Warranty Offering Customization for Configurable Products

Yiliu, Liu*, Zixian, Liu
School of Management, Tianjin University, Tianjin, China, 300072

* Corresponding author: Email: leoyiliu@hotmail.com, Tel: 86 138 1102 2776
1 Background

Nowadays, manufacturing companies are trying to provide customers satisfying products with acceptable cost through the mass customization mode. Product configuration, as a key stage of customization, is a process of selecting suitable and compatible components for a product (generally one component is selected for each type), arranging them and then seeking one or more optimal options. Through configuration, customers can choose their desired product model from a product family.

Almost all aspects of a product are involved in configuration, including warranty period and relational warranty fees. A warranty is a contractual agreement between the seller and the buyer of a product, and this contract specifies product performance, buyer responsibilities, and what the warrantor will do if the performance of a product is below the expectation of a user. In some businesses, e.g. PC and cell phone, warranty is regarded as the same kind of independent variable as internal properties of a product, such as monitor type and memory capacity of a computer. For configurable products, although there are always several warranty options offered by the vendor, e.g. one year basic warranty without charge, two years warranty with additional $20, three years warranty with additional $50, their difference only comes from the warranty period rather than product properties. That is to say, these warranty offerings do not express inherent difference between different configuration schemes. For example, warranty offerings to a customer who orders a state-of-art computer are always totally same as those to a counterpart who orders an economic model. Actually, these two products are different in quality, repair cost and difficulty. In theory, warranty should provide customers with differentiation of the manufacturer.

Here, the authors propose a warranty cost based warranty offering method, so as to provide varied warranty plans for different product characteristics and different requirements of customers. For a given warranty period, warranty cost of a product depends on the reliability of, because it is always generated in repair, call back, replacement and maintenance practices. Reliabilities of different product configuration schemes maybe different, as well as their replacing component costs and complexities, therefore, their warranty costs can be supposed different.

2 Research Methods

In this study, a configuration scheme means a result of a configuration process, which is the model of a product, and can be expressed as a combination of components, relations and constraints. Meanwhile, a warranty plan is a package of service, repair and replacement provided by the seller. Such a plan, distinguished with the total warranty policy of a company, is a detailed specification for a specified product, such as “three years warranty with additional $50” mentioned above, and it can be selected by customers according to their own preferences.

The authors suppose a laptop computer market with competitions, where customers have more than option of one kind of product, they can configure their favorite product model, and they prefer to choose a product with less warranty fee in a given warranty period. The authors hope that the proposed warranty plan of a configuration scheme can reflect the real warranty expense of the vendor mostly. Four steps are included in the warranty offering customization
method:

a). Estimating probabilities of failures of components individually, with different periods, usage intensities and repair capacities;

b). Predicting the reliability of the configuration scheme based on failure possibilities of components involved;

c). Calculating warranty cost of the configuration scheme with varies warranty policies;

d). Offering and presetting warranty plan options for customer configuration.

At the initial stage of the algorithm, a Markov method is introduced to calculate the probability of failures of one component during a certain period, due to its flexibility and ability to integrate quality, usage frequency, and repair difficulty of a product into a single model. Operation of a component is regarded as a stochastic process after the product is delivered to the customer, and hence component states are summarized as four: functional, dangerous, usage, and failure. Where, the functional means the component can normally work, the usage means the component is working, the dangerous means the component has a undetected fault, and the failure means the fault is found and a claim occurs. Transition parameters between states include usage rate, usage completion time, fault possibilities of a component when it is working and idle, and repair time. Their values are determined according to practices and the literature, and the reliability of a component is calculated based on corresponding transition metric of this Markov state transition model.

Next, the whole product (a configuration scheme) is regarded as a system consisted with components. A product configuration network from product family model (PFM) is employed to transfer failure possibilities of individual components to the reliability of a whole configuration scheme. Such a network describes the compatibility relations and coupling strength between different kinds of components. With a product configuration network model, logical and functional relations between different components are identified and modeled with mathematics. Reliability of the product is achieved as a logical computation result based on reliabilities of involved components.

ROCOF (the rate of occurrence of failures) of a product from the reliability value obtained above is employed to calculate the failure possibility of the configured product model in a certain period, and then estimate the potential warranty cost. Here, the authors firstly regard free replacement warranty (FRW) as the basic warranty strategy.

After obtaining warranty costs of all configuration schemes, to simplify calculation in customer configuration system, and avoid providing customers too many options only with subtle differentiation, the authors propose a preset warranty plan offering method. According to the selling prices of different products in the family, the authors divide these products into several groups and set corresponding thresholds. Based on several warranty periods, customized warranty offerings are generated respectively according to average warranty cost in each group. Profit margin of the vendor in warranty services is supposed at a constant level. Once a customer completes his configuration, the selling price of this scheme is compared with thresholds, its belonging group can be determined, and then its warranty offerings are described before the customer.

In addition, the authors consider the issues of compatibility, dependence on time and imperfect repairs. Plans adapting with other warranty strategies such as pro rata (PRW), repair are also offered through transferring from basic strategies.
3 Applications and Effectiveness Analysis

A simplified example of laptop computer is studied in this paper to illustrate the procedure of the algorithm and test its effectiveness. The customization feature of this kind of product is the reason being selected. Currently, most vendors of laptops allow customers to configure their favorite products online or on sites.

There are five types of components in this product family, and each type includes two selectable components. Based on this, thirty-two configuration schemes are available for customers, and the warranty costs of these schemes can be estimated with the propose method. In this case, the authors divide schemes into three groups according to selling prices, for high-, middle- and low-end customers respectively, and two thresholds between groups are determined. Warranty plans for two and three year periods with additional fees are proposed in every group, and they can be shown before customers based on specific configuration requirement.

Relationships between the traditionally standard warranty offering and those generated with the proposed method are analyzed in this study. The authors identify the borderline of diversities in reliabilities of configuration schemes. Once the deviation of warranty costs of all schemes is over a certain value, the method in this study is effective in providing varied warranty offerings better adhere to real warranty costs.

4 Contributions

The main contribution of this study is to make it possible of providing customized warranty specifications for a certain configuration model. The authors bridge warranty specification and product configuration through the reliability methodology at the component level. Warranty is not ever regarded as an independent element when customers configure their products, and it is determined with the different reliabilities of different configuration schemes.

The result implies managerially that vendors of customer built products should not adapt same warranty strategy with those produce standard products. A standard warranty strategy is not enough for a product family, and it should be refined according to reliability properties of different product models. The proposed method in this study can reduce warranty fee of those low-end products, and so help the vendor to attract cost sensitive customers. And on the other hand, this method is beneficial for the vendor to calculate the possible profit margin in warranty services.