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Car Service Spare Parts Procurement Process Improvements Based on SOA

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Abstract

There are many kinds of automobile after-sale service spare parts, which are with a complex relationship in replacement and a large time span in models. The management of automobile after-sale service spare parts is a challenge, not only for automobile manufacturer but also for distributor. Therefore, it becomes an important and difficult task for automobile enterprises to do well in the supply of after-sale service spare parts, but also a target for automobile enterprises to explore and pursue continuously. Taking FAW-Volkswagen Automobile Co. Ltd. as the background, we conducted analysis on its procurement management process of spare parts; we also made some improvements on its process and pushed forward the corresponding products and solutions based on SOA (Service-oriented architecture) framework, so as to improve the procurement efficiency of automobile spare parts, and save cost.

Keywords*: automobile after-sale service, spare parts procurement, SOA, process optimization*

1. Introduction

Automobile spare parts are composed of parts assembly, parts sub-assembly, and individual parts of automobile which are consumed naturally and required to be supplemented in use of automobile or required to be replaced for maintaining good condition of automobile. The management of automobile after-sale service spare parts is a challenge, not only for automobile manufacturer, supplier but also for distributor. Making optimal inventory replenishment decision became critical for successful supply chain management [1].

Nowadays, there currently exist a number of methods to deal with the spare parts procurement problem. An e-SCM system for operating a procurement supply chain of a commercial vehicle company could be established by considering the information flow and business process between the paternal manufacturer and the 1st vendors, and between the 1st vendors and the 2nd vendors [2]. Besides, simulation-based optimisation could also help with the multi-location inventory problem by quantifying synergy potential between locations and how total service lifecycle cost can be further reduced [3]. A proportional hazard model could be used to estimate spare parts requirements [4], or a spare parts support optimization algorithm based on support degree could improve the efficiency of equipment support [5]. The automotive company could redesign its logistics operations by using an analytic hierarchy process for multi-criteria decision-making [6]. And a least squares support vector machines (LS-SVM) model optimized by particle swarm optimization (PSO) could be developed to forecast the demand [7]. However, there is no related way to solve the procurement management problem, especially asymmetric information problem among the entities related to spare parts procurement, so that we introduce SOA to provide flexible architecture for department management.

In this paper, we mainly discuss the spare parts procurement process in FAW-Volkswagen Automobile Co. Ltd. (referred to as FAW-Volkswagen). FAW-Volkswagen was formally established on February 6, 1991, a joint venture of China First Automobile Group Corporation (60%) and German Volkswagen Group (40%). The Spare Parts Management Department of FAW-Volkswagen is subordinate to the After-sale Service Department of FAW - Volkswagen Sales Company, and its main task is to supply original spare parts of all the models to FAW - Volkswagen dealer network, so as to meet the market demand for after-sale maintenance. The Spare Parts Management Department is responsible for spare parts management work of all the models of Volkswagen brand, including compilation of spare parts

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catalog, forecast of spare parts demand, procurement of imported spare parts, domestic spare parts, financing of home-made spare parts, and storage, sales and transportation of spare parts etc. FAW - Volkswagen needs to integrate internal and external business processes, and strengthen cooperation with suppliers of spare parts, so as to reduce the cost of procurement.

According to the analysis, the current specific problems of the Spare Parts Management Department of FAW - Volkswagen are as below:

(1) The increase of FAW - Volkswagen models

Along with the increase of models, the market possession quantity is bound to continue to expand. The management of after-sale service spare parts must deal with the shortage of spare parts for new models, and the problem of how to ensure the future spare parts for discontinued and offline models. Along with the increase of new models year by year, the challenge to the management of after-sale service spare parts will be greater and greater.

