http://ansinet.com/itj

ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 13 (8): 1572-1576, 2014
ISSN 1812-5638 / DOI: 10.3923/itj.2014.1572.1576

Capability Maturity Assessment Method of Civil Aircraft Customer Service System

[1,2]Xu Jun, [3]Chen Lin and [2]Sun Lei
[1]School of Economics and Management, Beijing University of Aeronautics and Astronautics, Beijing, 100191, People's Republic of China
[2]Comac Shanghai Aircraft Customer Service co., LTD., Shanghai, 200241, People's Republic of China
[3]The Law School of Shanghai Jiaotong University, Shanghai, 200030, People's Republic of China

Abstract: According to the basic ideas of the maturity model (Capability Maturity Model, CMM), the maturity model and its capability maturity comprehensive evaluation method of civil aircrafts' customer service system are established from five aspects: Engineering and technical support, marketing and customer support, spare parts support, flight training and technical publications. Referencing survey results of the customer service satisfaction from airlines, weights was determined by expert advice and the multi-level fuzzy comprehensive evaluation method was used, to evaluate maturity level on the actual customer service system of Comac's customer service center and to make the current maturity level clear. Finally, the continuous improvement suggestions were put forward.

Key words: Civil aircraft, customer service system, capability maturity, multi-level indicators, fuzzy evaluation method

INTRODUCTION

Today, the ability of civil aircraft customer service has become one of the key factors of civil aircraft manufacturers to participate in market competition. For civil aircraft industry, it is very important for the customer service ability of civil aircraft to build mature and rational customer service system which is suitable for national conditions and market demand of commercial service strategy.

Capability Maturity Model (CMM) was developed by Carnegie Mellon University's Software engineering institute for organization development in September 1986. CMM provided a framework of capability stepwise evolution process which could help developers to s elect process-improvement strategies by determining their current process maturity and identifying the most critical issues to improve their software quality and process. It was the gradual improvement of the management level and continuous process improvement. Since the launch of Capability Maturity Model (CMM) (Paulk, 1995), it has had a profound influence on the software industry around the world and achieved good success of solving the problem of software process (Herbsleb *et al*., 1997). This tool also has been gradually applied in various fields and then a multiple models based on CMM appeared, constituting the CMM cluster which is known as: Personnel Capability Maturity Model (P-CMM) (Curtis *et al*., 2009), Software Acquisition Maturity Model (SA-CMM) (Jiang *et al*., 2004), the Systems Engineering Capability Maturity Model degrees (SE-CMM), Project Management Capability Maturity Model (PMMM). At present, quite a few scholars are trying to apply CMM model in other areas, such as the construction enterprise project management, marketing, enterprise knowledge management, teaching management, teaching management and so on.

But there are only few research and development for the capability maturity model in the service area, such as the Service Capability Maturity Model (SEE-CMM) (Niessink *et al*., 2005) and IT service capability maturity model (Becker *et al*., 2009) . So it would be very meaningful to apply the Capability Maturity Model (CMM) to research the customer service system of civil aircraft whose role for the enterprise's sustainable development would be more and more important. So it requires the improvement and mature of the customer service system in the enterprise development and market competition. The CMM are used to divide maturity level of customer service system and determine the key process areas of each maturity level and set up goals and improvement order.

Civil aircraft customer service should include but not limit to the following content: The maintenance engineering support, technical publications, spare parts

Corresponding Author: Sun Lei, Comac Shanghai Aircraft Customer Service co., LTD., Shanghai 200241, People's Republic of China, Tel: +0086 18601693182

support, customer training, flight operation support, engineering services, technical services, fleet monitoring, field service, fast response. For the international famous manufactures, such as boeing and airbus, the customer service has formed mature systems of customer service after years of development which enhance their competitiveness for they always on the important position of enterprise development. But the civil aircraft development is relatively late in our country and the customer service is still at the exploration stage. According to the CMM maturity classification concept, the CMM is assessed to five level by the extent to which the process is initial, basic, defined, managed, optimal. The five level of capability maturity is shown in Fig. 1.

The characteristics of the five maturity levels are described respectively as follows:

The initial level: In this stage, the civil aircraft customer service system has not yet finished and customer service involves only simple maintenances and spares support services. Business scope is small, stable customer relationship has not yet been established and service product or organization has no standardized and not mature. Customer service ability is low and at the early stage of development.

