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Enterprise Business Processes System Analysis and Design

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Abstract

At present, more and more enterprises or departments seek to extend the application of information technology to the more complicated business processes, these business processes are characterized by a number of business activities, capable of handling multiple business objects, business logic and business rules complex. Thus, the enterprise business process management system arises at the historic moment. Enterprise business processes management system is not only a software product that provides a single function, but also you can customize for the different areas of the business process according to user's actual business needs. In the process of management platform, Process simulation for the process simulation module is put forward based on probability analysis, and for the process modeling module, more collaborative process modeling technology is put forward. In the business application layer, process monitoring application based on application driven is proposed. Positioning in the implementation of enterprise business process management system for business process simulation software implementation or, as well as to simulate the processes or processes of monitoring, diagnostic analysis and optimization. The innovation points of system design lies in three aspects: process simulation based on probability analysis, multiplayer collaborative process modeling technology and based on application-driven process monitoring.

Keywords: *enterprise business process; system design; probability analysis*

1. Introduction

At present, more and more enterprises or departments seek to extend the application of information technology to the more complicated business processes, these business processes are characterized by a number of business activities, capable of handling multiple business objects, business logic and business rules complex [1]. Combined with the current enterprise to BPMS product actual demand, this paper puts forward a business process management function model, and then based on the model, and gives the business process management prototype system structure, by introducing the event driven mechanism to complete the interaction of all related business process [2].

With the progress of science and technology, people's living standards improve, people's demand is fast changing, enterprise business environment and there are changes in the market competition are increasingly fierce. Enterprises want to survive in a changing environment and fierce competition must be on-demand, constantly adjusting and optimizing the various business processes of enterprises, to refactoring process. The use of information technology can accelerate the enterprise process reengineering, to achieve effective and orderly management and high degree of flexibility [3].

Within the enterprise business process management system for enterprise and enterprise between the various businesses to provide a unified modeling execution and monitoring

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environment. The platform needs of enterprise business process management system have a framework of enterprise application integration based on business process management. Enterprise applications integration is the Enterprise in the implementation of all kinds of information system after the inevitable demand. EAI is to focus on the purpose of the enterprise information system resources, including data resources and capabilities resources, reduce duplication of investment, reduce the data and function redundancy of data conflict and conflict. EAI's methods of implementation can be divided into four layers which include data integration, function integration, integration based on agent and service-oriented architecture. However they all cannot avoid data and function conflict bringing by data and function redundancy. So in order to manage services offered by various application which from inner business, we introduce BMP into enterprises. Further, these services can be coordinated and the enterprises' application integration will be achieve [4].

