PREFACE

This handbook originated in the reliability community within AT&T. AT&T has always placed a very strong emphasis on the reliability of its communications system, and hence on the reliability of the communications equipment developed by Bell Laboratories and manufactured historically by Western Electric. Extensive studies were supported to access the potential reliability of new technologies, and new products routinely underwent thorough reliability testing to be certain they were suitable for deployment. With divestiture and loss of monopoly status in 1984, AT&T was restructured into business units, each of which was expected to be a profitable and competitive enterprise. These business units set about to streamline their operations in response to business pressures. In particular, the business units engaged in communications equipment development were under pressure to shorten product development intervals, and reduce the cost of development and manufacture in order to be more competitive. This process gradually led to the elimination of a great deal of the extensive reliability work that had been supported in the monopoly days. In particular, the shortening of product design and development intervals did not allow for time-consuming reliability testing, and business units were under pressure to eliminate unnecessary costs, such as basic reliability studies, which were not considered essential to product development.

Since AT&T produced a wide range of communications products, from consumer products such as simple telephones to highly complex transmission and switching systems, it was natural that the different business units responded to market pressures in different ways befitting the individual markets for the different kinds of products they were producing. Within these markets there is recognized a spectrum of reliability requirements, ranging from very high requirements for large switching or transmission systems, which potentially involve a great deal of a customer's revenue stream, down to simple consumer products for which cost of goods and time-to-market are the principal driving forces and reliability must only be adequate for customer acceptance. Hence, within AT&T communications equipment business units, there arose a wide spectrum of approaches to reliability assurance which reflected the market forces of the individual communications equipment businesses. To economize in both time and money on the effort required to ensure adequate product reliability, the various business units instituted new or modified product development practices, such as robust design (including the avoidance of risk of unproved technologies), and adopted more efficient means of doing a reduced level of reliability testing.

One of the most successful efforts within the company to adopt improved reliability assurance techniques occurred in the computer products division in the early 1990s when one of the authors, Paul Parker, led an effort to adopt accelerated stress testing (AST) as a means of improving the line of personal computers. Product

development teams had adopted the practice of purchasing "motherboards" from a low-cost vendor and this had led to less than satisfactory reliability results. Using accelerated stress testing techniques, Paul was able to identify a number of component problems that were promptly fixed, leading to a marked improvement in product reliability. Paul based his approach on earlier successful work at Hewlett-Packard and IBM which had been reported in the technical literature. As word of Paul's success spread within the AT&T reliability and testing community, other groups began trying the technique, and a core reliability team was chartered in 1991 to support the optimization and deployment of accelerated stress testing throughout the company. This staff effort was part of a larger centralized "common technology" development effort that AT&T has traditionally supported. The editors of this handbook were members of this core team. This team was led by Mike Oien who had contributed plenty of ideas to the team in addition to providing excellent managerial support. S. Rajaram had completed a comprehensive survey of AST both within and outside of AT&T, and made a large contribution in the area of "safety testing."

One of the early activities of the reliability staff organization was to conduct a fairly extensive literature search and to establish liaison with some of the principal practitioners of accelerated stress testing. Particularly helpful were discussions with practitioners at Hewlett-Packard and IBM, and an early seminar conducted by Greg Hobbs, a noted consultant at the time on accelerated stress testing. The staff group took on the role of proselytizing the benefits of AST throughout the various equipment business units within AT&T and, as time progressed, a number of successful accelerated stress testing programs were initiated, both independently and with our help. One of our more successful efforts was in participating in the development of a Best Practice for performing AST within the switching equipment division of AT&T. This document was later expanded with input from numerous sources within AT&T to become a Best Practice suitable for all the equipment businesses and forms the core of this book

For AT&T, as is the case with most companies, reliability studies are generally considered to be proprietary information and rarely published. We have only been able to include the few case studies from AT&T which have been published, namely those by Paul Parker and by King Lo and Frank Lovasco. To strengthen the content of the handbook as a general reference for the electronics industry, we have also incorporated contributions from some of the principal non-AT&T practitioners of accelerated stress testing. In particular, we have included published case studies conducted by Clifton Seusy, Harry McLean, Don Dalland, Kevin Granlund, Edmond Kyser, Dennis Pachucki and Charles Shinner. In addition, Charlie Felkins of Storage Technology Corporation contributed a great deal to the chapter on equipment and techniques, Wayne Tustin of Equipment Reliability Group contributed a chapter on Shock and Vibration, Greg Pfeiffer offered an overview of failure analysis, and Kumar Upadhyayula and Abhijit Dasgupta presented their research on combined thermal cycling and vibration testing.

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