The basic level: In this stage, the overall framework of the basic civil aircraft customer service system is basiclly formed after training process, organization structure is more reasonable, customer service has accumulated some experience through a long time, business gradually is involved more comprehensive, the work team has a large scale, service process is more standard and preliminary customer service network, support network for supplier and spare parts support network is bulit and a basic ability of customer responsiveness, maintenance support, engineering technical support etc is built. But the business is still in the maturing and perfecting stage.

The defined level: After years of development, at this stage, the civil aircraft customer service system has developed relatively completed, with perpetual optimized organization, the standard customer service process, aircraft reliability monitoring management ability, rapid response ability, engineering technical support ability, aircraft maintenance support ability and the professional site representative team, management capabilities of suppliers, spare parts support network, as well as advanced technical publications compile ability, meeting the need of the large passenger aircrafts and regional aircrafts both at home and abroad. It has achieved international standards or requirements in customer

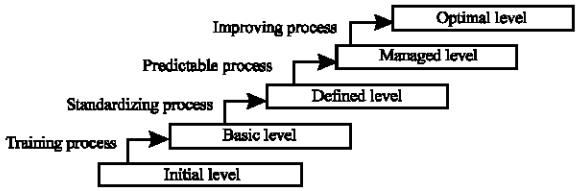

Fig. 1: Five levels of capability maturity

training quality, spare parts support system, technical publications compile level, customer support system and so on to.

The managed level: At this stage, the civil aircraft customer service system is almost mature. For engineering technical support, it has formed global service network, with the ability to support the customers both at home and abroad. For flight training support, it has the ability to aircraft operation support, customers training, research ability and so on core competencies. For spare parts support, it has the mature spare parts support network and logistics network and provide spare parts sales, leasing, agent, consignment, etc. It can provide all-inclusive service, paid by the hour service and other service products with high customer satisfaction. For technical publication support, it can provide a variety of products. It has mature customer relationship management system, to communicate with the customers and the digitization construction achieves a higher level.

The optimal level: In this stage, the ability of customer service system becomes one of the core competitiveness of enterprises with the characteristics of the brand customer service products. Enterprise has its own research and development team, its own independent intellectual property rights of new technology and new theory. Civil aircraft customer service system is one part of enterprise development and has a strong vitality and sustainable development.

Considering international experience and the actual requirement of the civil aircraft customer service, we evaluate the civil aircraft customer service capability maturity respectively from five big aspects, including the engineering and technical support, marketing and customer support, spare parts support, flight training and technical publications, about 18 items. The indicators of of capability maturity is shown in Table 1.

CMM ESTABLISHED AND ANALYZED

Comac's customer service center was established in 2008, has been completed regional aircraft flight training

Table 1: Indicators of capability maturity

Target	First Level indicators	The secondary indicators
The civil aircraft customer service capability maturity	Engineering technical support	Reliability monitoring management ability
		Quick response ability
		Engineering and technical support ability
		Aircraft maintenance support capability
		Professional site team
	Market and customer support	International business ability
	Spare parts support	Supplier customer service management capabilities
		Customer relationship management skills
		Customer product development and sales ability
		Warranty claim service ability
		Supplier support network
	Flight training	Materials logistics network
		Supply chain service business and service products
		Customer training ability
	Technical publications	Flight operation support capability
		Training research ability
		Advanced technical publications by ability
		Whole life tracking management ability

center and the construction of spare parts support center and now it is at the early stage of development and customer service ability is in the construction stage.

The fuzzy comprehensive evaluation model: Fuzzy comprehensive evaluation method is a assessment method that applies fuzzy mathematical principles to evaluate things and phenomenon affected by variety of factors. It applies the membership degree to change the qualitative evaluation into quantitative evaluate on, to gives object which is restricted by various factors to make an overall evaluation. It has the characteristic that results are clearly, systemic is strong and can well solve the problems of fuzzy and hard to quantify, suitable for all kinds of uncertain problems (Huang and Wang, 2004; Bai *et al*., 2010).

The membership functions can be determined based on the characteristics of the various evaluation factors. There are many kinds of methods to determine the membership functions, for example, F statistical method, distribution of various types of F. Of course, the value can be given directly by experts.

Specific steps are as follows:

- Determine the factor set of evaluation object, that is $U = \{u_1, u_2, ..., u_n\}$. It is a set composed of m kinds of evaluation factors
- Determine the evaluation set, that is $V = (v_1, v_2, ..., v_m)$. It's a set composed of n kinds of evaluation standards. Here, v_i may be "good", "important" and "mature" and so on
- Construct single-factor evaluation matrix. Evaluate single-factor and then get vector R as shown in Eq. 1:

$$R = \begin{bmatrix} R_1 \\ R_2 \\ \vdots \\ R_n \end{bmatrix} = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ r_{n2} & r_{n2} & \cdots & r_{nm} \end{bmatrix} \quad (1)$$

A single-factor evaluation matrix R is constituted by numbers of single-factor evaluation vector put together. The factor weight set of the second index factors set $A = \{a_1, a_2, \cdots, a_n\}$ as , where $a_i > 0$ and:

$$\sum_{i=1}^{n} a_i = 1$$

According to fuzzy transform principle, $B = (b_1, b_2, ..., b_m) = AR$, b_i is the membership degree.