2. The Position and Function of the Business Management System in the Enterprise Informationize Process

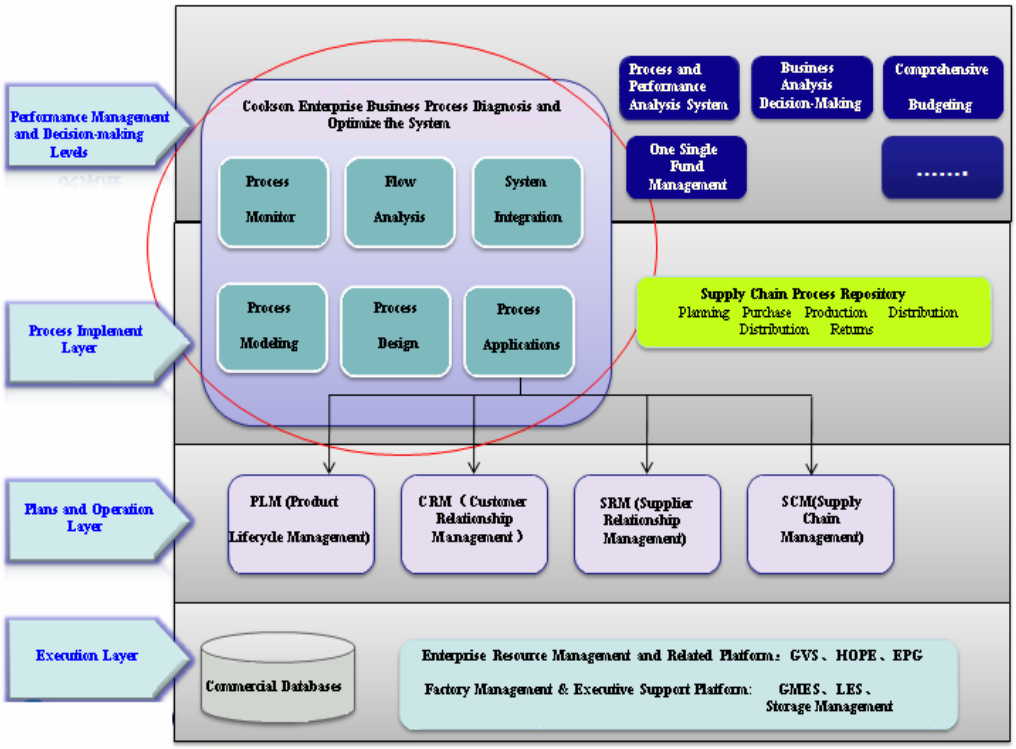

Figure 1. The position of the business management system in the enterprise informatization

In the whole information system of enterprise, enterprise business processes management system achieves management of person directly, and often integrate with other professional systems. So we usually divide the system into two layers (process implement level and performance management and decision-making level [5]) when make a classify about the it. The figure (Figure 1) take the large manufacturing enterprise's information system structure as an example and show the position of the enterprise business processes management system:

Not only enterprise business processes management system is a software product that provides a single function, but also you can customize for the different areas of the business process according to user's actual business needs. The manufacturing enterprise's core business process includes: market marketing (marketing management, and sales, and customer relationship), and product development (design development, and technology management, and customized products), and supply chain (plans, and procurement, and manufacturing, and warehouse transport), and technology service (technology response) etc. Its management process includes: human resources (leave position and into position, and assessment, and leave), and fixed assets (in and out baggage, and allocated, and obtaining and using), and finance (budget, and expenditure, and payment), and IT service management (resources bid, equipment repair) etc. On one hand, platforms can make the regulations originally existing in the documents or in the manager's minds "landing". Further, we can turn the regulations into software, then, go a step further to form rigid constraints of the implementation.

On the other hand, we can monitor and analyze the "landing" process to find the "bottleneck" and "redundant", thereby optimize the process and improve the management performance.

Enterprise business processes management system planning will face two directions:

To solve a single management or business professional tools and customize the standard process model in the area, provides to the users products and features of "buy and play", such as process and performance analysis of supply chain systems.

Solve all management and business process of generalization platform [6]: to provide the platform to the end-user or the third-party developers, who is responsible for the design process, and according to user's actual needs of development, keep on expansion and ongoing maintenance of the process.

3. System Design Scheme

Enterprise business processes management system architecture is divided into three levels, namely, business application layer, process management platform, and professional application layer, as shown in Figure 2.

The entire software application system based on process management platform and system manifest as construction of hierarchical systems [7]. Process management platform consists of eight components: The workflow engine, Process database, Business process database, Application integration interface, Process modeling module, Organization design module, Configuration tool and Process simulation modules.

The workflow engine. The workflow engine handles circulation of all automated processes, supports server clusters to improve performance and reliability [8].

Process database. Process database as data persistent storage entity of process management platform, include process model database, the rule model database and the process instance database, and so on.

