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# An Architecture of Problem-oriented E-learning System for Product After-sales Service: Design and Application

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**Abstract:** Customers expect to obtain the personalized knowledge when they encounter some problems during the use of product, however, the traditional after-sales service modes are difficult to meet this kind of demand. This paper adopts process-based design method to construct the problem-oriented e-learning process model for product after-sales service and analyze the functions of realizing this process, and then problem-oriented e-learning system architecture is designed for product after-sales service. According to the different characteristics of two categories firms, this paper respectively give the system architecture application strategies, namely the integration strategy of existing information systems with e-learning system for more mature firms in IT application, and the configuration of simple and practical architecture of e-learning system for small and micro firms.

Keywords: e-learning, after-sales service, system architecture, problem-oriented

## 1. INTRODUCTION

In the new era, firms require after-sales service system which can provide specific services based on customer's personalized needs. Especially for knowledge-intensive products, firms need to provide personalized and professional knowledge when customer encounters some problems during the use of product. Currently, common after-sales service modes for product knowledge, such as on-site service, service center, call center, E-mail service, FAQ(Tseng and Hwang, 2007) [1], generally take a lot of manpower and time, but are not really satisfactory to customers. In order to improve the efficiency and meet increasing personalized demand, firms have to explore new after-sales service mode, which can provide self-service based on customer's characteristics, specific needs and problems.

E-Learning system can provide personalized knowledge service according to learner's characteristics and personalized demands. The research about e-learning system at the present stage mainly focused on systematic knowledge learning of distance education and the training of firms' employees, the research about problem-oriented e-learning system and its architecture for product after-sales service is still rare. Therefore, from a perspective of knowledge learning for the problems solving encountered during customer's use of product, this paper study the problem-oriented e-learning process model for product after-sales service, analysis the e-learning system's functions to realize this process, and then design the architecture of problem-oriented e-learning system for product after-sales service.

The mainly methods to design information system are structured method, object-oriented method and process-based method. The process-based design method is easier to show the way of designer's thinking and more facilitate to combine information system with operation processes. Savvas and Bassiliades (2009) [2] consider that adopt the process-oriented design method is beneficial to provide the up-to-date and accurate information and knowledge through a web-based knowledge management system for public organizations; Tallon (2001) etc. [3] adopt a more inclusive and comprehensive based-on process design method in order to measure IT business value, then design a process-oriented model to assess the impacts of IT on critical business

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activities within the value chain.

Problem-oriented e-learning system for product after-sales service based-on customer's characteristics and demands provides customers problems-related knowledge during the process of product using. This paper adopts the process-based design method to construct e-learning process model and analyze system's functions, on these bases, designs the problem-oriented e-learning system architecture for product after-sales service. Finally, aimed at two categories firms, the paper respectively provides the referable architecture application strategies.

## **2. MODELING OF THE PROBLEM-ORIENTED E-LEARNING PROCESS FOR PRODUCT AFTER-SALES SERVICE**

From after-sales service perspective, Shostack (1984) <sup>[4]</sup> analyzes the causes of many problems and brings customer demand into constructing after-sales service process; Legnani etc. (2008) <sup>[5]</sup> propose an after-sales service model which includes some phases, such as demand analyze, resources deploy, solutions formulate, solutions provide, related information obtain and request finish. From e-learning perspective, Moen and Norman (2006) <sup>[6]</sup> present PDSA, namely Plan-Do-Study-Act learning process model, Phipps and Kelly (2006) <sup>[7]</sup> think learner's demand is the core of e-learning process model; Through researching and analyzing online-learning and distance learning, Alonso etc. (2005) <sup>[8]</sup> divide the learning process into analyzing, designing, implementing, executing, evaluating five phases.

