Chapter 136
Research on the Civil Aircraft Customer Service System Simulation Based on SD Model

Jun Xu and Cui-xia Bi

Abstract Customer service ability is one of the key competitiveness in market competition for civil aircraft manufacturers who participate. To establish the mature reliable civil aircraft customer service system based on the service strategy is an important aspect to reflect the customer service skills. Based on the idea of system dynamics, this paper constructed a system dynamics model (SD model) of the customer service system of COMAC, and through the simulation of the system, analyzed the key factors which affect the running of the customer service system, to provide the basis for decision-making and measures.

Keywords Civil aircraft · Customer service system · Simulation · System dynamic model

136.1 Introduction

Customer service ability is one of the key competitiveness in market competition for civil aircraft manufacturers. To establish a mature reliable civil aircraft customer service system based on the service strategy is an important aspect to reflect the customer service skills, and has a close relationship with the well development of China's civil aircraft industry.

The customer service system of COMAC, is involving COMAC, customer service center, suppliers, airlines and other subjects. These different subjects relate to each other, and interact with each other, which together form a large complicated system. In the situation that we cannot completely achieved quantitative

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E. Qi et al. (eds.), *The 19th International Conference on Industrial Engineering and Engineering Management*, DOI: 10.1007/978-3-642-38391-5_136,

data, in order to analyze the working principle and the system function of the large and complex system better, this article chooses using system dynamics model to research problems. The article will construct SD model of the customer service system of COMAC, and through the simulation of the system, to analyze the key factors which affect the running of the customer service system, to provide the basis for decision-making and measures.

136.2 Establish the SD Model of Civil Aircraft Customer Service System

System dynamics is an efficient approach to understanding the behavior of complex system. It deals with internal feedback loops and time delays that affect the behavior of the entire system (Wang 1994), and has been applied extensively in multiple fields (Lyneis 2000; Tan and Wang 2010; Ovalle and Marquez 2003; Gao et al. 2006; Angerhofer and Angelides 2000; Kim 2003).

Customer service system of COMAC as the subsystem of the social economic system, is a organic whole, its external system is the environment, which mainly including the social, political, economic and other external environment, also including systems of suppliers, logistics system, COMAC, airlines and other clients systems, which closely related with its operation.

COMAC customer service internal system is included management system, technology system, security system, the evaluation system. The relationship of each subsystem and relationship between systems and external environment are shown in Fig. 136.1.

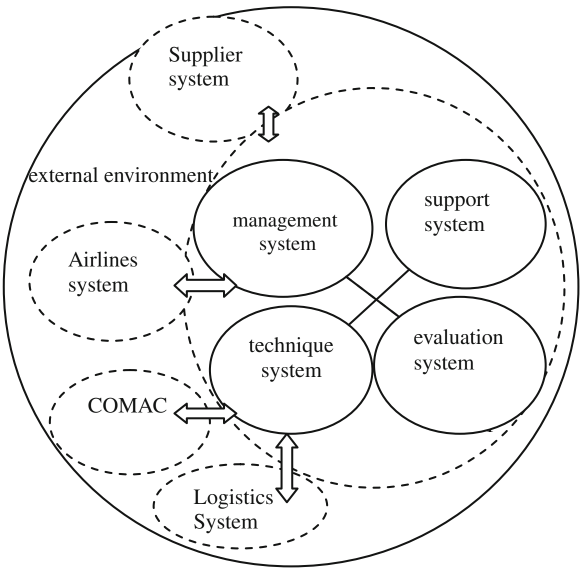

Fig. 136.1 System structure of customer service system of COMAC

Customer service system of COMAC is an open, dynamic and complex time-varying system, the main internal factors is including the demand of customer service, the progress level of science and technology (such as infrastructure construction level, inventory management ability, modernization of the organization operation and management, information level and working staff), customer service capability (include fast response time, service satisfaction) and so on. The main external factors are social and economic development level, COMAC profit level, the investment of COMAC for customer service center, the service level of the supplier and the supply capacity, logistics development level, etc.

In order to simulate COMAC customer service system, we must comprehensive considerate the internal and external influence factors.

In this paper, the SD software Vensim PLE 32 (Ventana Simulation Environment Personal Learning Edition) was applied to establish the customer service system based on its practical operation and powerful design tools.

136.3 Establish the SD Causality Diagram of COMAC Customer Service System

By the comprehensive analysis of the causality relationship between the internal and external factors of COMAC customer service system, this paper give an SD causality diagram of COMAC customer service system as shown in Fig. 136.2.

