Improving of performance system of warranty for automotive engineering abroad on the basis of data of rejections analysis

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Abstract. Article deals with improvement possibility of warranty package fulfillment system of automobile vehicles manufacturer in the foreign markets by application of warranty complete sets preparation technique taking into account climatic features of the countries which influence reliability parameters

1. Introduction

Positions’ stability of cars producer companies in foreign markets depends on the quality of planning and forecasting, used in the development of the organization's strategy of firm service (FS). Successful development of FS abroad is both in a systematic approach to the creation of both dealer and service network (DSN) and the organization of processes during its operation, which is provided as background information, including the operation of equipment in the region, as well as tools reliability for its analysis and forecasts for subsequent periods.

The purpose of managing of such a system is to meet the customer's applications in a service that depends, particularly, on timely and qualified providing dealership and service center (DSC) by spare parts. The task of delivery planning of spare parts to DSC is mostly solved on an intuitive level. This approach does not lead to losses not only in the absence of relevant items in stock but also in the storage of spare parts unclaimed.

2. The basic part

For more effective planning of structure and spare parts’ time of delivery it should be taken into consideration that the various components, accessories and systems in motor vehicles have different resource and have varying degrees of reliability, which, in its turn, depends on many factors that are stochastic.

Reluctance in vehicle occurs at the moment of time $T_{\text{inc}}$ that with a certain probability can be predicted. As experience of the technical products’ operation shows, changing in the failure rate $\lambda(t)$ of vast majority of objects is described by U – shaped curve and is divided into three operational phases [1; 2] in the break-in period an increased failure rate is observed, that is connected with running parts and caused usually by manufacturing defects (Im. 1). During the period of full-time operation failures are random and appear suddenly, primarily due to non-compliance with the operating conditions, load changes, the impact of adverse external factors, etc. (Im. 2). The third period is characterized by an increase of the failure rate, which is caused by aging and other factors, associated with prolonged use. Considering all above, the provision of spare parts should include functionally distinct mechanisms. Since the warranty period is the most important to maintain customer loyalty, firstly the issue of providing quality service exactly in this period is solved.
It’s impossible to fight with failures in \textit{running-in period}, but statistical analysis of appeals to auto center helps to reveal details which are mostly susceptible to premature failures. For providing uninterrupted service at the stage of running mechanism calculating the qualitative and quantitative structure of warranty spare parts kits (WSPK) was developed, which are forming for the next batch of sold cars and sent to the operation region along with it.

During the \textit{period of full-time operation} failures are mostly depend on operation’s conditions, have stochastic character and so the forecast requirements for spare parts is based on the dependencies established by analyzing references in DSC [3].

Assigning the warranty period, the company-producer includes in it not only a break-in period, but part of the full-time operation period. However, as evidenced by the nature of the failures’ curve rate, relations of failures number of developments in these areas are described by two fundamentally different laws. Therefore, provision of spare parts during the warranty period should include two functionally distinct mechanisms. In break-in period calculation method of qualitative and quantitative structure of warranty and spare parts kits (WSPK) is required. WSPK for another party of realized cars is formed and sent to the region of operation along with it. At the stage of full-time operation the methodology of possible applications is needed, which will work with failures of this or that detail, taking into consideration the statistics’ information data if previous periods. This method of planning is the basis for the formation of structure and calculation of the delivery date in the control center dealer and service network (DSN). The composition of parties in both cases formed the basis of information about failures within the warranty period of operation [4].

As providing of DSN abroad with all necessary spare parts during the warranty period is one of the most important aspects of observation of producer company’s warranty liability, the most attention is paid to working the forming methods out. The methodic is formed on the basis of failures’ statistic analysis in warranty period. However, in our view, insufficient attention is paid to the account of climatic characteristics of the region.

For confirmation of this thesis the analysis of qualitative and quantitative composition compliance of WSPK for Cuba Republic was made, as it has savannah climate and refers to the second group, selected in accordance with the classification of climates by V.P. Koppen [5].

