RELIABILITY AND MAINTAINABILITY IN PERSPECTIVE

Also by the same author

Reliability Engineering, Pitman, 1972

Maintainability Engineering, Pitman, 1973 (with A. H. Babb)

Statistics Workshop, Technis, 1974

Reliability and Maintainability in Perspective

Technical, management and
commercial aspects

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First published 1981 by
THE MACMILLAN PRESS LTD
London and Basingstoke
Companies and representatives throughout the world

ISBN 978-0-333-31049-6 ISBN 978-1-349-16649-7 (eBook)
DOI 10.1007/978-1-349-16649-7

Typeset in 10/12pt IBM Press Roman by
STYLESET LIMITED
Salisbury · Wiltshire

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Acknowledgements

I would particularly like to thank the following friends and colleagues for their help and encouragement with this book. Alex Babb, coauthor of *Maintainability Engineering* (Pitman 1973), for permission to quote freely from those pages and for his helpful suggestions concerning various aspects of the maintainability chapters.

Bernard Sharp, who has many years experience of reliability engineering with London Transport, for his very detailed study of the manuscript. His positive and helpful critique has played a significant part in finalising the style and layout.

Bruce Beach, of California USA, for his help with the software chapter and for permission to make use of some of his own material.

Len Nohre for a very thorough checking of the final manuscript and for his many helpful suggestions.

Brian Tilley, of Bristol Polytechnic, for comments on the chapter concerning product liability.

My wife, Margaret, for much help in preparing the manuscript.

I would also like to thank the Civil Aviation Authority and ITT Europe for permission to reproduce their failure report forms and the US Department of Defense for permission to quote from MIL Handbooks, in particular US MIL HDBK 217C.

Introduction

Reliability and Maintainability are already an essential part of design expertise demonstrated by more and more engineers being aware of such parameters as Availability, Down Time, Mean Time Between Failures and their economic importance in the finished product. This trend is largely due to the inclusion of Reliability and Maintainability requirements in the specifications called for by large national users of electronic and electro-mechanical equipment in particular the Ministry of Defence and the British Post Office. Since the middle 1960s these bodies, and many of the manufacturers of electrical and telecommunications equipment have invested in major reliability training schemes for their design, quality, production and management staff. The author has designed and run many such courses and management seminars for national and private organisations.

It cannot be overstated that satisfying such requirements is largely a matter of good engineering practice and the application of formal controls in design, manufacturing and service. The mathematical aspects of the subject, although important, serve only to refine measurement and do not themselves create a more reliable or more easily maintained product. Too often has the author had to discourage efforts to refine a reliability prediction or more precisely define a failure rate when an order of magnitude estimate would have sufficed. As with all aspects of engineering the ability to recognise the degree of accuracy required in a calculation and then to devise appropriate measurements is of the essence.

Reliability and maintainability are enhanced by the feedback of test and field-defect analysis, by the duplication of components and modules, by component selection and burn in and by the many management activities which it is the purpose of this book to outline. Very high costs of repair and the similarly high penalties which are incurred by expensive equipment being out of use, push reliability and ease of maintenance continually higher in the ranking of important design parameters. A single defect to a finished equipment, costs, more often than not, over £10 in diagnosis and replacement if it is detected in the factory, whilst the same fault in the field will likely cost upwards of £100 to rectify. An hour of down time of a communications link carrying several hundred telephone channels represents a lost revenue of at least £1000.

At the same time as escalating repair and down time costs increase the importance of these design parameters the task of achieving them is made more difficult by the complexity of the equipment. High function density components

(LSI chips) increase the possibility of obscure and elusive failures. The increasing use of computer control in the form of microprocessors, now used in many products from washing machines to petrol pumps, from telephones to motor cars, brings with it the possibility of equipment failure due to unforeseen behaviour of the software.

Ever decreasing development cycles, particularly for components, bring the complication that before a device is fully evaluated from field failure data a new generation has arrived to replace it. The more reliable the component the less failure data will present itself, thus aggravating the problem. In a rapidly changing technology the engineer has to accept a multi-disciplinary role in order to embrace reliability, maintainability, automatic test equipment, computer software in design, statistical methods, algorithmic maintenance instructions, legal and contract implications and many other topics. The following chapters aim to cover the very wide spectrum of activities and techniques involved in setting, measuring and achieving both reliability and maintainability objectives. The mathematical aspects are presented, not in erudite depth, but in as simple a way as possible consistent with imparting adequate knowledge and formulae for most practical purposes. Management and contractual aspects are covered and a chapter is devoted to a case study used for many years in training technical managers. Product Liability and Terotechnology are related topics of growing interest and are therefore included.

Since we are dealing with a number of engineering parameters, a practical, cost related, approach is essential. There will be a cost to achieve any parameter and a cost associated with each failure. Reliability and maintainability management aims to select and to achieve such levels of failure rate and repair time which keep the total of these costs to a minimum and only in this way can it justify its place in the spectrum of business activities.