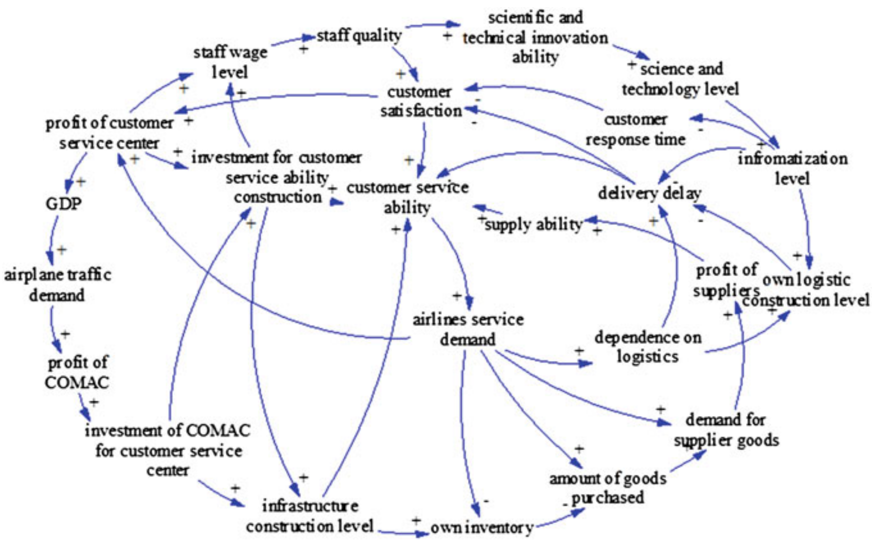

Fig. 136.2 The SD causality diagram of COMAC customer service system

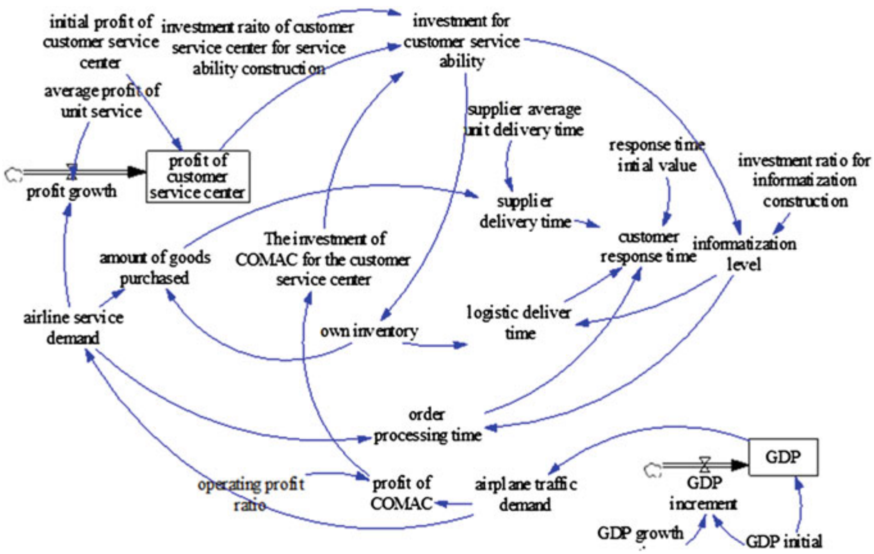

Fig. 136.3 SD flow figure of COMAC customer service system

This paper used flow figure to research the system dynamic simulation of COMAC customer service system. This paper based on the analysis of the causality diagram of COMAC service system to determine the flow figure.

In Fig. 136.3, this paper use the customer response time to stand for the service ability level of COMAC customer service system, use the information level to stand for the customer service center investment in logistic and information level construction, use the supplier delivery time to stand for the supplier availability (Hui and Jha 1999; Jenkins 1999). This paper is based on these hypotheses, to carry on the SD simulation experiment. Specific variables and equation set of this paper as follow.

136.3.1 Equation of State

In the model there are two state variables that are GDP value and profit of customer service center. Two equations of state as follow.

- GDP value = GDP initial value + GDP increment
- customer service center profit = profit initial value + profit increment

State variable is connected with its initial value and growth rate. The growth rate is description by rate equation.

136.3.2 Equation of Flow Rate

In the model there are two flow rate variables that are GDP increment and profit increment. Two equations of flow rate as follow.

- GDP increment = GDP value * GDP growth rate
- profit growth = Airline service de mand * average profit of single service.

136.3.3 Assistant Equations

Assistant equations can make the rate equation be expressed briefly. In this paper the assistant equations as follow.

- The civil aircraft traffic demand

In this paper the civil aircraft traffic demand can be obtained by regression analysis based on the proportion of annual air transportation in GDP value.

According to the data of China Statistical Yearbook from 2000 to 2010, by simple linear regression we got the formula as follow.

$$y = 0.0081 * x + 565.08, \quad R^2 = 0.9756 \tag{136.1}$$

We can see the goodness of fit is greater than 0.95, it is means that the fitting precision is high, the equation is available. The unit of airplane traffic volume is hundred million passenger-kilometers.

- Profit of COMAC

Suppose the relationship between the plane traffic demand and the operating profit is linear, the operating profit ratio is referred to the ratio of BOEING, and set it to be 8 %. The profit of COMAC can be obtained by the formula as follow.

The Profit of COMAC = The civil aircraft traffic demand * the operating profit ratio.

- Airline service demand

Suppose the relationship between the airplane traffic demand and the service demand is linear. And also suppose the service demand of unit traffic demand is 0.3.