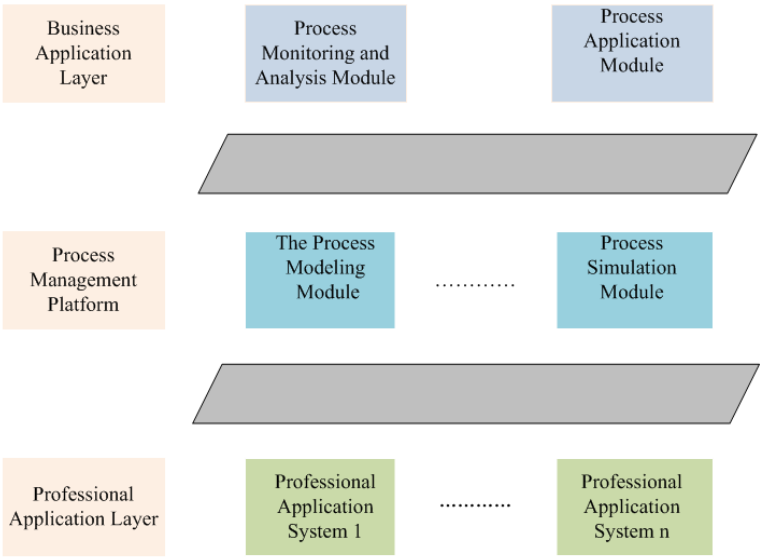

Figure 2. Enterprise business process management system architecture

Business process database. Business process database is used to store and manage plentiful and numerous process business data. The data is from artificial entry of the management process or from extraction of other professional application system.

Application integration interface. Application integration interface is the standard interface provided by the system. It can make remote calls and data exchange with the available software systems. System itself embeds access mechanism with the common database. You just need to make a simple configuration, then you can view or modify the data inside the flow chart from the available system.

Process modeling module. Process modeling module is the collaborative process design and development environment. In a single integrated environment it combines with the characteristic of process development and form design. Users can easily create forms, define business logic and integrate database, etc without programming or writing a script. It has the following features:

Graphical development: graphical realization of the process complex rules, minimizing code development;

Version control: the user designers can use the design tools from the business sector's demand to provide strict access control and process version control;

Multiplayer collaborative process modeling technology: The key of multiplayer collaborative process modeling is "partitioning" of process, that is, during the description of the process model, you should create a "process partitions" object, all operations on the process should also establish on a partition. The model structure is shown as Figure 3.

Process modeling module is C/S Structure, after different client connect a service, in editing process or a process partition. First of all, you want to "check out" operation, at the server-side you can lock the process or processes partition. In this way, other clients will not be able to simultaneously edit the same process or a partition of process. When you complete editing, you can proceed to "check in" operation to release the lock and in order to other clients perform the "check out" operations.

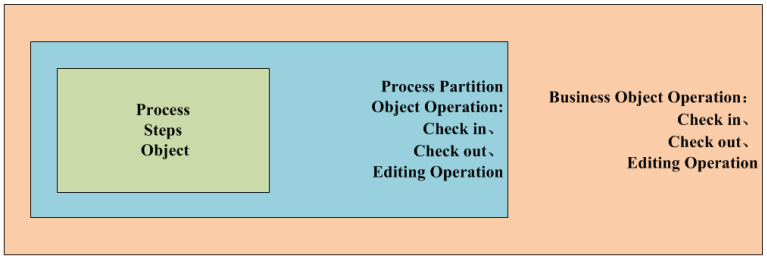

Figure 3. More collaborative process modeling structure

Organization design module. Organization design module used to build the organization chart of unit process for users, it has the following features:

Identify the relationship between the people involved in the process and the roles realize the role transfer function;

Provide a variety of working groups (weight ratio workgroup, priority workgroup and work queue, *etc*.), and meet the various requirements of process automation, such as countersign;

A lot of Substructure organizational structures can be nested a large organizational structure to satisfy the complex construction of organizational structure;

Support a variety of directory services, such as MSAD or other LDAP compatible user management, you can use the user's existing user rights management mechanisms, without having to create a separate user management.

Configuration tool. Configuration tool is used to implement the client program and database connection settings, process version control, process and instance delete functions, etc.

