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# Enterprise Information Engineering Utilizing Enterprise Modeling with Quality Function Deployment*

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**Abstract**

Because of the lack of methodology, there are many difficulties in the requirement analysis phase and system design phase of the enterprise information engineering. An enterprise business driven method of the analysis of information system's business requirement, utilizing enterprise modeling, is proposed based on the idea of the total solution of enterprise informatization. Utilizing the method of Quality Function Deployment (QFD) to link the business requirement with the function structure of information system, the implementation approach and decision principle are also proposed for the requirement anaylsis phase and the initial design phase of the information engineering.

*Keywords:* Enterprise Information Engineering; Enterprise Modelling; Quality Function Deployment; Software Engineering

## 1. Introduction

It is attached importance to by more and more enterprises that strengthening the enterprise competency through using the information technology to rebuild and advance the tradition industry. To drive the industrialisation by informatization has become the self-conscious operation and goal of most enterprises. However, enterprise information engineering is a very complicated engineering, especially during the phase of requirement analysis and system design. There still exist many difficulties and lack of methodology, including: it is very difficult and boring to start the collection and analysis of the information system requirements at most time, thus, the function modelling process of information system depends on the experience greatly; because there has no effective method to guarantee the consistency between the requirement phase and design phase of system, the results of requirement analysis are mostly distorted or abandoned and the product is disjointed with the requirement finally; in design process, the so much attention is paid to the realization of system function, that the flexibility and reusability can't be taken account of sufficiently.

Aiming at the above problems and based on the the idea of the total solution of enterprise informatization[1], an implementation approach of enterprise information engineeing utlizing enterprise modeling and QFD (Quality Function Deployment) is proposed facing the requirement analysis and initial design phase.

## 2. Business-driven requirement analysis of enterprise information system

During the traditional software requirement analysis process, the first thing is function modelling and to build the functional structure or use-cases of software system. But, most of the system analysts are not able to face the great difficulties when confirming the system functions and structures directly. In fact, enterprise information system takes the role of one type of enterprise resource to operate enterprise business process. The dialogs between the operator and the information systems, and the operations between systems themselves compose the enterprise business processes. The business requirements of enterprise are the direct requirements of information systems, and the functions of systems are the result of abstraction and trimming of these business processes. Thus, functional requirement analysis of enterprise information systems should start with the business modelling and analysis.

Enterprise model affords the abstract of the enterprise information, especially the business information. During the requirement analysis phase of the enterprise business driven information engineering, an enterprise model, facing the whole life cycle of enterprise products, should be built at first. This model regards the business process model integrated with enterprise organization structure and resource structure as the core part, in order to analyze, diagnose and optimize the enterprise business with the model, and to find the key processes which take effect on the business goal and business strategy. The selection of key business process is to afford the gist for the decision of the style, starting time and estimation the risk of the information engineering.

Following the enterprise modelling process, business can be analyzed by many means, such as the benchmarking analysis with business reference models, and using varieties of emulator or mathematics tools to find the problems, errors or bottle-necks of the active business processes. According to the analysis results,

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correlative business processes, resource deployment and organization structure can be optimized to assure that the information system to be designed based on this business model is reliable at the aspect of the business at least.

After acquiring the exact business requirements of information system utilizing enterprise modelling, the conversion from the enterprise business model to the information system model (function model, use-case model, and information model) should be dealt with. Figure 1 shows this conversion process.

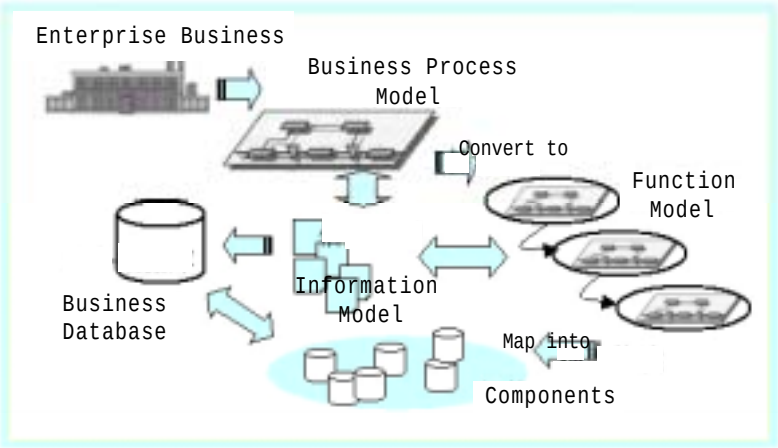


Fig. 1. the conversion process from business model to information system model

According to the optimized business model, the business function units and function structure of information system can be taken out and organized from the process models by describing the function each business process or activity is operated to realize. During the conversion process, the business activities of the business process, relationship between these activities, and the information flow are mapped into the functional operations in the function units, interaction between function units and the information flow of the whole information system, respectively. At the final phase of information engineering, these function units are to be configured as the sub systems or system components of the information system product. On the other hand, an information model can be attained by collecting and organizing all the data used by business activities or transformed between them in process model, which can be represented as table form. The information model is the blueprint of the information system database. Information model describes the data structure and data relationship of the information system and is the source of the data which function units exchange in the function model. At last, referring the product information, organization information and resource information associated with the business processes, which are described in the business model, the system architecture of the future database, the network architecture of the future information system can be confirmed, and the integrating strategy for all the function units in the system can also be attained.

