Book review: Alessandro Birolini - Reliability Engineering: Theory and Practice

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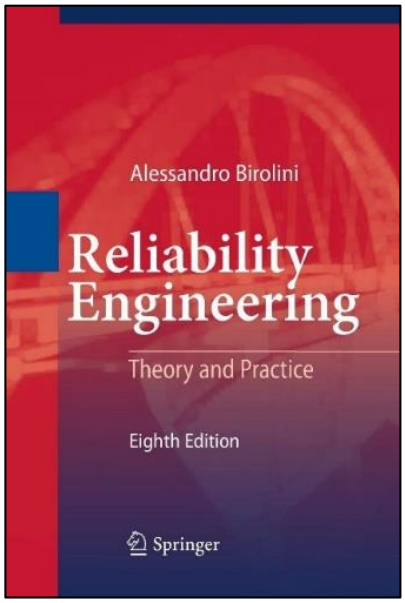
Professor Emeritus Alessandro Birolini recently published at the prestigious Springer Publishing House the 8th English edition (the final one) of his monumental book "*Reliability Engineering: Theory and Practice*". This book is considered amongst the specialists in the field as a "Bible of Reliability".



The request for a Chinese translation of this book and the very high eBook requirements (more than 10,000 per year since 2013) were the motivation for this final edition.

This book shows how to build in and assess reliability, availability, maintainability, and safety (RAMS) of components, equipment & systems. It presents the state-of-the-art of reliability (RAMS) engineering, in theory & practice, and is based on the important author's industry and academic experience in this field.

Performance, dependability, cost, and time to market are key factors for today's products and services. However, failure of complex systems can have major safety consequences; reliability engineering can help. Consequently, in the vision of Prof. Birolini, the purpose of this book is to develop methods and tools to evaluate and demonstrate reliability, maintainability, availability, and safety of components, equipment & systems, and to support development and production engineers in building

in these characteristics. To build in reliability, maintainability, and safety into complex systems, failure rate and failure mode analyses must be performed early in the development phase and be supported (as far as possible) by failure mechanism analysis, design guidelines, and design reviews. Before production, qualification tests are necessary to verify that targets have been achieved. In the production phase, processes have to be qualified and monitored to assure the required quality level.

This book presents the state-of-the-art of reliability engineering in theory and practice. It is a textbook based on the author's experience of 30 years in this field, half in industry and as founder of the Swiss Test Laboratory for VLSI ICs in Neuchâtel, and half as Professor (full since 1992) of Reliability Engineering at the prestigious Swiss Federal Institute of Technology (ETH) Zurich, one of the best-rated technical universities in the world. It also reflects the experience gained in an effective cooperation between University and Industry over 10 years, with more than 30 medium and large industries.

The structure of the book has been maintained through all editions, with main Chapters 1 to 8 and Appendices A1 to A11 (A10 and A11 since the 5th edition 2007), but new models and considerations have been added for each successive new edition. Chapters 2, 4 and 6 (230 pp.) deal carefully with analytical investigations, Chapter 5 (25 pp.) with design guidelines, Chapters 3 and 7 (90 pp.) with tests, and Chapter 8 (15 pp.) with assurance activities during the production phase. Appendix A1 (15 pp.) defines and fully comments on the terms commonly used in reliability (RAMS) engineering. Appendices A2 - A5 (30 pp.) have been added to Chapter 1 (25 pp.) to support managers in answering the question of how to specify & achieve high reliability (RAMS) targets for complex equipment & systems. Appendices A6 - A8 (150 pp.) are a careful introduction to probability theory, stochastic processes, and mathematical statistics, as necessary for Chapters 2, 4, 6, and 7, consistent from a mathematical point of view but still with reliability engineering applications in mind (demonstration of established theorems is referred, and for all other propositions or equations, sufficient details for a complete demonstration are given). Appendices A9 - A11 (20 pp.) include statistical tables, Laplace transforms, probability charts, basic technological component's properties, and problems for homework.

I have already analyzed in detail some of the previous editions of this book, so I do not want to go into details in the following; those interested are kindly requested to access these reviews [1] [2]. Also, more details about the life and work of Professor Birolini, considered as "A Guru of European reliability", can be found in a presentation [3], as well as in two interviews he has given to me [4] [5].

[1] I.C. Bacivarov, Alessandro Birolini: Reliability Engineering. Theory and Practice - A Bible of Reliability, Quality Assurance, Vol. XVI (2010), Issue 63, pp. 4-6

[2] I.C. Bacivarov, Alessandro Birolini: Reliability Engineering. Theory and Practice, Proceedings of the 12th International Conference in Quality and Dependability - CCF2010, Sinaia, pp. 3-5

[3] I.C. Bacivarov, Professor Emeritus Alessandro Birolini. A Guru of European Reliability, Quality Assurance, Vol. XVI (2010), Issue 63, pp. 2-3

[4] I.C. Bacivarov, Lessons from a Life Dedicated to Reliability. An Interview with Professor Emeritus Alessandro Birolini, Quality Assurance, Vol. XVI (2010), Issue 64, pp. 5-8

[5] I.C. Bacivarov, An Interview with Professor Emeritus Alessandro Birolini, International Journal of Information Security and Cybercrime - IJISC, Vol. VI (2017), pp. 53-58

Extended and carefully reviewed to improve accuracy, the final edition of the book represents - in author's opinion - the continuous improvement effort to satisfy reader's needs and confidence.

New for the 8th English edition are an introduction to risk management with structurally new models based on semi-Markov processes, reliability and availability analysis of some redundant structures, new homework problems, and refinements, in particular, on multiple failure mechanisms, approximate expressions for large complex systems, a.o.

The book has been used for many years (beginning with the 1st German edition - 1985, Springer) as a textbook for three semesters beginning graduate students at the ETH Zurich, in several European technical universities as well as for courses aimed at engineers in industry. The basic course (Chapters 1, 2, 5 and 7, with introduction to Chapters 3, 4, 6 and 8) should belong to the curriculum of most engineering degrees, considers the author.

I have personally used - during the last 20 years - Professor Birolini's book as a reference material for the Master "Quality and Dependability in Electronics and Telecommunications" developed at the University Politechnica of Bucharest, as well as for the PhD students in the field.

All in all, the book of Professor Birolini is an excellent one, which can be highly recommended for both academia and industry as a veritable guide to the interdisciplinary field which is reliability.

It is important to mention that summed over the German and English editions (1st edition - 1985 and 1994, respectively), this is the 13th edition of this excellent book, distributed over 30 years all around the world. It's an impressive number of editions for a technical book, that comes to reinforce the value and interest of the specialists for this work.

This final edition reviews, refines, and extends all previous editions of this book. With the ability, patience and talent of a Swiss jeweler, Professor Birolini has polished this book to perfection for over 30 years and in 13 successive editions, of which eight in English. And the result - the final edition in English of the book Reliability Engineering: Theory and Practice, is a real jewel, with an infinite value for both theory and practice in the field of Reliability; a true Bible for this domain.

The Chinese language edition that will be soon published, under the auspices of the Springer publishing house too, will be an award for Professor Birolini's book value and will provide the great number of Chinese researchers and academics with a valuable - theoretical and practical - working tool in the field of reliability engineering.

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