Information available on the failures has been grouped. Likewise grouping parts that make up WSPK supplied in Cuba Republic were performed. The obtained data were compared, which revealed deviations of WSPK’s structure to the number of failures. Such inconsistencies lead to overstocking and freezing of service centers’ assets because of a significant proportion of unclaimed parts and, at the same time, lead to decreasing service quality owing to increasing of waiting time because of necessary spare parts lack. During the commercial operation of the vehicle increasing of time being in service leads to loss of customer’s confidence in the brand [6; 7].
For aligning the structure of WSPK to the number of failures its optimization was performed. Results of redistribution are shown in Table 1, which represents the warranty kit’s interest structure with the climatic conditions of the Republic of Cuba.

Table 1.

| Name of detail                      | Failures (%) | ГКЗЧ before optimization (%) | ГКЗЧ after optimization (%) |
|-------------------------------------|--------------|-----------------------------|-----------------------------|
| Ventilation, heating                | 0.95         | 0.16                        | 0.95                        |
| Engine                              | 5.69         | 38.34                       | 6                           |
| Wheels and tires                    | 3.89         | 3.1                         | 3.1                         |
| Transmission                        | 2.94         | 0.16                        | 2.94                        |
| Back axle                          | 2.93         | 4.73                        | 4                           |
| Double reduction axle              | 4.81         | 4.4                         | 4.9                         |
| Window                              | 0.42         | 0.33                        | 0.33                        |
| Forked axle                         | 2.56         | 3.1                         | 3.1                         |
| Bracket                             | 2.12         | 4.24                        | 2                           |
| Tackles                            | 8.7          | 2.77                        | 8.7                         |
| Exhaust system                      | 0.95         | 2.94                        | 2                           |
| Cooling installation                | 7.06         | 2.61                        | 7.06                        |
| Fuel feed system                    | 5.86         | 14.68                       | 6                           |
| Decelerator system                  | 8.89         | 5.38                        | 6.85                        |
| Engine clutch                       | 8.2          | 0.98                        | 8.2                         |
| Steering system                     | 4.38         | 0.65                        | 4.38                        |
| Cam and roller hoist                | 9.88         | 0                           | 9.88                        |
| Electrical equipment                | 19.61        | 11.26                       | 19.61                       |
| **TOTAL**                           | 100          | 100                         | 100                         |

As it can be noticed from diagram, given on image 3, optimized WSPK more closely matches the distribution of failures of vehicle components in a given climate group. That’s why it can be confirmed that using of a methodology for WSPK, considering the influence of climatic conditions allows to align its structure allocation of vehicle details’ failures [8; 9].
Annual economic effect for DSS Economic effect of the service center by reducing the unclaimed assets invested in warranty and spare parts kits will be 37,400 rubles. Economic benefits for the car owner, expressed by decrease of lost profits size due to reduced downtime in awaiting repair will be 6992 rubles.

3. References

[1] Malkin V S 2007 Technical operation of vehicles: the theoretical and the practical aspects. – M.: Academy – 288 p
[2] Kugel R V 1961 Durability of vehicles. “Mashgiz” pub. house
[3] Mirotin L B 2005 Modern tools of logistics management – M.: “AST Publishing Group” 494 p
[4] Habibullin R G 2012 Supply management of spare parts in the system of firm service vehicles by predicting appeals // Innovative information technology № 1 P 563-565
[5] Koeppen V P 1938 Fundamentals of climatology (Climats of the globe). M.: Uchpedgiz – 376 p
[6] Kramarenko G V 1983 Technical operation of cars - M: Transportation, – 488 p
[7] Khalafyan A A 2007 STATISTICA 6. Statistical analysis. – M.: Binorm-Press 512 p
[8] Makarova I V 2011 Application of modern methods of modeling and management for improving the effectiveness of the firm service car Vestnik of IzhSTU № 1 P 118-121
[9] Habibullin R G 2012 Supply management of spare parts in the system of firm service vehicles by predicting appeals // Innovative information technology № 1 P 563-565
[10] Gertsbakh I B 1966 Failures model -M.: Soviet radio 166 p