- The investment of COMAC for the customer service center

Suppose the investment takes up about 20 % proportion in the profit of COMAC.

- The investment for the construction of customer service ability

This investment = the investment of COMAC for the customer service center + profit of the customer service center * the investment ratio for customer service ability construction

Suppose the ratio is 30 %.

- Information level

Information level = the investment for customer service ability construction * the investment ratio for information construction

- Order processing time

Order processing time = square of airlines service demand/Information level

- Own inventory

Own inventory = the investment for customer service ability construction * 0.5 * 0.8

Own inventory is the spare parts of airlines demand which can be met by their own stock. We suppose there is about 50 % of the investment for service ability construction of the customer service center to be used for spare parts inventory level construction. And suppose there is about 80 % of the own inventory can meet the demand.

- Amount of goods purchased

Amount of goods purchased = airlines service demand- own inventory

- Logistics delivery time

Logistics delivery time = Square of own inventory/information level

- Supplier delivery time

Supplier delivery time = Amount of goods purchased * Supplier average unit delivery time

In this paper the unit delivery time is supposed to be 2.

- Customer response time

Customer response time = Supplier delivery time + Logistics delivery time + Order processing time

136.3.4 Model Constant

- GDP initial value

This paper chose the value of 2010 to be the initial value; it is about 39 trillion RMB.

- The initial value of Customer service center profit

This paper chose the value of 2010 to be the initial value. In this year the profit is −790, the income is about it is about 95.33 million RMB.

- GDP growth ratio

This paper chose the average growth ratio between 1980 and 2010 to be the GDP growth ratio. By calculating it can be determined to be 10 %.

- Average profit ratio of single service

Suppose average profit ratio of single service is 15 %.

- The investment ratio for information construction

Suppose this ratio is 20 %.

136.4 The System Simulation Results Analysis

This paper based on the above assumptions to carry on the simulation of the model, took the customer response time to be the target variable, to examine the response time change level in different conditions. In this paper result 1 is obtained based on the original hypothesis. Result 2 is obtained based on the condition that the ratio of investment for information construction is raised to be 40 % and the other conditions remain unchanged. Result 3 is obtained based on the condition that the ratio of investment for inventory construction is raised to be 60 % and the other conditions remain unchanged. Result 4 is obtained based on the condition that supplier average unit delivery time changed to be 2.5 and the other conditions remain unchanged. Result 5 is obtained based on the condition that the ratio of investment of COMAC changed to be 40 % and the other conditions remain unchanged. Result 6 is obtained based on the condition when the ratio of investment for inventory construction has been raised to be 0.5 and the other conditions remain unchanged. In the research the choice of time span for 5 years, and the result as follow.

We can see from Fig. 136.4 that, the best results are result 1 and result 2, the better results are result 5 and result 6, the curve of the result 3 has a transitory decline at first and then rose again as same as result 4. So we can get some inference from this.

- The result 2 shows that the information construction level has large contribution to the customer response time, so the service center should strengthen the construction for it. Here the information network not merely be the construction

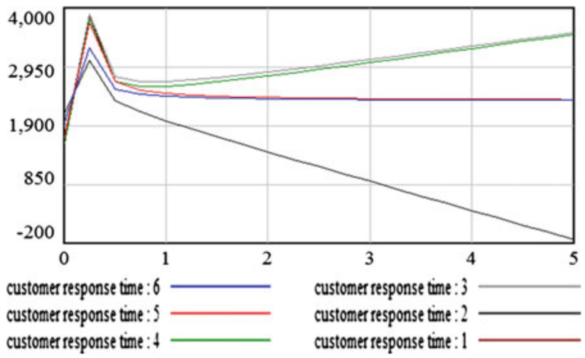

Fig. 136.4 Contrast figure of customer response time

of information network system, but also be the logistic network system. For the customer service center of COMAC, if it has its own logistic team, it can save the customer response time and rise customer satisfaction.

- We can see from the result 5 and result 6 that at present the construction for basic ability should be strengthened, but after the time when basic ability had met the demand, more investment will not bring about more contribution.
- We can see from result 3 that when the center input too much on the inventory construction, the repay may not homologous be more, but may be bad. That because when the investment for inventory is too much, the spare parts inventory will be too much, the pressure on the management of inventory will be too high, this may lead to a negative influence for the operation of the center. That is in accordance with the principle that Inventory and not the more the better.
- We can see from result 4 that the supplier average unit delivery time does negative influence for the customer service ability. So in the process of the customer service center development, it should be put more attention on the choice of suppliers.

136.5 Conclusion

Insufficient and inaccuracy data, difficulty of quantifying the relationship are knotty problems in the research of social and economic problems study. The structure of the SD model is based on feedback loop, the existence of the multiple feedback loops make the system behavior pattern is no sensitive to parameters. So the system behavior can be similar so long as the parameters are in accepted scope. Just because this principle this paper gave the SD simulation of the civil aircraft customer service system, and the result is objective and credible.

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