

Customer pattern search for A/S association in manufacturing

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Abstract: Manufacturing corporations aim to sell their goods while they try to keep a sound customer relationship by providing high quality after-sales service (A/S). This is because while such services have always been important in marketing and sales industries, they are currently gaining importance in the manufacturing industry as well. Therefore it is important to identify the needs of different customer groups and to provide respective A/S for each group accordingly. In this study, we propose a framework that consists of fuzzy clustering and an association rule to identify customer groups and their needs. We first carried out fuzzy clustering of customers in terms of indicators of CSI (Customer Satisfaction Index). Next, the association rule is used to grasp the kind of A/S that customers consider important. Our results identified three groups of customers and their needs: Group 1 represents those who have a high degree of satisfaction, loyalty and high number of complaints. This group considers the home visiting service most important. Despite the fact that the Group 1 has high degree of complaint occurrence, they show a high degree of loyalty. Group 2 has very high degree of satisfaction and loyalty with a low level of complaints. This group considers important the A/S factors in all of service sections, including at the call center, the home visiting service, and claim handling. Group 3 has average satisfaction, number of complaints, and loyalty. Group 3 customers put weight on A/S factors dealing with the call center and the home visiting service. We expect that manufacturing firms can strengthen CRM (Customer Relationship Management) by offering tailored A/S for each group accordingly.

Keywords: A/S (After-sales Service), fuzzy clustering, association rule, CRM

1 Introduction

Currently, service programs are gaining importance in the manufacturing sector. Manufacturing firms make an effort to sell their goods, keep customer loyalty and create growth opportunities in markets. Accordingly, 'servicization' has become prevalent in

the manufacturing industry [1, 2].

Excellent service affects the retention of existing customers and inducement of new customers. As a result, it brings high customer retention and satisfaction [3]. A/S (after sales service) can play a very important role in manufacturing firms, because

manufacturers can get information about their product and service from customers through the processes of A/S. Therefore, many manufacturing firms concentrate on improving customer satisfaction via A/S. However, customers' needs for A/S are not homogeneous throughout.

The main objective of this paper is to find the satisfying A/S characteristics for specific groups of customers. In this manner, we expect to provide customer-tailored A/S in manufacturing.

In order to accomplish this objective, we propose a framework that consists of the clustering of customers in terms of CSI (Customer Satisfaction Index) toward the A/S provided, as well as extracting the association of the preferred kind of A/S for each clustering of customers. The result of this research is expected to offer useful strategic information for each cluster of customers.

The organization of this paper is as follows. In Section 2, we introduce a proposed framework which consists of the two steps. In Section 3, we apply the proposed approach to the A/S data of manufacturing companies in Korea. Finally, in Section 4, we summarize the study results and offer valuable information for the effective management of customers by manufacturing industries.

2 Research Framework

We propose a research framework to analyze customer patterns in terms of A/S. The methodology is composed of two steps as shown in Fig.1.

At Step 1, we divide customers who use A/S of manufacturing firms into several groups using Fuzzy C-Means (FCM) clustering via customer satisfaction, loyalty, complaints that can be obtained as resulting indicators of CSI.

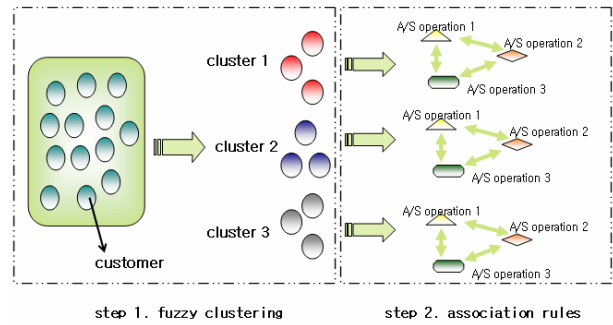


Fig. 1 Proposed research framework

Various CSI models which are ACSI (American Customer Satisfaction Index) and ECSI (European Customer Satisfaction Index) use multiple indicators to measure overall customer satisfaction, complaints, and loyalty via customer expectation, perceived quality, and perceived value [4, 5]. They are measured in terms of the variables described in Table 1.

The advantage of clustering analysis is useful to identify groups of customers with similar characteristics.

In Step 2, we use association rules to determine which A/S operations each group of manufacturing customers thinks are very important. A/S operations in the call center, the home visiting service, and claim handling.