### 3. Conversion from the business model to information system model

The method of utilizing the enterprise model and enterprise modelling to realize the business driven information engineering is proposed above. But how to decide the function structure of the future information system from the business model, and to deploy the business requirements to function units of system completely, exactly and flexibly is still a boring question. We propose to use the Quality Function Deployment (QFD) method of the product design field to help to solve this question.

QFD[2] is a planning process of the market oriented product design and development, and it is the kernel technique of the product quality engineering. The basic thought of QFD is that all the activities of the prodcut development process are driven by the customer's requirements, favourites and expectations. QFD assures the product satisfying the customers by deploying the requirements, favourites and expectations into the products and processes through „what" and „how". The primary method of QFD is to build House of Quality (HoQ), the relation matrix between the requirement elements and the designing elements, that is to say, to deploy the requirements represented by the customer language into the design elements represented by the technology language. Basing this basic idea, QFD method has been widely applied in many fields besides the product innovation, and recently, it has been taken great effect on assuring the software quality in the software engineering field[3,4].

Towards the enterprise information engineering, the business processes described in the enterprise model are the requirements from the enterprise, the customer of the informatin system, in fact. On the other hand, because the function units can be mapped into software components, basing the component-based design style of information system, functions can also be regarded as the design elements for the information engineering. Thus, the relation matrix between the business processes and the business functions can be built samely utilizing the HoQ tool of QFD. Because of the different research objects, the business engineering and the software engineeing use and understand the different models. This realtion matrix can also be used as the communication diagram between the business engineerings and the software engineerings.

Figure 2 shows a business-function realtion matrix built by HoQ.

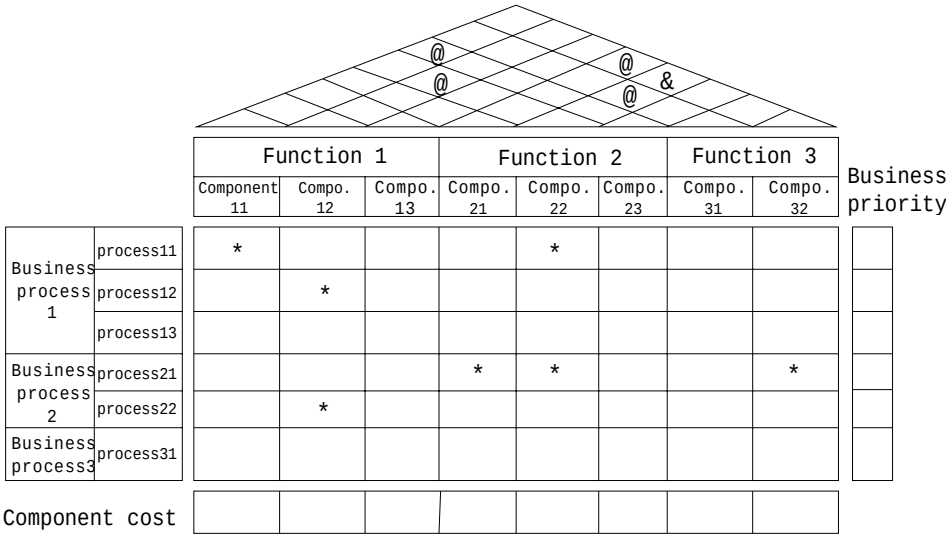


Fig. 2. the business-function relation matrix

In this relation matrix, the rows are filled with all the business processes described in the enterprise model, regarded as the business requirements of the information system, and the columns are filled with the software function structure, regarded as the technology requirements of the information system. Usually, a software provider, which follows the component based information system architecture, has an abundant software component depository for customers to choose components from. We can classify all the components in the depository by the function, and put them into the column headers of the relation matrix. In addition, the priority and importance of each process can be got according to the degree of bottle neck effect and relation with the enterprise competency in the active business, based on the result of the foregoing diagnose and analysis of the enterprise model. Then, quantitive priority values are put at the right side of the relation matrix. Similarly, the software characteristics of each component such as cost, upgrade capacity and efficiency provided by the software providers are put at the bottom of the relation matrix in order to afford the reference for the decision of the final information system's function structure. Above the matrix, there is another matrix is used to describe the dependency and interaction relationship between the components themselves, and the different degree of tightness should be represented by different symbols. The grids, core part of the matrix, are filled with the symbols representing whether the functional components of the column can accomplish the business process of the row.