(2) The increase of discontinued models and variety of spare parts

FAW - Volkswagen also has discontinued and offline models every year. The management of spare parts for discontinued models will be the biggest problem in the management of after-sale service spare parts. After a model is discontinued, the production of its second-tier supporting supplier will also be discontinued; while some spare parts can continue to be used in the new model, but most spare parts belong to special parts of the new model, so they must be included into the series of spare parts to be discontinued. Along with the continuous emergence of new models, the variety of after-sale service spare parts is also increased year by year (as shown in Figure 1), and the management work of spare parts is becoming more and more difficult; in addition, the continuous offline of discontinued models is bound to lead to continuous increase of discontinued spare parts.

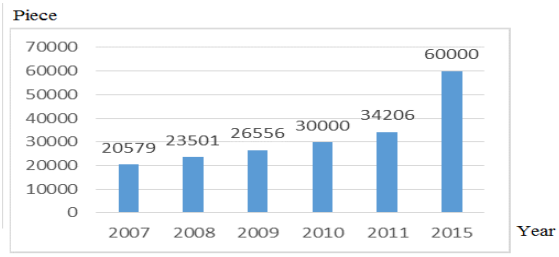

Figure 1. Variety of After-Sale Service Spare Parts (unit: piece)

In view of the above competitive environment and problems, FAW - Volkswagen needs to integrate internal and external business processes, and strengthen cooperation with suppliers of spare parts, so as to increase the efficiency of procurement management, reduce the cost of spare parts procurement, and enhance the service quality. Only through the constant innovation of services could improve the customer responsiveness and increase the weight of success of automotive manufacturing enterprises themselves when the customers using the products [8].

In general terms, Service Oriented Architecture (SOA) is widely considered to be the appropriate practice when solving process optimization problem. SOA is a perfect balancing point between ensuring current short-term efficiency and permanent improvement of enterprise IT environment, and a long-term strategy facing enterprise futures [9]. In this paper, an SOA based model is presented. By using SOA architecture, we could optimize the spare parts procurement process in the Spare Parts Management Department of FAW – Volkswagen to provide flexible specific functions and immediate service for customers and suppliers.

2. Spare Parts Procurement Process Analysis

The procurement management process of the Spare Parts Management Department of FAW - Volkswagen is as shown in Figure 2.

(1) The buyers regularly coordinate with suppliers on rolling plan of demand, urge suppliers to prepare the goods in advance, reach an agreement with suppliers on supply cycle of spare parts, and sign a written on-time delivery agreement with them.

(2) The buyers make orders according to the demand plan of spare parts, upload the orders to R3 system, and timely send the R3 orders to the suppliers of spare parts.

(3) The suppliers shall be responsible for delivering the goods to the designated spare parts warehouse in accordance with the requirements of spare parts orders.

(4) After the arrival of spare parts, the warehouse of the Spare Parts Department shall be responsible for checking, acceptance and storage processing. They shall inspect whether the spare parts are qualified, and those unqualified spare parts shall be returned through negotiation, and receiving information shall be saved into the R3 system.

(5) Financial accounting of the Financial Management Department.

(6) The Procurement Department shall conduct analysis and summary on delivery situation of the suppliers in last quarter according to the R3 data at the beginning of every quarter, those suppliers with serious shortage of goods shall be implemented 3% deduction according to the procurement contract, and those suppliers with good delivery performance shall be awarded.

(7) For quality problem of spare parts incurred, the Procurement Department shall assist the Spare Parts Warehouse to negotiate and handle with the suppliers of spare parts.

(8) According to the need, visit those suppliers of spare parts with serious shortage of goods, and improve the visit information.