For the first evaluation set, it can get C according to $C = A.B = (c_1, c_2, c_3, c_4, c_5)$ which is the general objective evaluation vector. A is the value of the weight of evaluation index for the first layer.

The weight of a judge set is $G = (g_1, g_2, ..., g_m)$. g_i is a numeric value. So the single factor integrated evaluation can be got by formulation $X_i = B.G^T$ and the multi-factor comprehensive evaluation value can use the formula $X = C.G^T$ to get.

Determining evaluation system and the weight vector: The evaluation factors system was determined by the way of actual investigation, experts opinions, reference of related research. The assessment factors system U and weighting vector A are get by Delphi method combined with analytic hierarchy process, regardless of the weights of experts themselves. Which are shown in Table 2.

Determine the fuzzy relationship matrix: The evaluation sets of customer service maturity are : $V = \{v_1, v_2, v_3, v_4,$

Table 2: Weight of two evaluation indicators

Indicator	Maturity				
Ui	0.2114	0.2	0.2068	0.1932	0.1886
Uij	0.1990	0.1850	0.3390	0.3352	0.489
	0.1974	0.2148	0.3408	0.3408	0.511
	0.2012	0.2124	0.3202	0.3240	
	0.2023	0.1850			
	0.2001	0.2029			

v_5} = {Initial stage, the simple specification level, the standard level, maturity level, continuously improve level}.

According to the results of 10 experts who are invited to score , fuzzy relationship matrix are get as follows:

$$R_{u1} = \begin{bmatrix} 0.4 & 0.5 & 0.1 & 0 & 0 \\ 0.3 & 0.6 & 0.1 & 0 & 0 \\ 0.2 & 0.6 & 0.2 & 0 & 0 \\ 0.2 & 0.7 & 0.1 & 0 & 0 \\ 0.3 & 0.5 & 0.2 & 0 & 0 \end{bmatrix}$$

$$R_{u2} = \begin{bmatrix} 0.8 & 0.2 & 0 & 0 & 0 \\ 0.2 & 0.6 & 0.1 & 0.1 & 0 \\ 0.3 & 0.5 & 0.2 & 0 & 0 \\ 0.7 & 0.3 & 0 & 0 & 0 \\ 0.6 & 0.4 & 0 & 0 & 0 \end{bmatrix}$$

$$R_{u3} = \begin{bmatrix} 0.2 & 0.7 & 0.1 & 0 & 0 \\ 0.5 & 0.4 & 0.1 & 0 & 0 \\ 0.8 & 0.2 & 0 & 0 & 0 \end{bmatrix}$$

$$R_{u4} = \begin{bmatrix} 0.1 & 0.6 & 0.3 & 0 & 0 \\ 0.2 & 0.6 & 0.2 & 0 & 0 \\ 0.9 & 0.1 & 0 & 0 & 0 \end{bmatrix}$$

$$R_{u5} = \begin{bmatrix} 0.2 & 0.2 & 0.6 & 0 & 0 \\ 0.2 & 0.7 & 0.1 & 0 & 0 \end{bmatrix}$$

Determining the results vector: The evaluation vector of customer service capability maturity is get by putting corresponding factor weights and evaluation matrix into fuzzy evaluation model, the calculation results are as follows:

Engineering technical support ability evaluation vector:

$$B_{u1} = A_{u1} \cdot R_{u1} = (0.1990, 0.1974, 0.2012, 0.2023, 0.2001) \cdot \begin{bmatrix} 0.4 & 0.5 & 0.1 & 0 & 0 \\ 0.3 & 0.6 & 0.1 & 0 & 0 \\ 0.2 & 0.6 & 0.2 & 0 & 0 \\ 0.2 & 0.7 & 0.1 & 0 & 0 \\ 0.3 & 0.5 & 0.2 & 0 & 0 \end{bmatrix}$$
$$= (0.2796, 0.5803, 0.1401, 0, 0)$$

The other customer service evaluation vectors are get in the same way:

B_{u2} = (0.5060, 0.4087, 0.0640, 0.0215, 0)
B_{u3} = (0.494, 0.4376, 0.0680, 0, 0)
B_{u4} = (0.3933, 0.4380, 0.1687, 0, 0)
B_{u5} = (0.2000, 0.4555, 0.3445, 0, 0)

So:

$$B = \begin{bmatrix} 0.2796 & 0.5803 & 0.1401 & 0 & 0 \\ 0.5060 & 0.4087 & 0.0640 & 0.0215 & 0 \\ 0.4944 & 0.4376 & 0.0680 & 0 & 0 \\ 0.3933 & 0.4380 & 0.1687 & 0 & 0 \\ 0.2000 & 0.4555 & 0.3445 & 0 & 0 \end{bmatrix}$$

Multi-factor fuzzy comprehensive evaluation matrix: The multi-factor comprehensive evaluation vector for customer service capability maturity can be get according to the above results:

$$C = A \cdot B = (c_1, c_2, c_3, c_4, c_5) = (0.3763, 0.4654, 0.1540, 0.0043, 0) \quad (4)$$

The evaluation vector is the comprehensive result of the single factor evaluation result above which is the comprehensive evaluation vector for the customer service capability maturity. It considers not only the influence of the first level of evaluation index, also the effect of secondary indexes, thus kept all evaluation information at all levels.

Supposing the weight of each evaluation grade of the judge set V = (v_1, v_2, ..., v_m) is G = (1, 2, 3, 4, 5), respectively represent initial stage, the simple specification level, the standard level, maturity level, continuous improvement.

The single factor evaluation results can be obtained $X_{u1} = B_{u1} \cdot G^T = 1.8605$.

The corresponding indicators of single factor evaluation results are get in the same way:

$$(X_{u1}, X_{u2}, X_{u3}, X_{u4}, X_{u5}) = (1.8605, 1.6014, 1.5736, 1.7754, 2.1445) \quad (5)$$

Multi-factor evaluation results are obtained by formula X = C.G^T, that is the capability maturity of customer service system is 1.7734. The result shows that

the maturity level of customer service center system is between the initial level and simple specification level and tends to simple specification level. This result matches the situation that the customer service center was just built and the business is not comprehensive, with little accumulate experience.

CONCLUSION

It can be seen from the above evaluation results, the customer service system is still in a lower maturity level, with customer service ability needing to improve. Analyzing evaluation results of each single factor, it can be seen that the corresponding technical publications business maturity is highest, followed by engineering and technical support, flight training, marketing and customer support, the last is spare parts support. This shows that customer service center should pay attention to the supply chain support network of suppliers, logistics network first, next to the customer relationship maintenance, flight training ability, engineering technical support, etc., because they are still in the primary stage. So the departments of customer service company need to accumulate experience, constantly improve customer service system, strengthen the investment in main business and standard the job process, to adapt to the future development needs.These results are applied in the actual enterprise strategic planning and day-to-day operations and play a positive role.

REFERENCES

Bai, S., S. Li, R. Feng and Y. Guo, 2010. Organizational project selection based on fuzzy multi-index evaluation and bp neural network. Proceedings of the International Conference on Management and Service Science, August 24-26, 2010, Wuhan, pp: 1-5.

Becker, J., R. Knackstedt and D.W.I.J. Poppelbub, 2009. Developing maturity models for IT management. Bus. Inform. Syst. Eng., 1: 213-222.

Curtis, B., B. Hefley and S. Miller, 2009. People Capability Maturity Model (P-CMM), version 2.0. Carnegie Mellon University Research Showcase, Software Engineering Institute. http://repository. cmu.edu/ cgi/viewcontent.cgi?article=1048&context=sei.

Herbsleb, J., D. Zubrow, D. Goldenson, W. Hayes and M. Paulk, 1997. Software quality and the capability maturity model. Commun. ACM, 40: 30-40.

Huang, L.M. and H. Wang, 2004. Multilevel fuzzy comprehensive evaluation method of network security. J. Liaoning Tech. Univ. (China), 23: 510-513.

Jiang, J.J., G. Klein, H.G. Hwang, J. Huang and S.Y. Hung, 2004. An exploration of the relationship between software development process maturity and project performance. Inform. Manage., 41: 279-288.

Niessink, F., V. Clerc and H. van Vliet, 2005. The IT service capability maturity model. Retrieved January 3, 2005.

Paulk, M.C., 1995. The Capability Maturity Model: Guidelines for Improving the Software Process. Addison Wesley Pub. Co., Michigan, USA., ISBN-13: 9780201546644, Pages: 441.