This paper refers and combines above two aspects researches, according to customer's interaction process with e-learning system for seeking solution to the problem of product use, dividing the problem-oriented e-learning process into five phases: customer service request, customer problems and characteristics analysis, knowledge matching for problem solving, knowledge learning for problem solving, process evaluation and feedback. Thus the problem-oriented e-learning process model for product after-sales service is constructed.

### **(1) Customer service request**

When customer encounters problems about product basic knowledge learning and product using which require solving, they can send service request through the interface, register/login to e-learning system, input the problems and complete simple tests about customer's characteristics.

### **(2) Customer problems and characteristics analysis**

After service request, system starts to analyze customer's problems and save the analysis results into customer demand base, problem base, and characteristic base. Then system tests and analyzes customer's characteristics when they first login, system also analyzes whether the problem is new one, if not, just directly go into the knowledge learning phase, otherwise, the system should save this new problem and go into knowledge matching phase.

### **(3) Knowledge matching for problem solving**

E-Learning system matches the personalized knowledge for problem solving based on customer's specific demands and characteristics. Referring to the researches of Coomey and Stephenson (2001) <sup>[9]</sup>, Xiao Weisheng and Fang Zhijun (2009) <sup>[10]</sup> about online learning models, the paper divides e-learning mode into adaptive learning mode and instruction learning mode. Adaptive learning mode automatically collects knowledge from knowledge-base or FAQ-base which based-on customer's personalized information and matches suitable knowledge for problem solving as recommendation knowledge. Customer also can self-collect problem solving knowledge from knowledge-base; Instruction learning mode matches problem solving knowledge by service personnel through knowledge-base, FAQ-base or their own experience knowledge.

### **(4) Knowledge learning for problem solving**

Customer begins to learn knowledge provided by system for problem solving. In the process of adaptive

learning, customer successively self-manages and self-controls the online learning process; In the process of instruction learning, customer learns the relative knowledge following service personnel's instruction and management. If encounters with difficulties during learning process, customer can obtain interactive instruction through online consulting, E-Mail system, BBS message boards etc.

(5) Process evaluation and feedback

E-Learning system should evaluate the whole after-sales service process and customers learning effect. Evaluation and analysis results should be saved into learning evaluation database and new problems will be feedback to relevant departments of the firm. Making full use of customer's information, the firm can provide much better satisfactory knowledge service, improve after-sales service efficiency and service quality.

To sum up, the problem-oriented e-learning process model for product after-sales service is constructed. See Figure1.