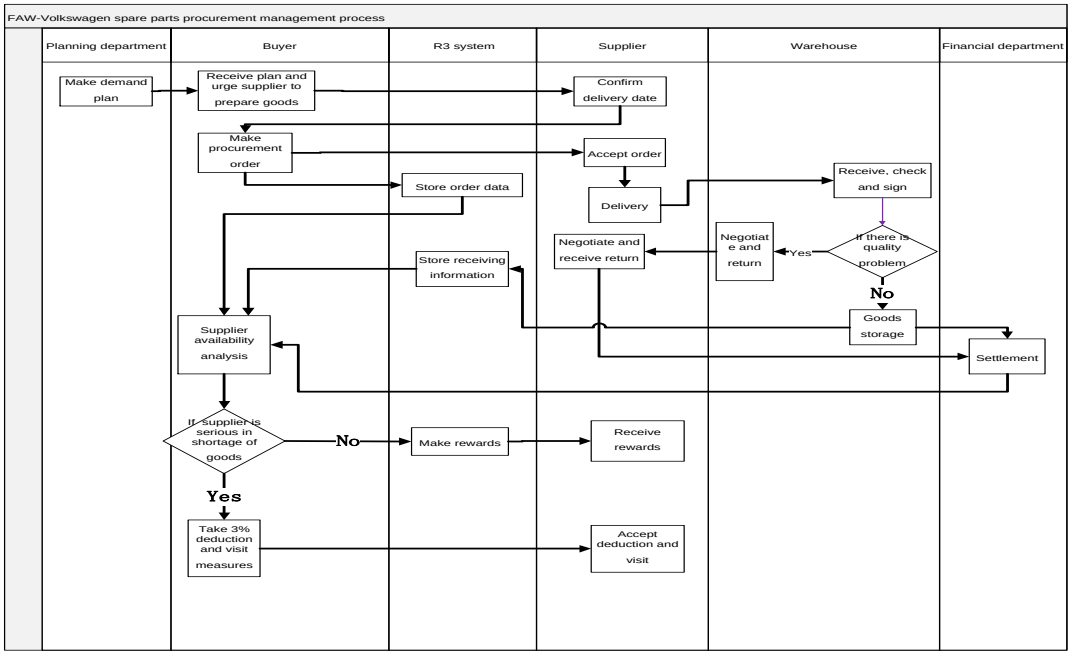

Figure 2. Procurement Management Process

According to the analysis, the above operation process has the following problems:

(1) In the operation of making procurement order, receiving goods and settlement, the employees of various departments do not have good communication and cooperation. As a result, the efficiency of processing business is low, and in the case of high customer demand for spare parts, it is easy to lead to shortage of spare parts, and thus cause reduction of customer satisfaction.

(2) In the operation of urging suppliers to prepare goods, receiving goods and returning goods through consultation, it requires the enterprise to have a good communication with the suppliers, so as to make spare parts supplied timely. But it is understood that FAW - Volkswagen has a big problem with its suppliers in information communication. FAW - Volkswagen has more than 500 suppliers, infrastructure status of the suppliers are all different, and the platforms of FAW - Volkswagen to communicate with the suppliers are mainly SAP R3 system, free mailbox and mail.

(3) When FAW - Volkswagen provides the R3 system to a supplier, a certain installation fee needs to be charged, and a fixed maintenance fee also needs to be paid every year, so only some suppliers with a large quantity of delivery have installed the R3 system, while those suppliers with a small quantity of delivery choose to give up the installation, and seek other information platform.

(4) The free mailbox of FAW - Volkswagen is relatively small in capacity. After communicating for a period of time, the suppliers need to clean up e-mail regularly, otherwise new e-mail cannot be delivered. Some suppliers have not designated personnel to be responsible for the free mailbox of FAW - Volkswagen, often causing that information cannot be received in time.

(5) E-mail is the most basic communication form between FAW - Volkswagen and its suppliers, but the personnel of some manufacturers have changed very frequently, email addresses are often changed, and thus it is easy to cause information interruption.

(6) Lack of communication with customers easily leads to a shortage of goods, plan making requires a certain period of time, and it is easy to lead to the occurrence of goods shortage. A collaborative service platform can be used to make plans directly according to customer demand, so as to reduce the occurrence of goods shortage situation, and deal with the demand of urgent orders effectively.