Process simulation modules. Process simulation modules, before the process simulation, first of all, the user draw a flowchart base on actual business processes, and based on statistical data actual of implementation, setting the properties of each step, such as people (resources) quantity of execution steps, rate, completion timeframes and the rewind percentage of task, and so on. And according to the actual situation, set up the simulation process parameters such as the frequency, the number of simulated processes; proceed simulations, you can intuitively observe each step load in a graphical manner, and simulate implementation progress. After the simulation completed, analog data, by ways of report, you can evaluate various indicators of the processes and the different steps of the process;

Process simulation based on probability analysis: Before process simulation analysis, to input the scene parameters, these parameters include: process for the launch of the frequency, each step of number of handle people or equipment, step to takes, steps to deal with rates, rates of return, *etc*.. The actual circumstances, the actual values of these parameters could not be constant, but in line with normal distribution of certain statistical laws. Therefore, if analysis with constant as a parameter value, input is relatively simple, but between the results of monitoring and analysis and the situation are often larger deviations.

Enterprise business process management system based on the principles of probability theory, design a professional process simulation modules. Its principle as shown in Figure 4: Workflow engine of system has two kinds of working condition: normal working condition and simulation working condition. In normal working condition, workflow engine with an interval of fixed minimum poll task queue, after process routing judgment and submitted to the next step; In the simulation condition, workflow engine in the polling task queue, will through the random

number generator, according to the mean and standard deviation of user Settings, get an experimental value of conform to the normal distribution. First of all, according to experimental data delay, and then submit processing, and with the actual working condition height consistent.

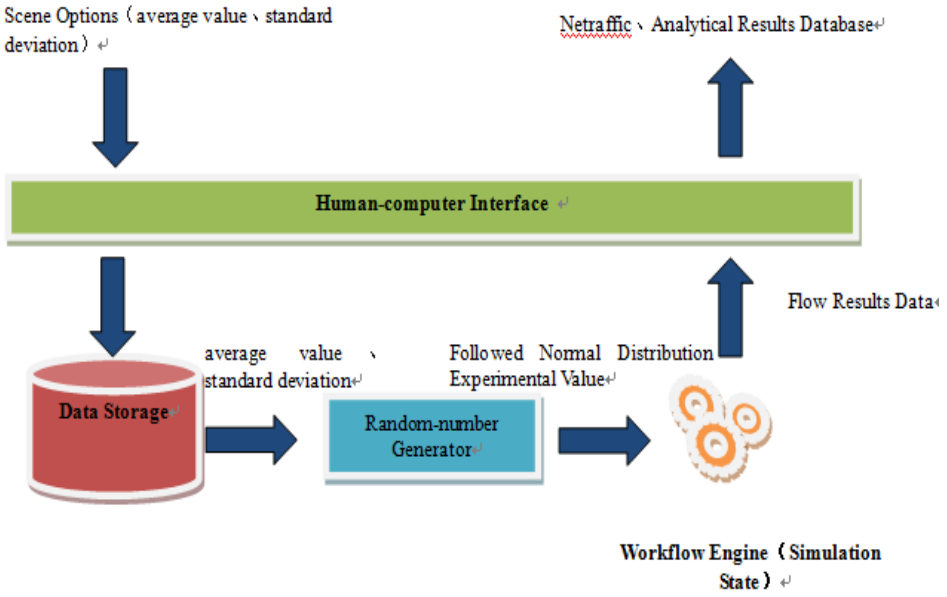

Figure 4. Schematic diagram of process simulation analysis

In process management platform, Process simulation for the process simulation module is put forward based on probability analysis and for the process modeling module, more collaborative process modeling technology is put forward. In the business application layer, based on driven process monitoring application is proposed.

Taking energy management of fiberglass manufacturing industry as an example, analysis and verification is conducted in this paper.

