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Engineering Failure Analysis

Failure analysis and warranty modeling of used cars

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ARTICLE INFO	ABSTRACT
	Reliability is an important aspect of product perception and manufacturers are compelled to take corrective actions on the items failing within the warranty period. Automotive manufacturers are being exposed to significant operating costs as a result of warranty claims affecting an individual unit or mandatory (sometimes voluntary) recalls affecting a batch. Underlying principles of warranty modeling are built by considering both subjective issues and objective constraints such as competition, quality, and performance under the goal of achieving desired levels of reliability and cost in a balanced manner. This paper reviews the warranty cost models with an emphasis on the failure analysis of used vehicles. Expected warranty costs are calculated by taking into account the age, usage, and maintenance data of the product in question. Failure intensities and characteristics are identified in order to propose a policy that highlights the trade-off between the cost and the warranty length. A case study on a popular brand's initiation of factory certified pre-owned program for the local automobile market of Turkey is presented in detail. © 2011 Elsevier Ltd. All rights reserved.

1. Introduction

Reliability is one of the most important product attributes for consumers in making their selections among different alternatives[1]. Researchers showed a great deal of interest towards the studies involving reliability modeling and failure analysis of automotive industry related products. Schneider and Tibbets[2] evaluates engine reliability by analyzing warranty data. Root-cause analysis of the ignition system used in Ford during eighties is presented by Thomas et al.[3] and then later on several warranty provision scenarios of these units are discussed in Pecht[4]. Surface defects on car paint are investigated by Torkar and Godec[5] to conclude the problems in galvanic zinc coating process. Naikan and Kapur[6] propose a procedure for reliability analysis of lubricating oil used for car engines. In case where the product of interest is a car, consumers' perception of reliability simply turns into a function of warranty features such as the policy length and coverage. By definition; warranty of a product is a bounding contract offered by the producer to the consumer to replace or to repair a faulty item, or to refund the whole or a part of the price of the product to the consumer when the product fails within the stated time period[7].

In today's fiercely competitive environment, length of the offered warranty period is gone out of being a legal obligation (minimum of 2–3 years depending on the country of sale) and has become one of the most important marketing tools and design parameters of the producers. Several big automobile manufacturers recently extended their warranty lengths and used this action as a primary driving force in their advertisements campaigns. For example; Hyundai extended its offer of 5 years unlimited kilometer warranty to 10 years/100,000 mile in all their products offered in the United States[8], where Honda extended its 3 years/100,000 km warranty to 6 years/150,000 km in all its cars for sale in Turkey[9]. Note that far eastern manufacturers tend to have longer warranty periods as opposed to their European counterparts. However, their mandatory periodical services also tend to be more frequent. (i.e. 10,000 km as opposed to 15,000 km). As a result of these warranty length and coverage initiatives, automotive industry handles more than 100 million warranty claims each year[10].

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