(7) The analysis on supply capacity of suppliers is not accurate enough. When making analysis on the capacity of suppliers, it is only conducted according to the relevant data of goods shortage in the SAP-R3 system, but not considering goods quality of the suppliers, the reasons for shortage and other information, which will cause the situation that the analysis results are not accurate enough.

3. Research Method

In this paper, we build a model based on Service-oriented Architecture (SOA). We first establish a component business model (CBM) to analyze enterprise business contained in the procurement process and break down them as corresponding modules. We put all modules into two dimensions – business ability and responsibility level, and then we found the "thermal component", which means the important business. After CBM, we establish Service-Oriented Modeling and Architecture (SOMA), which could help us develop a service-based IT solution. In the basis of CBM and SOMA, we could get the design for service implementation and revised system flow chart.

3.1. SOA

Service-oriented Architecture (SOA) is a kind of architecture model and a set of design methodology, which aims to maximize the reuse of neutral services in application to improve IT adaptability and efficiency. SOA advocates that developers create distributed software systems whose functionality is provided entirely by services [10]. It promises interoperability, reusability, loose coupling, and protocol independency of services as core principles of SOA [11]. In the management of after-sale service spare parts of FAW - Volkswagen, there are some communication problems with the suppliers, and the information sharing is not achieved between the departments. Therefore, a SOA platform could be built according to the procurement process of spare parts after the business transformation. The SOA plan can be implemented through the life cycle of a full SOA. After collecting business demands and designing business processes, the modeling phase will be started. After optimizing the business processes, the business processes will be implemented through the combination of new services and available services. Then, the assets will be deployed to a security integration environment, so as to integrate personnel, processes and information.

3.2. Component Business Model (CBM)

(1) Component mapping

Business component is a function module for realizing enterprise business, and CBM model conducts organization on component according to the two dimensions of business ability and responsibility level. Through the CBM model, it can be assumed that how the current business activity is implemented by a series of interconnected modules. Figure 3 is a component mapping in the procurement management of spare parts.

(2) Looking for "thermal component"

Component mapping (as shown in Figure 4) can help managers to analyze existing businesses from strategic level. By analyzing the business values of mapping fields, we found out the most significant component - “thermal component”, which is in red background in figure 3. “Thermal component” includes procurement plan, service management, delivery capability analysis, order management, business performance management, customer service, delivery time management, goods shortage processing, order generation, and transferring to rush order.