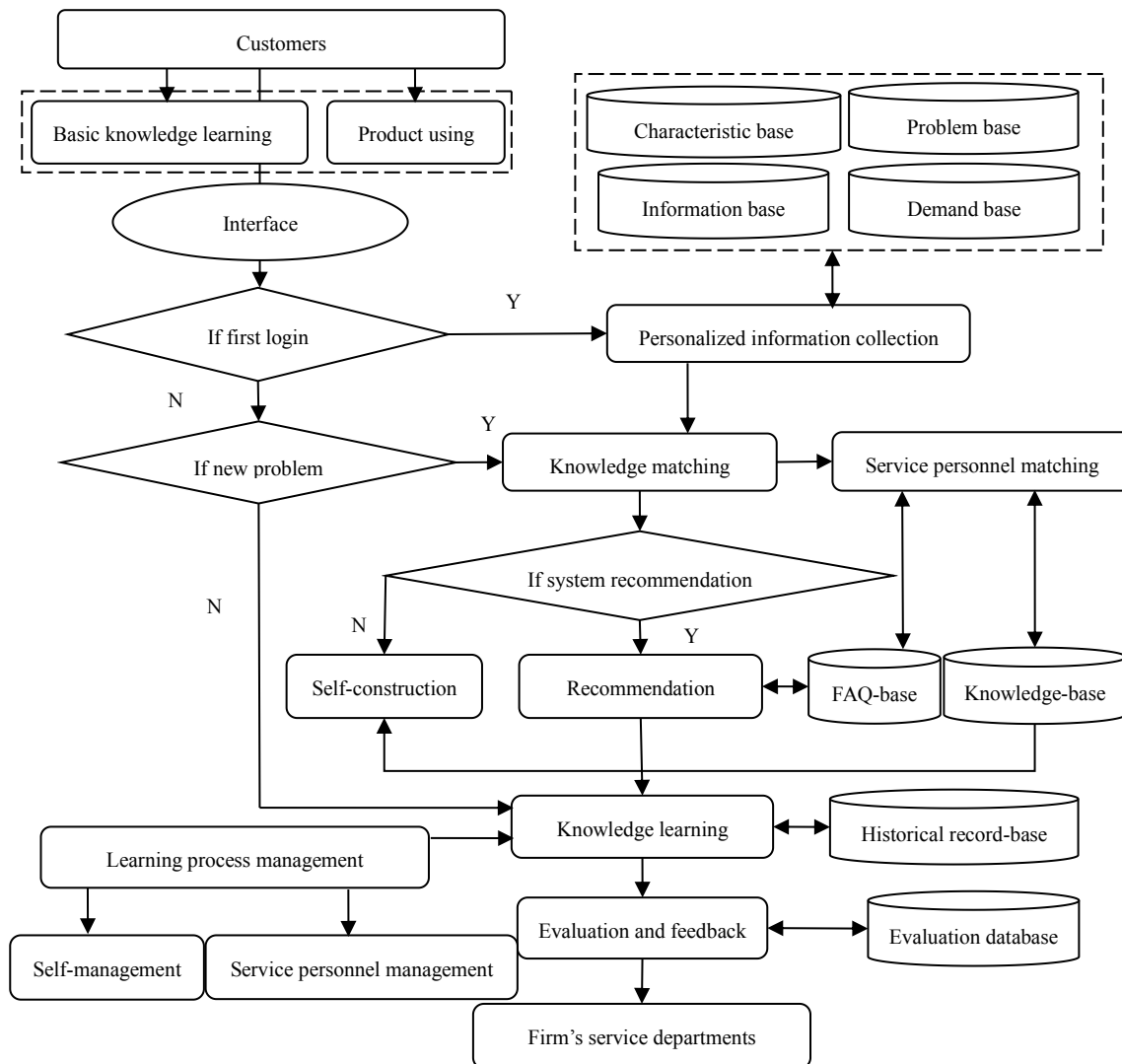


Figure 1. Problem-oriented e-learning process model for product after-sales service

### 3. ANALYSIS OF THE PROBLEM-ORIENTED E-LEARNING SYSTEM FUNCTIONS FOR PRODUCT AFTER-SALES SERVICE

The problem-oriented e-learning process model for product after-sales service can reflect the functional demand of e-learning system. Firstly, the service process of providing knowledge to customers for problems

solving, the e-learning system should have customer-oriented functions; Secondly, in order to improve after-sales service efficiency and service quality, decrease service costs, strengthen internal information flowing and communication, the e-learning system should include firm's internal department-oriented functions; Lastly, in order to realize personalized knowledge learning process, the internal functions of e-learning system should be analyzed.

(1) Customer-oriented functions analysis

Customer-oriented functions mainly include customer register/login, online asking questions and online learning. When customers encounter some problems want to solve, they need to register or directly login to e-learning system to input their problems, through analyzing and processing of system internal functions, customer learns personalized knowledge with their specific problems.

(2) Firm's internal department-oriented functions analysis

Firm's internal department-oriented functions should include product information sharing, online employees training and product development supporting. E-Learning system shares all kinds of information which come from evaluating, analyzing and summarizing within all different departments. Information sharing is better for firms to accurately grasp customer's demands and problems, and reduce information asymmetry in each department. Problem-oriented e-learning system for product after-sales service also can provide personalized online training for various after-sales service employees to improve training effect and cut down training costs. The function of product development supporting makes firms rethink and redesign product through process evaluation and feedback after learning for problems solving, thereby designing the product to meet customer's personalized demands as best as possible.

