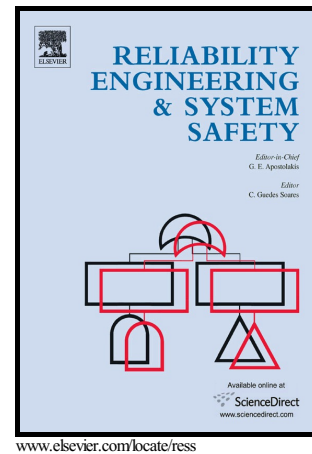# Author's Accepted Manuscript

Joint optimization of design, warranty and price for products sold with maintenance service contracts

M.N. Darghouth, D. Ait-kadi, A. Chelbi

Cite this article as: M.N. Darghouth, D. Ait-kadi and A. Chelbi, Join
optimization of design, warranty and price for products sold with maintenanc
service contracts, *Reliability Engineering and System Safety*
http://dx.doi.org/10.1016/j.ress.2017.03.033

This is a PDF file of an unedited manuscript that has been accepted fo
publication. As a service to our customers we are providing this early version o
the manuscript. The manuscript will undergo copyediting, typesetting, and
review of the resulting galley proof before it is published in its final citable form
Please note that during the production process errors may be discovered whicl
could affect the content, and all legal disclaimers that apply to the journal pertai

# Joint optimization of design, warranty and price for products sold with maintenance service contracts

M. N. Darghouth[a,b], D. Ait-kadi[a,b], A. Chelbi[c,b*]
[a]Mechanical Engineering Department, Laval University, Québec, G1V0A6, Canada
[b]Interuniversity Research Center on Enterprise Networks, Logistics and Transportation (CIRRELT), Canada
[c]University of Tunis, Centre de Recherche en Productique (CEREP), École Nationale Supérieure d'Ingénieurs de Tunis, 5 Av. Taha Hussein-Tunis, Tunisia

**Abstract**

In this paper a modeling framework for optimal design, warranty and price for new products sold with a maintenance service contract is developed. The model considers situations with one customer and a unique service provider which is the Original Equipment Manufacturer (OEM). The latter intends to offer with each sold product a service contract according to which he commits to perform all maintenance actions over the product lifecycle. Four contract options are to be investigated by the manufacturer depending on the coverage period and the nature of the maintenance activities to be performed. Two scenarios, related to product warranty and price, are considered. The learning effects arising from the impact of the total sales volume on the product price, as well as the impact of the experience gained in the product maintenance on the preventive maintenance cost are also considered. The model allows the manufacturer to set the optimal combination of the product design (reliability), sale price and warranty period which maximizes the discounted profit over the product lifecycle for each option and for the two scenarios of pricing and warranty. The necessary optimality conditions for each scenario are derived.

## 1. Introduction

The technological advances achieved in recent years have led to the emergence of increasingly complex products in the marketplace. As a result, customers have become concerned about the capability of the acquired product to consistently achieve its planned functions over its life cycle. Here, warranty plays a significant role in reassuring customers, as the warranty provided by the manufacturer is usually associated with product reliability. Warranty can be considered an agreement between customers and sellers in the form of a contract, which begins at the moment of product acquisition and terminates at the end of the warranty period.