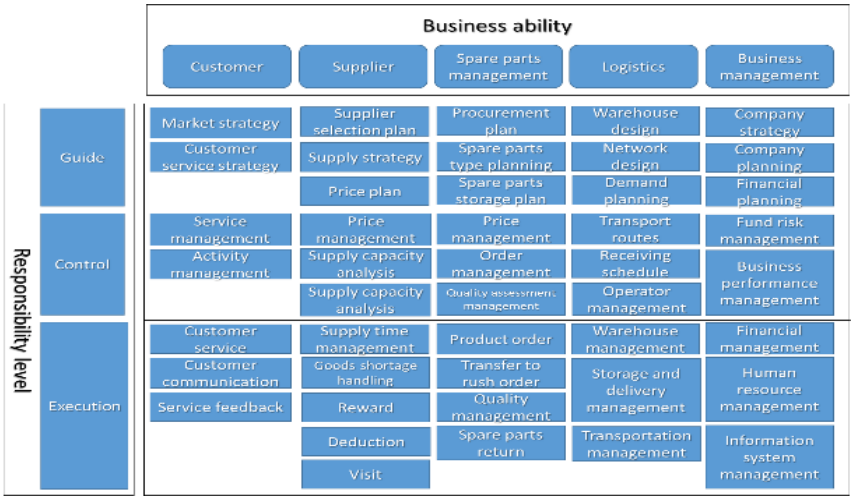

Figure 3. CBM

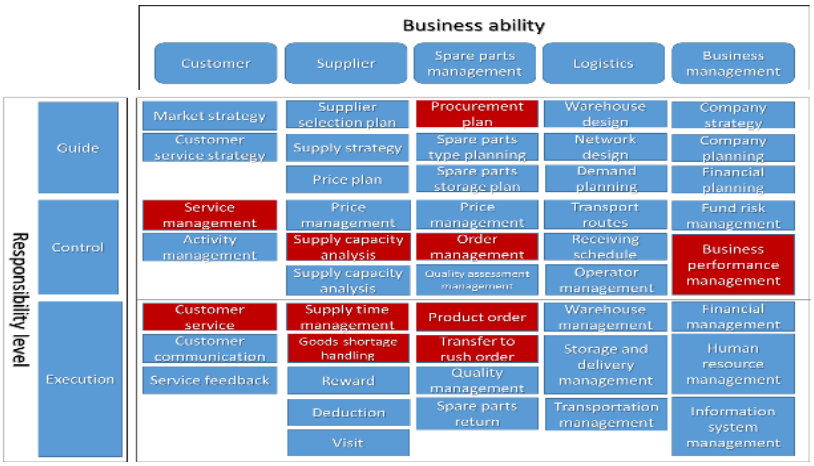

Figure 4. Thermal Component

3.3. Service-Oriented Modeling and Architecture (SOMA)

After modeling of the above business component, SOMA will be conducted. SOMA is to achieve the target business process by defining and developing a service based IT solution. SOMA has provided a communication bridge between business requirements and IT solutions. The core of SOMA is to determine the specifications of services, components, and processing procedures, which mainly includes three stages: (1) the identification of services, in which, a variety of techniques are used to determine a comprehensive list of candidate services; (2) the identification of the specifications of the services, in which, the detailed service and component design will be completed; and (3) the realization of the services, which focuses on the decision structure.

(1) Service identification

a. Through analyzing the gap between business objectives of the enterprise and the problems in procurement business process of existing spare parts, find out the value of SOA. The analysis results will serve as a guide for service modeling and architecture design, but they also will be the important basis for the validation of project effects, as shown in Figure 5.

b. The procurement process of spare parts is decomposed step by step, making it become the service candidates at all levels. The service process after decomposition is shown as Figure 6.

