

SPECIAL SESSION

In Honor of
Professor Emeritus Alessandro Birolini, PhD
At his 70th anniversary



Professor Emeritus Alessandro BIROLINI - A Guru of European Reliability

During the six decades of relatively short history of reliability, a number of top professionals marked the evolution of this important interdisciplinary field.

Among the European specialists who brought remarkable contributions to the development of this domain, the name of Professor Dr. **Alessandro Birolini** from the Swiss Federal Institute of Technology (ETH) Zürich is a prominent one.



Professor Emeritus
Alessandro BIROLINI

Alessandro Birolini was born on the 13th September 1940 in Lugano, Switzerland and is presently **Professor Emeritus of Reliability Engineering** at ETH Zürich.

It is important to mention that the **Swiss Federal Institute of Technology (ETH) Zürich** is itself a pole of excellence in science and technology and is ranked among the top universities in the world (being classified as the 3rd in Europe, after the universities of Cambridge and Oxford).

After his Dipl. Ing. HTL, Dipl. El.-Ing. ETH, Ph.D. (ETH), and 15 years of industrial experience (of which 4 years in charge of setting up the **Swiss Test Laboratory** for VLSI ICs in Neuchâtel), Dr. **Alessandro Birolini** was from 1986 to 1998 Professor and head of the Reliability Laboratory at the ETH Zürich (Full Professor since 1992).

His research interests included fault tolerant systems with hardware and software, stochastic processes for reliability theory, test & screening strategies, and failure mechanisms.

Prof. **Birolini** has also been involved in an effective cooperation with 30 large and medium industries for over 10 years. He is author of more than 40 research & tutorial papers as well as of several monographs and books, among which the habilitation thesis *On the Use of Stochastic Processes in Modeling Reliability Problems* (Springer 1985) and the book *Reliability Engineering: Theory and Practice* (Springer, 6th Ed. 2010, 1st Ed. 1994, 1st German Ed. 1985, 4th German Ed. 1997).

Achievements include a new approach to compute the transition probabilities for Markov, semi-Markov & semi-regenerative processes and the development of approximate expressions for the reliability and availability of complex fault tolerant systems.

During more than three decades **Alessandro Birolini** brought an important contribution to the development of reliability, to its recognition as important domain of interest in the engineering and academic fields, not only in Switzerland but in the entire Europe. The international cooperation developed by Professor **Birolini** as Director of the Reliability Laboratory from ETH Zürich, the important number of international conferences and symposia in the field organized by Professor **Birolini** in his laboratory in Zürich (which became a veritable European pole of excellence in its field) entitle the opinion of several international experts in the field to consider Professor **Birolini** as a veritable **Guru of European Reliability**.

Engineer and philosopher (or “*Ingenieur et penseur*” - as he defined himself on the cover of his remarkable book ***Reliability Engineering: Theory and Practice***), Professor **Birolini** brought an important contribution to the development of theory and practice of reliability, to its recognizing as an university domain of education and research.

I had the opportunity to work, for a short period in 1994 as an Invited Professor at the Reliability Laboratory of the Swiss Federal Institute of Technology (ETH) Zürich, when I presented a short course on “*Dependability of Complex Systems*”. I had the extraordinary opportunity to work during this period with Sandro Birolini and I was impressed not only by his professional stature, but also by his human stature. Indeed, Professor **Birolini** is not only an excellent manager and specialist in Reliability field, but a man of an exceptional integrity, kindness and modesty.

Several honors gather to crown his exceptional career: **Alessandro Birolini** is a Life Member of the Swiss Academy of Engineering Sciences, Honorary Member of the Romanian Academy of Sciences, Life Senior Member of the IEEE, Recipient of the IEEE Third Millennium Medal. Professor Birolini was President of the Swiss Information Technology Society and Chairman of the IEEE Switzerland Section as well as Founder and Chairman of the IEEE Switzerland Reliability Chapter a.o.

The special session organized during the 12th ***International Conference on Quality and Dependability - CCF2010*** in the honor of Professor Emeritus **Alessandro Birolini** represents the homage of the specialists in the field for a remarkable specialist and man.

The participants at CCF2010 will have the special opportunity to meet Professor **Alessandro Birolini**, who will present a conference concerning “*Approximate Expressions for the Reliability and Availability of Repairable Large Systems*”, and will launch the 6th edition of his monumental book ***Reliability Engineering: Theory and Practice*** (published by Springer Verlag in September 2010).

