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# Estimation of the Relationship between the Products Reliability, Period of Their Warranty Service and the Value of the Enterprise Cost

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**Abstract**

The competitiveness of the manufacturer in modern conditions is determined by many factors. One of these factors is the products warranty. Nevertheless, this service considers additional manufacturing costs. The purpose of this research is to determine the dependence of the accessible reliability of products with the expenses level of the manufacturer, offering warranty services. To achieve this goal, the methods of mathematical statistics and probability theory were used. The research has determined the content of warranty service, has introduced the integrated indicator of warranty services quality, and has showed the level of products reliability as a dependence from the costs of their manufacturing and warranty service. The study results can be used by manufacturers in determining cost-effective period and depth of warranty services

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*Keywords:* cost structure, warranty servicing, warranty period, reliability level, probability of failure of the product, unit cost

## 1. Introduction

Every company is fighting for the consumer under the circumstances of modern market economy. To attract and retain consumers of their products, companies develop and offer a huge range of additional features that make the

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produced product more attractive. These features include favorable terms and conditions of payment, flexible system of discounts for customers, as well as a system of products warranty.

The consequence of technical progress is the production of increasingly high-tech devices and mechanisms there are various requirements towards the level of their reliability.

Consumers need assurance that the product will perform satisfactorily over the useful life of the product. There are many different aspects to warranty and these have been studied by researchers from many different disciplines.

The higher the reliability requirements towards the product are, the higher the quality of warranty service is. In their turn, these aspects affect the manufacturer's costs.

The warranty servicing costs vary from 2–10% of the sale price depending on the product and the manufacturer. As a result, warranty and product reliability are very important in the context of new product development.

Reliability of a product conveys the concept of dependability, successful operation or performance and the absence of failures. It is an external property of great interest to both manufacturer and consumer. Unreliability (or lack of reliability) conveys the opposite. A more technical definition is the following:

- the reliability of a product (system) is the probability that the product (system) will perform its intended function for a specified time period when operating under normal (or stated) environmental conditions (Blischke and Murthy, 2000);
- the reliability of a product gets determined by the decisions made during the pre-production stages (Front-end, Design, Development) and the production stage of the product life cycle (Murthy and Jack, 2007).

Both warranty and reliability have received a lot of attention over the last fifty years (Murthi, 2008).

The area of warranty has been studied by researchers from many different areas such as economic, engineering, statistics and more. A number of techniques have been used as a method in solving warranty problem. In past few years, there has been an increased used of statistical methods instead of soft computing methods in warranty related applications. However, soft computing methods have been used by many researchers in the other research area which can provide some feasible solutions for the complex real-world problems (Majid *et al.*, 2013).

Thus, the relevance of the present study is obvious; the research is aimed at assessing the impact of reliability of manufactured products on the cost structure of the manufacturer providing the warranty repair of the product. To achieve this goal there have been identified a number of objectives:

- to determine the essence of the warranty repair and service;
- to specify the types of warranty service;
- to determine the order of formation of the manufacturer's costs of the warranty service of products produced at a specified level of reliability;
- to analyze the relationship between the manufacturer's cost and a warranty period of service and reliability of manufactured products.

Reliability theory deals with the interdisciplinary use of probability, statistics and stochastic modelling, combined with engineering insights into the design and the scientific understanding of the failure mechanisms, to study the various aspects of reliability. As such, it encompasses the following: reliability modelling, reliability analysis, reliability engineering, reliability science, reliability management.

Reliability Improvement Warranty policies are offered with complex systems intended for long use. The basic idea is to extend the notion of a basic consumer warranty to include guarantees on the reliability of the item and not just on its immediate or short-term performance (Murthi, 2008).

The novelty of this article lies in the fact that it allows the manufacturer, using mathematical calculations, make an economically sound choice between repair and replacement of the failed product during the warranty period. It is obvious that the probability of failure-free operation of the product will decrease with the increase of its useful life. The originality of this article is determined by using methods of mathematical statistics and probability theory in the dependence evaluation according to the manufacturer's costs to the duration of the warranty period and reliability of manufactured products.

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