Identification of association rules will provide feedback for strategic customer management of manufacturing firms.

In the next section, we apply the proposed methodology to the case of survey data regarding the A/S of manufacturing companies in Korea.

3 Case Study

In this section, we apply the proposed analysis framework to A/S activities of manufacturing companies in order to examine what kind of A/S

operations affects each group of manufacturing customers.

3.1 Data collection and pre-analysis

In order to attain our study objective, we surveyed customers who have experienced A/S from two manufacturing companies. One produces a water purifier and a water softener. Customers who rented or purchased its products receive a regular A/S visit. The other produces home appliances such as TV's, refrigerators, and air conditioners. It provides A/S in the form of a home visit upon request when products are out-of-order.

The questionnaire covers evaluation components of resulting indicators (customer satisfaction, loyalty, complaints) of CSI models and A/S operations along with customers' personal information. The measurement variables described in Table 1 and A/S factors in Table 2 were the components of involved

quality with a corporation's service [4, 5].

Each variable was measured in a 10 point scale. For example, if the overall satisfaction measurement variable is 10 points that means the customer is greatly satisfied, and when the frequency of complaints measurement variable is 10 points that means the customer is not at all satisfied.

The survey was conducted in 2006 during the month of December through a professional survey agency. This agency completed the survey with an internal panel consisting of three-hundred seventy-six people who responded to an on-line web survey.

Based on the survey data for A/S quality indicators, we conducted CFA (Confirmatory Factor Analysis) to evaluate the validity of latent factors in terms of measurement variables, as shown in Table 1.

Table 1. Result of confirmatory factor analysis

Latent Factor	Measurement Variable	Loading Values
Customer Expectation	·overall expectation of companies' service	0.83
	·expectation regarding customization	0.83
	·expectation regarding reliability	0.88
Perceived Quality	·overall evaluation of companies' service	0.93
	·evaluation of customization experience	0.92
	·evaluation of reliability	0.93
Perceived Value	·rating of quality given price	0.92
	·rating of price given quality	0.93
Customer Satisfaction	·overall satisfaction	0.91
	·expectancy disconfirmation	0.57
	·received service versus ideal service	0.61
Customer Complaints	·level of customer complaints to a company directly about a service	0.71
	·frequency of customer complaints	1.00
Customer Loyalty	·likelihood to recommend other people to purchase companies' services	0.95

	·likelihood to repurchase companies' services	0.90
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The loading value is the correlations between the measurement variables and the latent factor. For example, Table 1 shows the overall expectation of a companies' service, expectation regarding customization, and expectation regarding reliability scales load onto the customer expectation factor.

Our results indicate that the loading values are mostly above 0.8, which suggests confirmed validity about the composition of latent variables and the selection of measurement variables.

3.2 Fuzzy clustering

In this section, we carry out clustering to divide customers into groups using confirmatory factor analysis. We use MATLAB to do FCM (Fuzzy C-Means) clustering using the latent factors such as customer satisfaction, complaints, and loyalty.

The K-means algorithm is required to define the number (c) of initial seeds of FCM clustering. The FCM clustering uses c for k that results from K-means clustering [6, 7, 8]. Accordingly, to the result of K-means clustering, 3 is suitable for c. So, we use 3 initial seeds for FCM clustering. The result of FCM clustering is that the 376 customers were segmented into three groups, with 106 customers belonging to Group 1, 166 customers belonging to Group 2, and

104 customers belonging to Group 3. The characteristics of each group are as follows:

Group 1: The average customer satisfaction and loyalty are about 8 points, and complaint is about 7 points on average. It means that customers grumble about the company's services very often, although the overall satisfaction level is high.

Group 2: The average of customer satisfaction and loyalty are 8 points, but complaint is on average 2 points. Customers of this group are very positive about the service of the company.

Group 3: The customer satisfaction, loyalty and complaint values are about 5 points on average. They are neutral about the service of the companies.

3.3 Association rule

In this section, we extract the association rules from each cluster of FCM. We want to find out what kind of A/S operations customers of each group think are important. In Table 2, A/S operational characteristics are classified into call center, home visiting service, and claim handling.

We analyze association rules using SAS Enterprise Miner. Because many A/S operations are considered, we consider four items in the association rules and use confidence levels of 80%.

