

Modeling Quality and Warranty Costs

— *Problem Definition*

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Problem Definition

The overall objective of this effort is to develop models that optimize warranty and quality costs for telecommunications products, encompassing both hardware and software, while satisfying customer requirements for reliability and availability.

Warranty costs can constitute a significant portion of a product's cost over the product life-cycle. These costs are difficult to predict, though it is known that warranty costs are related to product quality. There is not much in the modeling literature relating warranty and quality costs over the product life-cycle. Adding further complexity to the problem is the fact that warranties with respect to quality, which were traditionally limited to replacement or repair of the product during the warranty period, have now been extended into parameters such as reliability, down-time, and maintenance costs. This is particularly the case with long-life products such as telecommunication systems. This practice is in line with the need to optimize users' costs — life-cycle costs. There is a need, therefore, to study warranty policies and costs jointly with quality policies and costs and with reliability requirements.

We define next the context for this work. The product realization process for a telecommunications product or service involves the following sequence¹ of steps.²

- Specify reliability and availability objectives based on standards, users' requirements and performance of existing systems and services.
- Develop architecture (hardware and software) alternatives to meet reliability objectives.
- Implement/design the architecture, that is, make design choices.
- Implement design, associated with which are the following product/service attributes:
 - quality level of design Q_d ;
how will the quality be quantified, use quality index to quantify
 - cost of implementation at Q_d is $C(Q_d)$
 - warranty cost at Q_d is $W(Q_d)$

The problem to be modeled then is the following:

Minimize warranty plus implementation cost
subject to
quality attributes $> K$
reliability attributes $> M$

where the quality level, Q_d is the decision variable (to be determined) to achieve optimal cost.

Part of the problem is to determine the form of the quality level variable, Q_d . This could be a vector of quality metrics, a quality index, etc.

1. This is a simplified view of the process and does not imply that the activities are carried out in a strictly linear fashion, many of the steps in the process are iterative.

2. Only the activities that are specific to the quality and reliability attributes of the product are listed here.