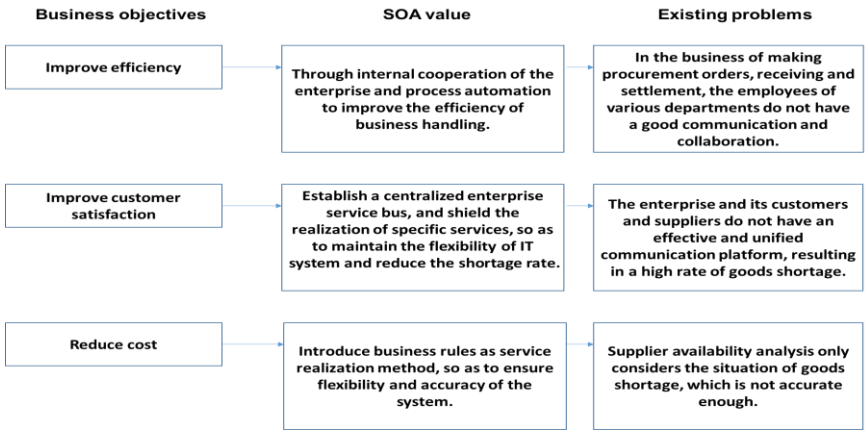

Figure 5. Service Identification

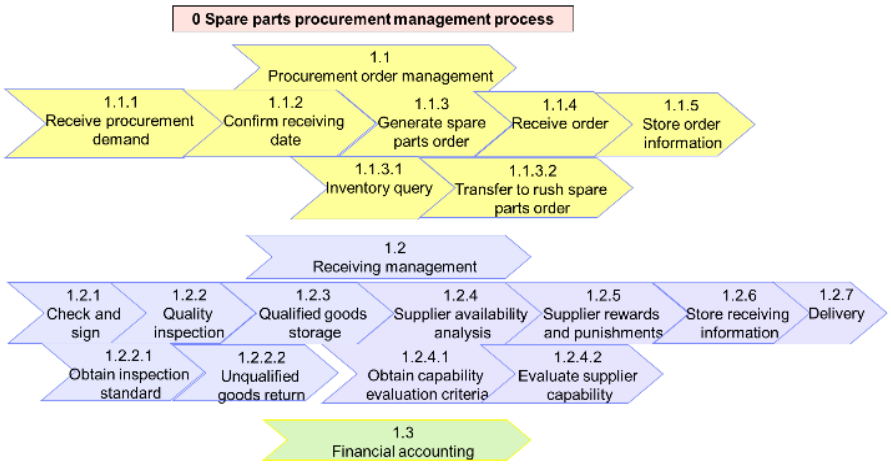

Figure 6. Service Process after Decomposition

c. Analyze key business indexes to verify the existing service candidates and find out the missing service candidates. Key business indexes include: average processing time of each order is reduced by 10%, self-service rate of maintenance station is increased by 60%, rate of goods shortage is reduce by 50%, and cost of goods shortage and cost of communication and order processing are reduced by 40% (as shown in Figure 7).

d. Through the analysis to SAP R3 system and collaborative work platform, find out the missing service candidates, and provide the basis for service implementation.

(2) Service specification

Through the above steps, the combinations of service candidates and the decisions of service exposures can be obtained, then use the input business components to classify the service candidates, so as to make preparations for service specification and service implementation. The classification results of service components are as Table 2.

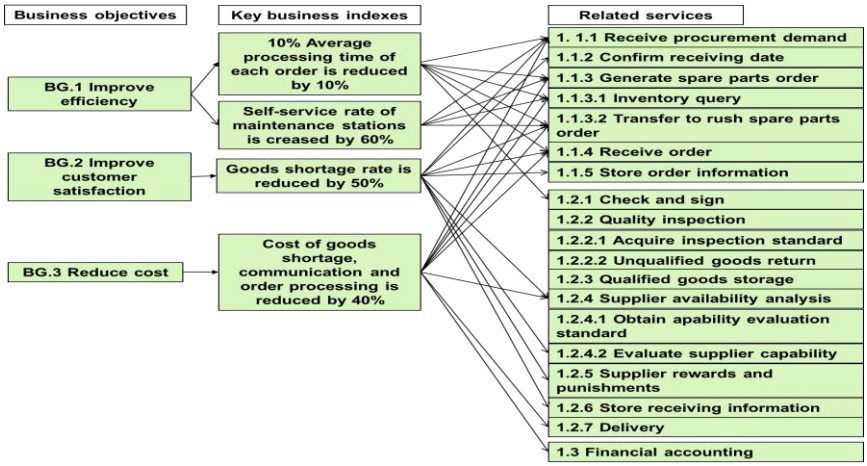

Figure 7. Business Objectives and Related Services

Table 1. Systems Analysis

System number	System name	Related service	Platform	Interface type
APP1	SAP R3 system	Goods storage, quality inspection, spare parts storage, delivery, order information storage, and receiving information storage	Multiple platforms: Windows/NT/...	Web Service EJB
APP2	Collaborative work platform	Receiving procurement demand, order generation, transferring to rush order, consultation with supplier, supplier capability analysis, supplier capability evaluation standard, and financial accounting	Windows .NET	Web Service

Table 2. Service Components Classification

Order management service	Storage management service	Financial management
1.1.1 Procurement requirement receiving	1.2.1 Check and sign	1.3 Financial accounting
1.1.2 Receiving date determination	1.2.2 Quality inspection	
1.1.3 Spare parts order generation	1.2.2.1 Obtaining inspection standard	
1.1.3.1 Inventory query	1.2.2.2 Nonconforming product return	
1.1.3.2 Transferring to rush order for spare parts	1.2.3 Qualified goods storage	
1.1.4 Order receiving	1.2.4 Supplier availability analysis	
1.1.5 Order information storage	1.2.4.1 Obtaining capability evaluation criteria	
	1.2.4.2 Supplier capability evaluation	
	1.2.5 Supplier rewards and punishments	
	1.2.6 Receiving information storage	
	1.2.7 Delivery	

