Successful Prediction of Product Performance

Quality, Reliability, Durability, Safety, Maintainability, Life-Cycle Cost, Profit, and Other Components
Other SAE books of interest:

**Automotive E/E/ Reliability**
By John Day
(Product Code: T-126)

**Design and Reliability Factor**
By John Day
(Product Code: PT-174)

**Automotive Electronics Reliability**
By Ronald Jurgen
(Product Code: PT-144)

**Reliability, Maintainability, and Supportability Guidebook**
By: Multiple authors from Government and Industry
(Product Code: M-102/95)

For more information or to order a book, contact
SAE International at
400 Commonwealth Drive,
Warrendale, PA 15096-0001, USA;
**Phone:** 1+877.606.7323 (U.S. and Canada only) or 1+724.776.4970 (outside U.S. and Canada);
**Fax:** 1+724.776.0790;
**Email:** CustomerService@sae.org
**Website:** http://books.sae.org
Successful Prediction of Product Performance

Quality, Reliability, Durability, Safety, Maintainability, Life-Cycle Cost, Profit, and Other Components

Lev Klyatis
Professor Emeritus
Dr.-Ing. Habil., Dr. of Technical Sciences, Ph.D.

Warrendale, Pennsylvania, USA
Dedication

To My Wife NELLYA KLYATIS
Language Editor

Brian Dodson
# Contents

**Preface** ................................................................. xi

**Introduction** ........................................................ xv
   Current Situation with Recalls and Related Problems .................. xvi
   Current Situation in Performance Prediction .......................... xx
   The History of Reliability Prediction ................................ xxiii
   References ........................................................... xxvii

**Chapter 1: Terms and Definitions for Successful Prediction, Reliability, and Durability Testing** ................................................. 1
   References .......................................................... 9

**Chapter 2: Analysis of Current Approaches in Simulation and Testing** ......................................................... 11
   2.1 General ....................................................... 12
   2.2 Elements of History of Physical Simulation Development ....... 12
   2.3 Physical Simulation of the Real-World Conditions. Current Testing ........................................................ 14
   References ......................................................... 26

**Chapter 3: Methodological Aspects as the First Basic Component of Successful Prediction of Product Performance** ................................................. 29
   3.1 Introduction ................................................... 29
   3.2 Common Principles of Successful Performance Prediction ....... 33
   3.3 Common Criteria for Successful Prediction of Product Performance Components ................................................. 34
   3.4 Methodology for Selecting Representative Input Regions for Accurate Simulation of Real-World Conditions ................. 43
   3.5 Aspects of Successful Prediction of Product’s Performance By Taking Into Account Coefficients of Recalculation that Depend On Manufacturing Technology Factors and Usage Conditions ......... 49
   3.6 Building a Specific Type of Influence Function for Reliability and Maintainability Prediction ................................. 52
   3.7 Basic Methodological Aspects of Quality Prediction ................ 57
   3.8 System Reliability Prediction from Testing Results of the Components ................................................................. 60
   3.9 Durability Prediction with Consideration of Expenses and Losses ...... 61
   3.10 Prediction of the Product’s Spare Parts ............................ 66
Chapter 4: Basic Aspects of Accelerated Reliability/Durability Testing as the Second Basic Component of Successful Prediction of Product Performance

4.1 Introduction................................................... 81
4.2 The Basic Concepts of the Strategy for Development of Accurate Physical Simulation of Real-World Conditions and ART/ADT ........ 84
4.3 The Principles of System of Control for Physical Simulation of Random Input Influences .......................... 98
4.4 Trends in the Development of ART/ADT ......................... 105
References .................................................................. 110

Chapter 5: Integrated Equipment for Physical Simulation of Interacted Real-World Conditions ........................................... 113

5.1 Introduction .................................................................. 113
5.2 Combined Testing Equipment ........................................ 114
5.3 Equipment for Accelerated Reliability and Durability Testing ....... 136
5.4 The Mechanisms for Control of Simulation of the Real-World Random Input Influences ...................................... 145
References .................................................................. 154

Chapter 6: Financial Considerations, Use of the Author’s Approach, and Some Published Reviews to the Author’s Previous Books

6.1 Financial Considerations ........................................... 158
References .................................................................. 163
6.2 Use of the Author’s Approach (Publications) ................. 163
6.3 Some Published Reviews to Author’s Previous Books .............. 171

Chapter 7: Improving the Standardization of Accelerated Reliability and Durability Testing ........................................... 177

7.1 Current Situation ................................................... 177
7.2 Standards in Combined Testing .................................. 178
7.3 Standards in Reliability Testing .................................. 185
7.4 SAE International Standards in Reliability Testing ............ 187
References .................................................................. 206