The important and difficult section of this example is the part of analysis and forecast management. In order to make effective prediction about the data that has yet produced and draw up energy consumption plan, the analysis and forecast management mainly makes effective data analysis for the historical data by the means of mathematical model. Enterprise energy available is the sum of production of energy products, volume of receipts and inventory. A moderately numerical limit-ratio is limited between available and requirement about enterprise's energy. The production and operation of one enterprise can be considered reasonable if and only if the ratio is proper. We can use the following formula when make a concrete analysis:

Ratio of energy supply and demand= energy available/Energy demand expected

Currently, we take the mathematical method of moving weighted average method: this method allocates equal weight to each variable which is limited in the fixed spanning-period. The principle is: the effect about the prediction of the future-phase's requirement-volume is different and the requirement-volume is based on the data information demanded in each historical period. Except the variable value of n cycle, the influence of variable value that away from the target value is relatively lower. Therefore, we give it less weight. The formula is as follows:

$$Y_{n+1} = \sum_{i=n-k+1}^{n+1} Y_i x_i$$

Type of Y_{n+1}-weighted average of the n+1 phase.

Y_i-actual value of the i phase.

x_i-weight of the i phase(the sum of weight is equal to 1).

n-Current period.

k-Move across the stage.

We can make data analysis using this formula. The formula is flexible and effective. The weight can be set dynamically by system. The cycle is variable. According to users' requirements, weights can be chosen freely by month or by year to analysis. Data volume can be big or small. We can make year-prediction about the energy consumption of this year at the beginning of the year. Meanwhile, we also can make month-prediction by the reference of historical months' data. In order to achieve the best effect, balanced energy supply and demand analysis is conducted in the performance management.

The ratio of energy supply and demand about the fiberglass is one analyzed result of energy supply and demand simulation which is based on the probabilistic statistical method. And we take it for an example (set energy available is less than energy demand expected or equal to energy demand expected). Assume that in the same boundary conditions in to simulat test n times, the simulation results for the $x_1,x_2,\cdots,x_n$ (x_i is the i test results from the simulation). First assume that every time the simulation test are independent of each other, and under the same conditions, assuming $x_1,x_2,\cdots,x_n$ have the same distribution. In order to determine the $x_1,x_2,\cdots,x_n$ probability distribution, [12] the central limit theorem in probability shows that independent of each other and with the same distribution sequence of random variables $x_1,x_2,\cdots,x_n$, [14] when n is large enough, the standardization of random variable factor ξ_i asymptotic obey the standard normal distribution N(0, 1), thereinto:

$$\xi_i = \frac{\frac{1}{n}\sum_{i=1}^{n} x_k - u}{\frac{\sigma}{\sqrt{n}}}$$

A type of μ, σ is of the mathematical expectation and variance of random variables x_i. So by the basic properties of the normal distribution, the random variables

$\frac{1}{n}\sum_{i=1}^{n} x_k - \mu$ must be gradual to obey normal distribution $N(\mu, \frac{\sigma^2}{n})$.

By the simulation results of the mean to estimate μ, due to just one point, there is error is inevitable. If we allow little deviation to ε> 0 is limited, from $\overline{x} - \varepsilon$ to $\overline{x} + \varepsilon$, when the ε greater, give a person the sense of trust greater, such as 0 ~ 100% energy supply and demand, is reliable for sure, but it is too rough. According to the theory of interval estimation principle is: fully use the sample data, to ensure reliability, then try to improve the precision under this premise. A given α (confidence level) and ε (precision), and requirement

$$P\left|\left[\bar{x}-\mu\right]\le\varepsilon\right|>1-\alpha$$

.

When the sample drawn from the normal distribution overall $x_1,x_2,\cdots,x_n$, μ and σ^2 are all unknown, request μ interval estimation. The point estimation of μ for the sample mean $\bar{x}$, σ by sample standard deviation S, estimates the variables $\sqrt{n}(\bar{x}-\mu)/S$.

$S=\sqrt{\frac{1}{n+1}\sum_{i=1}^{n}(x_i-\bar{x}^3)}$ obey the distribution of tn-1, and the parameters of the μ, σ

has nothing to do. In addition: $t_{n-1}(1-\frac{\alpha}{2})=-t_{n-1}(\frac{\alpha}{2})$.

