cost and improve resource utilization rate enormously and the efficiency of risk management, etc.

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