(3) E-Learning system internal functions analysis

E-Learning system internal functions should include problem analysis, knowledge matching, learning process management, process evaluation, system maintenance and updating. Problem analysis makes system clear about customer's problems which is the basis and premise of fulfilling personalized knowledge service in e-learning systems; knowledge matching is representation, retrieval, collection and matching of knowledge resources in e-learning system; learning process management generates learning path, manages and controls the learning process. Problem analysis, knowledge matching and learning process management are the functions of specifically realizing problem-oriented customer personalized knowledge learning. Process evaluation mainly analyzes and evaluates the learning effect; system maintenance and updating is responsible for timely updating and maintaining knowledge resources and system resources.

To sum up, the functions of problem-oriented e-learning system for product after-sales service can be shown in the Figure2.

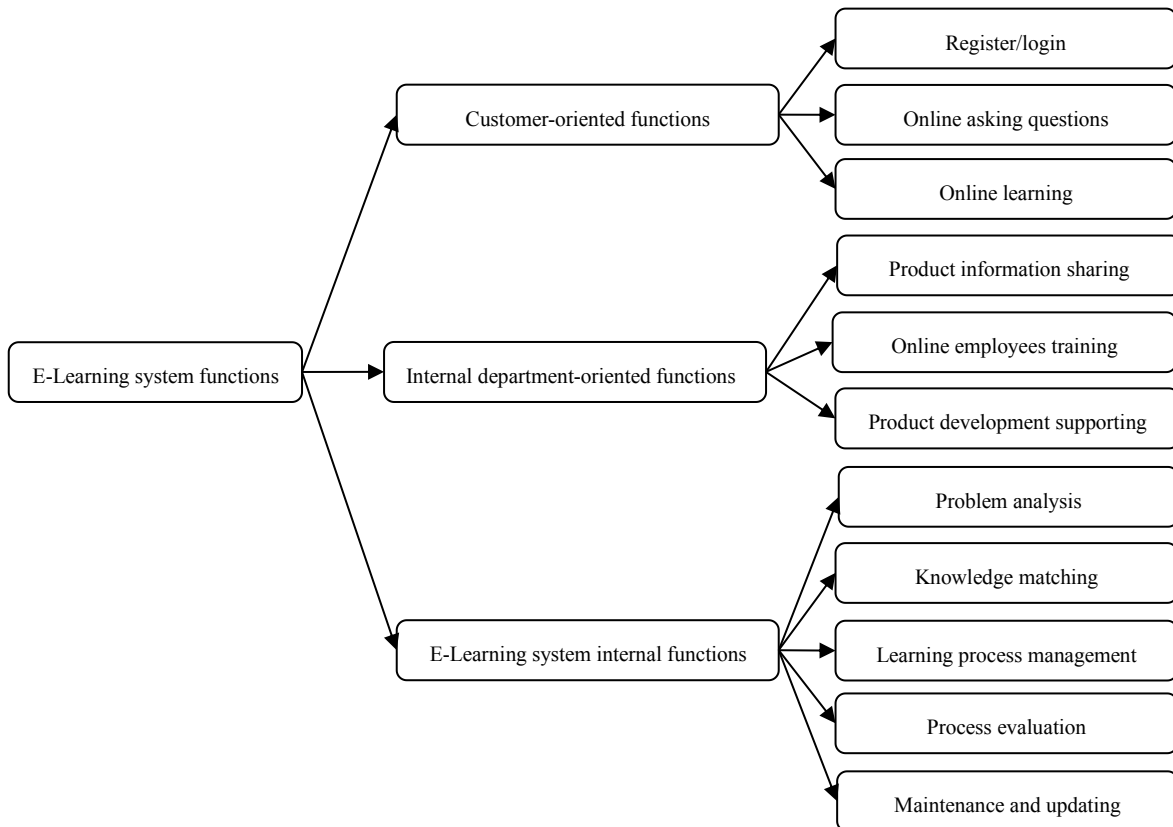


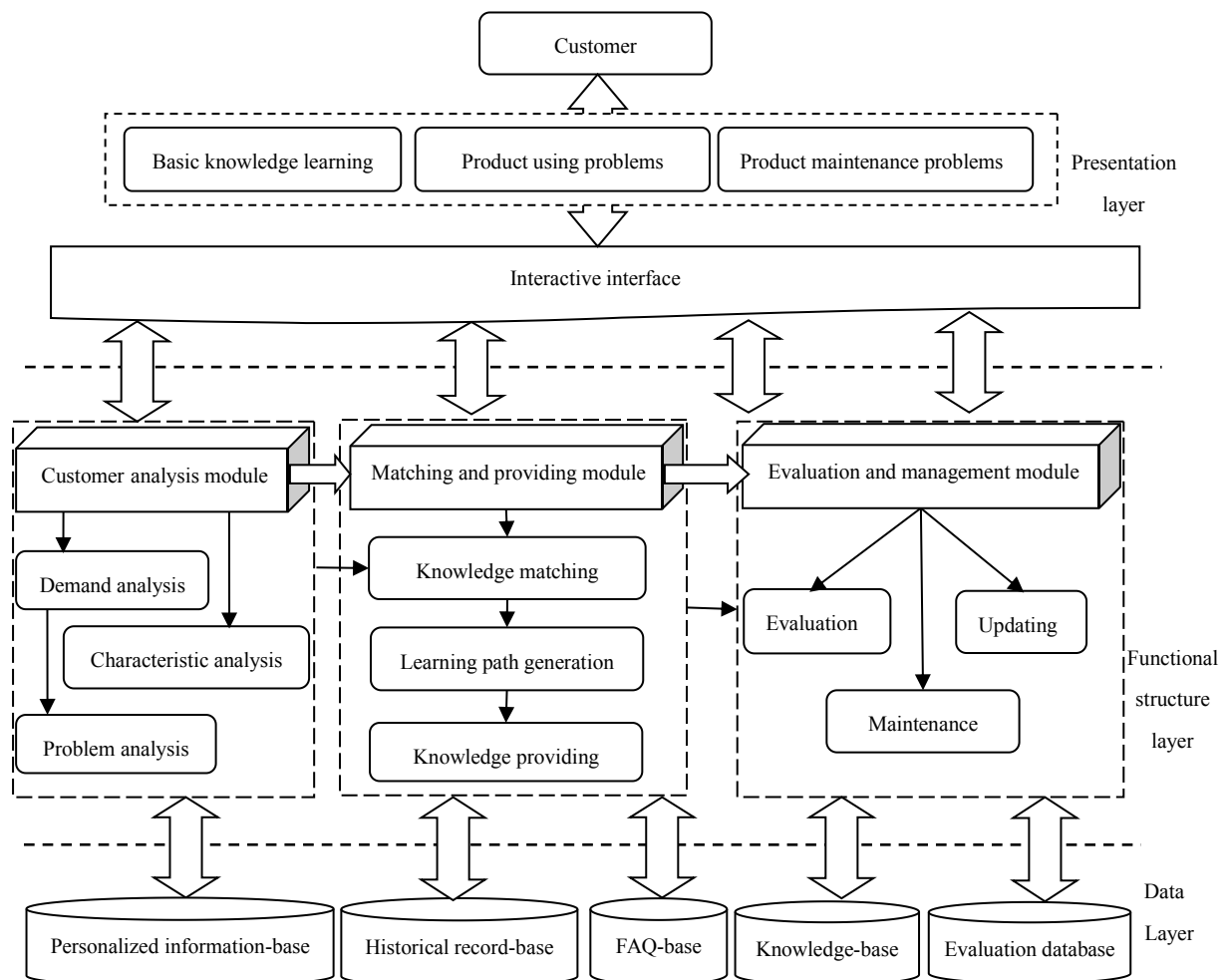
Figure 2. Analysis the functions of problem-oriented e-learning system for product after-sales service