The detailed process of receiving the function structure and developing strategy utlizing the business-function relation matrix is described as follow:

(1) To list the business requirements and functional components. The first step is to put the business processes from the enterprise model and the functional components from the software component depository into the headers of the matrix. Next, we should fill the business priority values and other business process characteristics which probably affect the decision, and the characteristic values of the components, according to the perfomance desciption in the depository, into the matrix.

(2) To fill the component-component realtion matrix. According to the transfer or citation realtionship between the components and the complexity of the interfaces, we decide the degree of dependency between the components and fill it into the component-component matrix above the business-function matrix.

(3) To fill the business-function matrix. We can analyze that which componets can be used to accomplish the selected business process according to the functional description of each component in the depository. The relations between the business processes and the functional components can be classified into five types: i) the selected process can be completed with one component only; ii) the selected process must be completed by the cooperation of several components, and all the components belong to the same functional field; iii) the selected process must be completed by the cooperation of several components, and each component belongs to a distinct functional field from the others; iv) the selected process can be completed with an alternative component (or component group); v) there still exists no appropriate component in the depository to satisfy the selected business process.

(4) To select the exist software components. The principles of the selection of the components to compose the information system using the business-function relation matrix include: i) the selected components satisfy the requirements of the business processes; ii) the relation beween all the selected components should be as loose as possible in order to be reused or rebuilt easily; iii) one selected component is able to serve as many business processes as possible; iv) if the components for one low priority business process has both the low use value and the high cost, it should be considered that this business process has to be deferred in the current life cycle of information engineeing.

(5) To modify or develop a new component. If one business process of high priority has no appropriate component to use with, we need to modify some exist comonents or redevelop a whole new component to satisfy this process.

(6) To modify the realtion matrix. The modifed or new components must be supplemented into the relation matrix and the matrix must be modified with the functional and other characteristics of the new components. Comparing with the past matrix, a solution with the least cost, the most flexibility and the greatest

performance is selected as the final function structure of the future information system.

The whole process of the requirement analysis and initial design phase of the enterprise information engineering utlizing enterprise modeling and quality function deployment is summaried in the Figure 3.

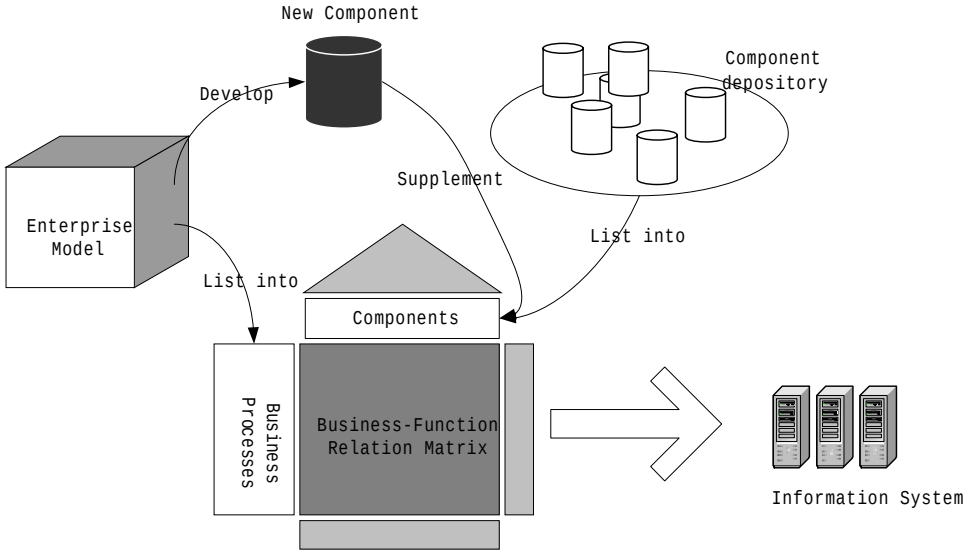


Fig. 3. the whole process of information engineering utlizing enterprise modeling with QFD

## 4. Summary

The total solution of enterprise information engineering is directed by the enterprise strategies, is driven by the enterprise business, and is based on the configurable and reusable software components. In this article, it is proposed that enterprise modelling and model-based business analysis are the start point of the information engineering and the assurance of the proper implementation. Enterprise model is used to summary and abstract the active business of the enterprise, including the information of product, business process, organization structure, resource, employee and information technology status, in order to make the information engineering have the concrete contents. At the same time, information engineering should be started with the processes which are the most urgent to be reformed and are the largest drawback of the enterprise business goal. The analysis of modelling process and the business diagnosis with model are implanted in order to find the requirements of enterprise business and the bottle neck problems, to figure the practical problems which need the information engineering to solve, and to afford the assistance for decision.

Enterprise model built by the enterprise modelling process can give the specific business requirements to the information engineering. Aiming at the problem that how to link these business requirements to the function structure of information system, a method to build the business-function relation matrix for enterprise information engineering utilizing QFD is proposed. Taking account of the priority of business processes, the cost of components, and the relationship between the functional components themselves, the primary implementation processes and decision principles of deciding the function structure and the development strategy of information system are also discussed.

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