Then, in the confidence level 1-α, μ of interval estimation is shown below.

$$P\left\{\mu\in\left[\bar{x}-S\cdot t_{n-1}(\frac{\alpha}{2})/\sqrt{n},\bar{x}+S\cdot t_{n-1}(\frac{\alpha}{2})/\sqrt{n}\right]\right\}\ge1-\alpha$$

If meet the above formula, it can make $\varepsilon\ge S\cdot t_{n-1}(\frac{\alpha}{2})/\sqrt{n}$,Then there

are $n\ge\frac{S^2\cdot t^2_{n-1}(\frac{\alpha}{2})}{\varepsilon^2}$.

Obviously, the number of simulation experiment is inversely proportional to the square of the allowable error, the requirements of the error are smaller and the simulation experiment is more.

According to historical data, determine the experience value of σ, replace the S, with the results value on the basis of the exist of simulation calculating S.
Approximate we can take $t_{n-1}(\alpha/2)=2.00$. Think a table of t distribution points, when the $\alpha\leqslant0.05$ or n>30, can take $t_{n-1}(\alpha/2)=2.00$, which has a little influence on the values of n>30. So when we calculated n>30, with the n as a number of simulation test, when calculate the n is not greater than 30, is needed to determine the "test method". With n-1 as the degrees of freedom (n is not less than 3), checking up t distribution points to obtain a meter ($\alpha/2$) quantile $t_{n-1}(\alpha/2)=2.00$, use to $n\ge\frac{S^2\cdot t^2_{n-1}(\frac{\alpha}{2})}{\varepsilon^2}$ calculate, repeat the process, until the adjacent two difference is small, if the resulting still less than 3,then n = 3.

According to production plan and maintenance plan, historical average state of the power and energy consumption, energy supply and demand schedule for guiding energy system according to the plan to organize production, to the main line to provide the supply and demand required amount of energy.

Business application layer: Application process provides a wealth of features, including: launch process, treatment process flow control, process monitor function, *etc*… It has a high level of maintainability and scalability. After the system is put into operation, users can create the new processes through a simple operation, modify the existing processes; Process monitoring analysis reports provide wizard-style without assessment report of code development performance, such as: instance spent time reports, procedures time reports, user activity reports flow, workload reports and other reports, monitoring and analyses aspects of from processes and circulation of the process instance, to achieve the purpose of evaluation and optimization [9].

Professional Application layer: Professional application is third-party development, professional applications operation in the enterprise systems of user, such as: ERP Systems, HR systems, financial systems and so on. In the process of operation the system will generate a lot of regular data. After the implementation of process management system, through a unified interface, you can access to these system data, such as: integrate financial data that already exists in the approval process, *etc*.

Process management platform provides application integration interface, and to exchange data with process business databases and other existing business database. Users through process modeling module for process design, through simple configuration, implement these new data displays or modifies data in the form.

Based on application-driven process monitoring: In order to ensure real-time and easiness to obtain data information, traditional process monitoring can only be achieved in the application system making the process run. However, because the business process contained in the traditional process applications system is not comprehensive, it difficult to achieve a complex and comprehensive business process monitoring and analysis.

This project firstly propose process monitoring based on application-driven, and make the monitor-process get rid of the third-party process applications. And the process monitoring bases on WebService Technology [10], provides standard interfaces of the launch, submit, cancel, and so on, included the surveillance process. It also achieves monitoring, analysis, and optimization cross-system processes [11] Through process monitoring technique based on application-driven, the business in the enterprises split into fragments by different software systems and section can execute “butt”. So we can analyze the process wholly.

4. Summary

Enterprise business process management system targets at simulation and software implementation of the business enterprise processes, as well as monitoring, diagnostic analysis and optimization for the simulated process or actual process. Its purpose is to help enterprises’ managers make more effective process regulations, and find "bottlenecks" and "redundant" of the available management-process, thus elevate management-performance continuously and improve the executive power of enterprises.

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