At the anniversary of seven decades of his exceptional life and career, we wish Professor Birolini a long and fruitful life, with many achievements in the field to which he devoted himself: RELIABILITY.

Professor Ioan C. BACIVAROV, PhD
Director of EUROQUALROM Laboratory
University “Politehnica” of Bucharest, Romania

Alessandro Birolini: RELIABILITY ENGINEERING. THEORY AND PRACTICE* - A Bible of Reliability

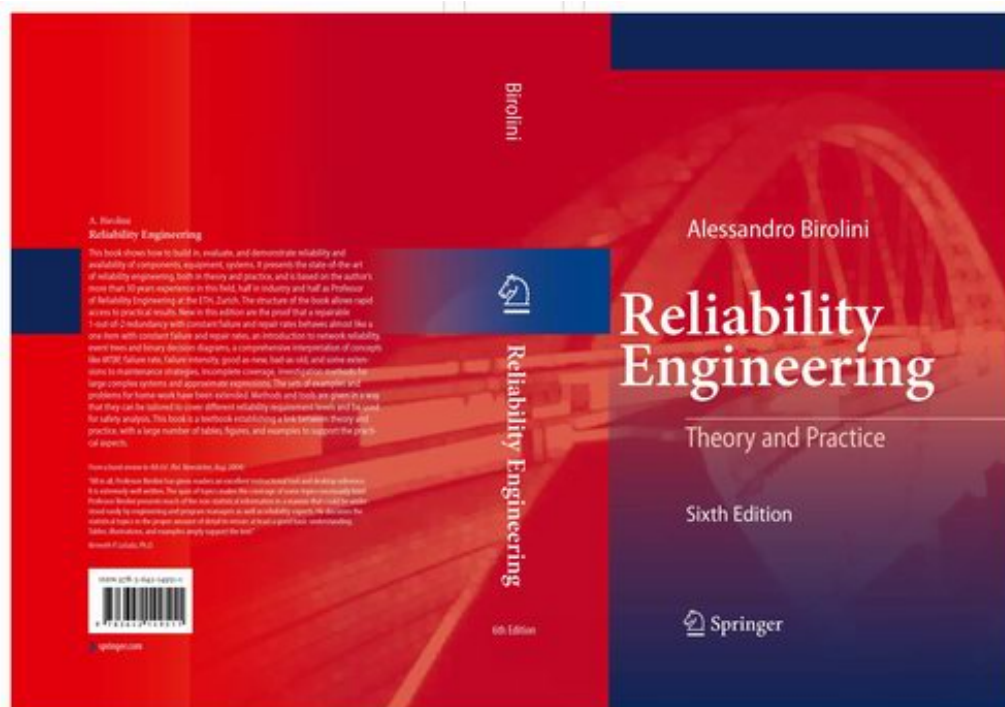
One has to learn to consider causes rather than symptoms of undesirable events and avoid hypocritical attitudes.

Alessandro Birolini

As mentioned Professor **Alessandro Birolini** in the *Preface* of his monumental book **Reliability Engineering: Theory And Practice**, 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.



* Alessandro Birolini: *Reliability Engineering. Theory And Practice*, Springer-Verlag, 6th edition, September 2010, 610 pages.

For many systems, *availability* requirements have to be met and stochastic processes are used to investigate and optimize reliability and availability, including *logistical support* as well.

Software often plays a dominant role, requiring specific *quality assurance* activities. Finally, to be cost and time effective, reliability engineering has to be coordinated with quality management (TQM) efforts, including value engineering and concurrent engineering, as appropriate.

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. 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.

Following Chapter 1, the book is structured in three parts:

1. Chapters 2 - 8 deal with reliability, maintainability, and availability *analysis and test*, with emphasis on *practical aspects* in Chapters 3, 5, and 8. This part answers the question of *how to build in, evaluate, and demonstrate reliability, maintainability, and availability*.

2. Appendices A1 - A5 deal with definitions, standards, and program plans for quality and reliability assurance / management of complex systems. This *minor part* of the book has been added to comment on definitions and standards, and to support managers in answering the question of *how to specify and achieve high reliability targets for complex systems, when tailoring is not mandatory*.

3. Appendices A6 - A11 give a comprehensive introduction to probability theory, stochastic processes, and statistics, as needed in Chapters 2, 6, and 7, respectively. Markov, semi-Markov, and semi-regenerative processes are introduced with a view developed by the author. *This part is addressed to system oriented engineers*.