#### 4. DESIGN OF THE PROBLEM-ORIENTED E-LEARNING SYSTEM ARCHITECTURE FOR PRODUCT AFTER-SALES SERVICE

In order to adapt to the rapid development of modern networks and meet customer diverse demands, this paper designs e-learning system architecture which based on B/S (Browser/Server) mode to achieve the problem-oriented e-learning system architecture for product after-sales service.

Combine existing research results of Zachman (1987) [11] and Schmidt (2003) etc. [12] about B/S mode three layer structures, Logically, according to problem-oriented e-learning process model and e-learning system function analysis, we design the problem-oriented e-learning system architecture for product after-sales service as presentation layer, functional structure layer and data layer. Presentation layer locates on client, functional structure layer and data layer situates in server. Presentation layer achieves the functions of customer register/login and online asking questions, and gains knowledge from the e-learning system; the key of designing e-learning system is functional structure layer, this layer mainly provides customer with knowledge which are related to problems solving and fulfills customer's personalized learning; design of data layer is based on all information and data of functional structure layer which is needed to achieve corresponding functional modules.

To sum up, the problem-oriented e-learning system architecture for product after-sales service is designed in the Figure3.



**Figure 3. Problem-oriented e-learning system architecture for product after-sales service**

#### (1) Presentation layer

Presentation layer receives customer's requests through interactive interface which gives customers the right to entrance e-learning system to fulfill problem-oriented online learning. This layer transfers customer's related information such as demands, problems and characteristics to the functional structure layer and intelligently presents knowledge to customers for problem solving. Presentation layer is not only the entrance for customers to problem-oriented e-learning system for product after-sales service but also the window of providing a variety of knowledge for customers.

#### (2) Functional structure layer

Functional structure layer is the main layer for problem-oriented e-learning system for product after-sales service. This layer receives customer's demands information which come from presentation layer, achieves customer's demands through interacting with data layer and sends back related knowledge to presentation layer.

Customer analysis module mainly obtains and analyzes personalized information, such as customer's characteristics, demands and specific problems, saves the analysis results into personalized information-base which is convenient to provide personalized knowledge service. Customer analysis module includes characteristic analysis sub-module, demand analysis sub-module and problem analysis sub-module which is the basis and premise for achieving personalized knowledge service.

Knowledge matching and providing module achieves matching, collecting and providing of personalized solving knowledge which is the core of e-learning system. The system collects knowledge from knowledge-base,

FAQ-base to match the problem solving knowledge according to personalized information and generate learning paths. Self-collecting problem solving knowledge or system recommendation knowledge based-on knowledge-base which achieves adaptive learning mode is high real-time while cuts down service costs, but largely relies on knowledge-base; Instruction learning mode solves customer's problems with high quality, but the real-time and efficiency are low and the service costs are high; Service personnel matches problem solving knowledge or system recommendation knowledge based-on FAQ-base which meets customer's real-time requests, but cannot provide personalized knowledge.

Process evaluation and management module evaluates and analyzes the whole e-learning knowledge process, stores the results into learning evaluation database and forwards customer's new problems to all kinds of service departments in firms which much better fulfills internal department-oriented functions. This module is also beneficial for maintaining and knowledge updating of e-learning system so that continuously improving the after-sales service efficiency and service quality.

### (3) Data layer

Data layer locates at the bottom of architecture which is used to store all resources for achieving the process and functions of problem-oriented e-learning system for product after-sales service. Data layer mainly includes customer personalized information-base, knowledge-base, FAQ-base, learning historical record-base, and learning process evaluation database. Data layer saves and manages all types of information and data which support to achieve the problem-oriented e-learning system functions for product after-sales service.