Table 2. The A/S operational characteristics

Field	Requirement	A/S operations
Call center	convenience of use	conversation by phone at night and on holidays, various and simple methods of inquiry
	speed of access	short call waiting time, short ARS opening line
	specialty of service representative	understanding customer needs, knowledge of company rules, knowledge and technical complexity of product/service, using easy terminology, ability to communicate
	speed of answering and handling	speed of handling problems and requirements, speed of connecting other A/S departments
	positiveness of	sufficient explanation, leading counseling, satisfactory call (making a call

	service representative	to check customer satisfaction after A/S)
	kindness of service representative	kindness of speech and sound, proper pace and pronunciation, listening to customer needs carefully, sympathy and response to customer needs, sincere explanation
Field service	convenience of use	providing service at night and on holidays
	timing of appointment	confirmation of visit appointment and visit, pre-contact of visit delay, abiding by visiting time and delayed visiting time
	visiting technician's ability	technical competence, performing exact A/S, using simple terminology, technical responsiveness
	speed of handling	prompt visit, promptly performing A/S and supplying of parts
	visiting technician's positiveness	sufficient explanation before and after repair
	visiting technician's kindness and neatness	showing identification, good attitude, cleanliness, listening to customer needs carefully, technician's appearance
Claim handling	convenience of claim handling	simple method of inquiry, claim contacts, simple compensation procedure, providing information on handling procedure continuously
	speed of answer and handling	speed of registration, providing adequate response, speed of compensation procedure
	propriety of claim handling	mediation from consumer protection board, possession of a certification for protecting customer rights, attentiveness to employee reaction to claim

Table 3 shows the result of the association rules in each group.

Table 3. The result of association rules in each group

Group	A/S factors	Support (%)	Confidence (%)	Lift
1	providing adequate response, sufficient explanation after repair & promptly pe A/S => providing service at holiday	20.72	100	1.36
2	attentiveness to employee reaction to claim, providing adequate response & providing service at holiday => sufficient explanation	28.92	82.76	1.02
3	technical competence, providing service at holiday & sufficient explanation => handling problems	20.19	84	1.3

Customers in Group 1 think the following A/S operations as important: providing an adequate response in claim handling, sufficient explanation after repair, promptly performing A/S, and providing service during a holiday.

The important A/S operations in Group 2 are as follows: nipping employee's attitude in the bud about a claim, adequate response in claim handling, and providing home visiting service during a holiday. Customers in this group also consider sufficient explanations from the service representative at the call center.

Group 3 thinks that technical competence of the

visiting technician, providing home visiting service during the holiday, and sufficient explanations from the call center are the most important A/S. Then customers in Group 3 concentrate on the speed of handling problems at the call center.

Generally, a high rate of support and confidence has a strong mutual relation. But significant association rules are those which have a lift value higher than 1. All groups showed lift above 1. Therefore, we can say that all groups have a strong relationship.

4 Conclusion

Lately, manufacturing firms make an effort to sell their products, maintain customer relationships, and improve market competitiveness through A/S. These efforts of manufacturing firms contribute toward keeping existing customers and attracting new customers. As a result, they grow in the marketplace and receive high levels of return.

Manufacturing companies can gain information about the design of products and service, quality, selling, and marketing activity from customers. Also, corporations achieve higher customer satisfaction and loyalty via A/S. So, many manufacturing corporations should concentrate on A/S.

In this research, we used fuzzy clustering and association rules to find out which A/S operations each group of manufacturing customers thinks are very important.

Group 1 considers the home visiting service most important. Customers in Group 1 grumble about the company's service very often, but they have a high level of loyalty. This is because manufacturing firms provide better service for customers and do not neglect customer's requirements.

Group 2 has a very high level of satisfaction and loyalty along with a low level of complaints. This group considers important A/S factors in all of the service sections, including at the call center, the home visiting service, and claim handling. Many firms think that the Group 2 is the best customers. However, customers in Group 2 do not give any critical feedback to firms. Companies need to be informed about customers' inconvenience, complaints, and requirements. We expect that manufacturing firms can strengthen customer relationship by providing improved services and offering tailored A/S for each group.

Previous studies pursued the enhancement of company competitiveness through improving the quality of products. But this research suggests that focusing on A/S in manufacturing corporations is of increasing importance to improve competitiveness.

We expect that the methods and results of this research will be valuable not only for A/S in manufacturing but also for the whole service industry. Also, this research suggests a powerful strategy is one of keeping existing customers through paying careful attention to customer responses. Further research will apply these methods to an entire service area such as mobile communication or internet service.

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