4. Results and Discussion

After CBM and SOMA modeling, we could give a design for implementation:

(1) Mapping

Based on the above analysis on service component classification and systems, we make the decision for service implementation, and map the above service candidates to R3 system as well as cooperative work system, as shown in Figure 8.

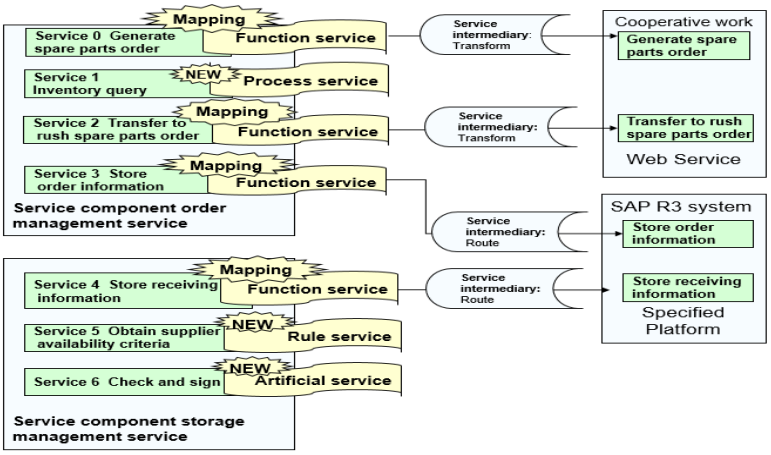

Figure 8. Service Implementation

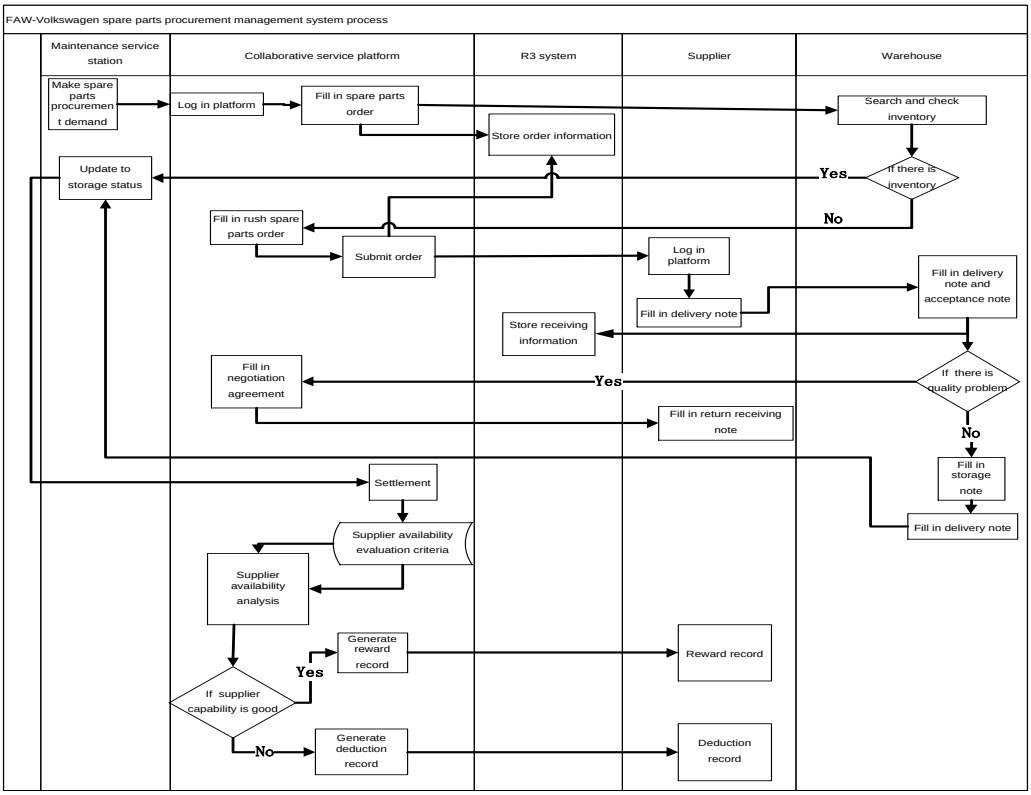

Figure 9. Revised System Flow Chart

(2) Revised system flow chart for procurement process

After above process, we get the revised system flow chart based on SOA, as Figure 9. We put the collabrative work system to optimaize spare parts procurement process. In this way, we could connect the staff, process, and information to share information. The suppliers could cooperate with after-sale department with collaberative work system; thus, the supplier could know the requirements of spare parts better and accelerate the speed of supplying after-sale spare parts.

(3) Architecture design

We conduct architecture design on the existing services, new services, and service intermediaries according to the SOA reference framework, as Figure 10. In this framework, we