Three layers for the problem-oriented e-learning system architecture for product after-sales service are not only mutual independent but also interconnected, the relationship between each two layers is loosed coupling. This architecture has better extension and practicability, this system is easy for customer's operation, using and firm's maintenance management.

## **5. APPLICATION OF THE PROBLEM-ORIENTED E-LEARNING SYSTEM ARCHITECTURE FOR PRODUCT AFTER-SALES SERVICE**

Different categories firms have various characteristics, the application of problem-oriented e-learning system architecture for product after-sales service should have different emphasizes. According to the different characteristics of two categories firms, this paper respectively gives the system architecture configuration strategies for reference.

### **5.1 The architecture application for more mature firms in IT application**

More mature firms in IT application have many information systems, the infrastructure level is much higher and human resources deployment is more complete, the problem-oriented e-learning system for product after-sales service should be integrated with other information system and plays a complementary role which is emphasis on architecture applications. Common firm's information systems mainly include ERP (Enterprise Resource Planning) system, R&D (Research and Development) system and CRM (Customer Relationship Management) system.

#### (1) Integrated with ERP system

Integrated with ERP system mainly achieves information sharing between human resources management module, marketing management module and e-learning system. Employees' training in human resources management module is used to passively impart knowledge, through integrating with ERP system, they can share all information which are related to customer's common problems and make employees' training become more specific so that firms improve their training effect. Integrated with marketing management module can share information such as customer's characteristics and product's demands which specifically formulate



different marketing strategies for achieving the integration between pre-sales and after-sales.

(2) Integrated with R&D system

Integrated with R&D system can know much about customer's problems during the use of product through feedback which comes from evaluating and analysis of customer's learning process and learning effect, product R&D becomes more specific, and can meet customer's demands as best as possible. Whereas R&D system is able to provide more product's using information and maintenance knowledge which enriches knowledge resources of problem-oriented e-learning system for product after-sales service.

(3) Integrated with CRM system

Integrated with CRM system enable to offer customer's personalized information such as characteristics and specific problems which makes customer's analysis and management more deep, respond customer's various demands more timely and improve customer's satisfactory.

## 5.2 The architecture application for small and micro firms

In general, IT application level is low for small and micro firms, the infrastructure level is weak and lack of human resources in service aspects. However, small and micro firms are at the growth stage and have much more development space. Therefore, they should focus on enhancing web-based knowledge service ability, and especially improving after-sales service quality and service efficiency through IT. Because of limitation by financial and human resources aspects, this kind of firms should configure economical and practical problem-oriented e-learning system architecture for product after-sales service.

Customer analysis module, knowledge matching module and process evaluation and management module are three essential modules for problem-oriented e-learning system for product after-sales service. Small and micro firms need to achieve the functions of e-learning system through the process from customer analysis to knowledge matching and then to process evaluation and management. Because of limitation by self-conditions, small and micro firms should adopt simple and practical e-learning system architecture. Data layer just set FAQ-base which includes common product problems and problem solving knowledge, FAQ-base automatically provides problem solving knowledge which is corresponding with customer's problems. Therefore, the structure of function layer can be relatively simple.

## 6. CONCLUSIONS

With the development of e-learning system is more and more mature, firms apply it into after-sales service areas not only can reduce service costs but also improve the services efficiency. This paper adopts the process-based design method to design the problem-oriented e-learning system architecture for product after-sales service and give two categories firms the corresponding application strategies according to their different characteristics and demands.

The design of problem-oriented e-learning system architecture will enable us to obtain a new and deep understanding about the composition and the effect of e-learning system, this research can help firms to have a better cognition on e-learning process and after-sales service process, to develop the problem-oriented e-learning system for product after-sales service. E-Learning system in firm's application aspect will continually broaden and further deepen, strengthen personalized after-sales service, improve service efficiency, service quality and customer satisfaction. E-Learning system will play an increasingly important role in firms.

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