Methods and tools are presented in a way that they can be tailored to cover different levels of reliability requirements (the reader has to select this level). Investigation of *repairable systems* is performed systematically for many of the structures occurring in practical applications, starting with constant failure and repair rates and generalizing step by step up to the case in which the process involved is regenerative with a minimum number of regeneration states.

For large series - parallel systems, *approximate expressions* for reliability and availability are developed in depth, in particular using *macro structures* as introduced by the author in 1991. Procedures to investigate *repairable systems with complex structure* (for which a reliability block diagram often does not exist) are given as further application of the tools introduced in Appendix A7, in particular for imperfect switching, incomplete fault coverage, elements with more than two states, phased-mission systems, and fault tolerant reconfigurable systems with reward & frequency / duration aspects. New design rules have been added for imperfect switching and incomplete coverage. A Monte Carlo approach useful for *rare events* is given. *Spare parts provisioning* is discussed for decentralized and centralized logistical support. Estimation and demonstration of a *constant failure rate* λ and statistical evaluation of *general reliability data* are considered in depth. *Qualification tests* and *screening* for components and assemblies are discussed in detail. Methods for *causes-to-effects analysis*, *design guidelines* for reliability, maintainability & software quality, and *checklists for design reviews* are considered carefully. Cost optimization is investigated for some practical applications. *Standards* and trends in *quality management* are discussed. A large number of tables, figures, and examples support practical aspects.

It is emphasized that care is necessary in *statistical analysis of reliability data* (in particular for accelerated tests and reliability growth), *causes-to-effects analysis* should be performed systematically at least where *redundancy* appears (also to support *remote maintenance*), and

further efforts should be done for developing *approximate expressions* for complex repairable systems as well as models for fault tolerant systems with *hardware and software*.

Most of the methods & tools given in this book can be used to investigate / improve *safety* as well, which no longer has to be considered separately from reliability (although modeling human aspects can lead to some difficulties). The same is for *processes* and *services reliability*.

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 and for courses aimed at engineers in industry. The basic course (Chapters 1, 2, 5 & 7, with introduction to Chapters 3, 4, 6 & 8) should belong to the curriculum of most engineering degrees, considers the author.

The large interest granted to this book by the community of reliability students and engineers (which consider this book as veritable "**Bible of Reliability**") made necessary six successive editions in English, all published by the well-known publishing house Springer. The basic structure of the book has been conserved through all editions, with main Chapters 1 to 8 and Appendices A1 to A9 (A10 & A11 since the 5th edition), allowing a rapid access to the practical results. But, it is important to mention that content of this book has been extended, reviewed and improved by the author for each new edition. New models & considerations have been added for each successive new edition.

All in all, the book of Professor **Biolini** 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.

New for the 6th edition in English of this book are the proof that a repairable 1-out-of-2 redundancy with constant failure and repair rates behaves almost like a one item with constant failure and repair rates, an introduction to network reliability, event trees and binary decision diagrams, a comprehensive interpretation of concepts like *MTBF*, failure rate, failure intensity, good as-new & bad-as-old, and some extensions to maintenance strategies, incomplete coverage, investigation methods for large complex systems & approximate expressions. The sets of examples and problems for home-work have been extended. Methods & tools are given in a way that they can be tailored to cover different reliability requirement levels and be used for safety analysis.

The 6th edition in English of the book **Reliability Engineering: Theory And Practice** - published by Springer in September 2010 - will be launched during the 12th International Conference on Quality and Dependability CCF2010, organized in Sinaia, Romania. The event will be organized on 23 September 2010, during the special session "*Homage to Professor Emeritus Alessandro Biolini at his 70th anniversary*".

It is important to mention that summed over the German and English editions (1st edition - 1985 and 1994, respectively), this is the 10th edition of this monumental book, distributed over 25 years all around the world. This last edition reviews, refines, and extends all previous editions of this book.

With the ability, patience and talent of a Swiss jeweler, Professor Biolini has polished this book to perfection for over 25 years and in 10 successive editions, of which six in English.

And the result - the sixth edition of the book Reliability Engineering: Theory And Practice, published in 2010, is a real jewel, with an infinite value for both theory and practice in the field of Reliability; a true Bible for this domain.

Prof. Ioan C. BACIVAROV, Ph.D.

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