integrate a new subsystem – cooperative work system into the R3 system to provide information communication. We put different services into different containers: interactive service container, process automation container, functional service container, and business rule container. Enterprise service bus (ESB) could connect different service nodes related to spare parts procurement, through route and information transformation. Thus, we could break down the boundaries among maintenance service station, spare parts suppliers, and warehouse and provide flexible service.

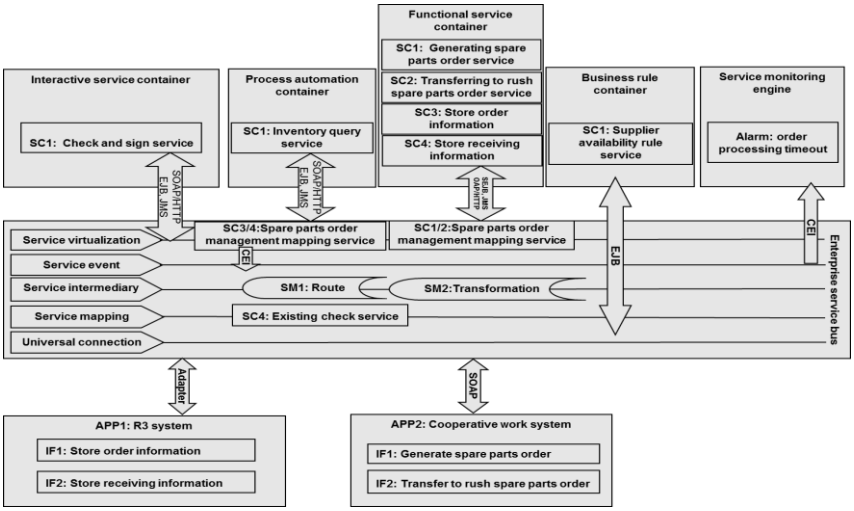

Figure 10. Architecture Design

Compared with other methods aiming at boosting procurement efficiency only, we could also solve the problem of asymmetric information among the maintenance service station, spare parts suppliers, and warehouse to improve customer satisfaction and provide flexible management of the procurement process, using the proposed architecture and revised spare parts procurement process.

5. Conclusion

Aiming at the procurement process of after-sale service spare parts of FAW - Volkswagen, and starting from enterprise positioning and business identification, this paper has completed SOA architecture realization. Firstly, analyses are made on the procurement process of after-sale service spare parts. Secondly, in the SOA modeling process, a case of SOA is studied carefully, which has constructed CBM and SOMA. Finally, we optimize the existing procurement process of automobile spare parts, so as to improve the procurement efficiency of spare parts.

Acknowledgements

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