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Introduction

1.1 RELIABILITY ASSURANCE

Reliability is an important consideration in the planning, design, and operation of systems. People have always expected trains to be on time, electric power not to fail, and so on. Before the Second World War, the concept of reliability had been only intuitive, subjective, and qualitative. The concept of quantitative reliability appears to have had its inception during the Second World War, and continues today, required by the size and complexity of modern systems.

The modern discipline of reliability is distinguished from the old concept by quantitative evaluation versus the older qualitative evaluation. When reliability is defined quantitatively, it is specified, analyzed, and measured and becomes a parameter of design that can be traded off against other parameters such as cost and performance [1].

The modern discipline of reliability had its origins in the military and space technology. Its influence has been steadily spreading into many other applications. This again is due to the growing complexity of systems, competitiveness in the market, and an ever-increasing competition for budget and resources. Neither can unreliability be tolerated nor are over designs permissible in todays market. The cost of failures in modern power systems and urban transportation system goes much beyond the cost of repair or replacement of effected parts. The inconvenience to consumers and commuters, lost products, crime, and decreased productivity cost much more than the price of immediate repairs.

1.2 PLANNING AND DESIGN

Quantitative reliability can play an important role in the planning, design, and operation of any system. As an example, consider transit facilities being planned for a city. The reliability characteristics of the vehicles and other equipment should be considered at an early stage [2]. The number of vehicles on scheduled maintenance and the number of vehicles that require service by failures should be allowed for while estimating the fleet size. A quantitative and consistent approach would be first to decide the level of service reliability with which the demand should be met and then develop a system reliability model utilizing failure rate data [2] to estimate the number of spare vehicles.

Another approach considers reliability both as a constituent cost and as an effectiveness constraint in assessing the total cost of system acquisition and ownership, that is, life cycle costing. There is a financial penalty associated with vehicle failures since they must be repaired and other vehicles must be available in reserve to maintain the required service level. Also if the system reliability is not adequate, it can lead to loss of revenue because of reduced ridership. On the other hand, it generally costs more money to build higher reliability into the system. Therefore, a trade off can be made between cost and reliability.

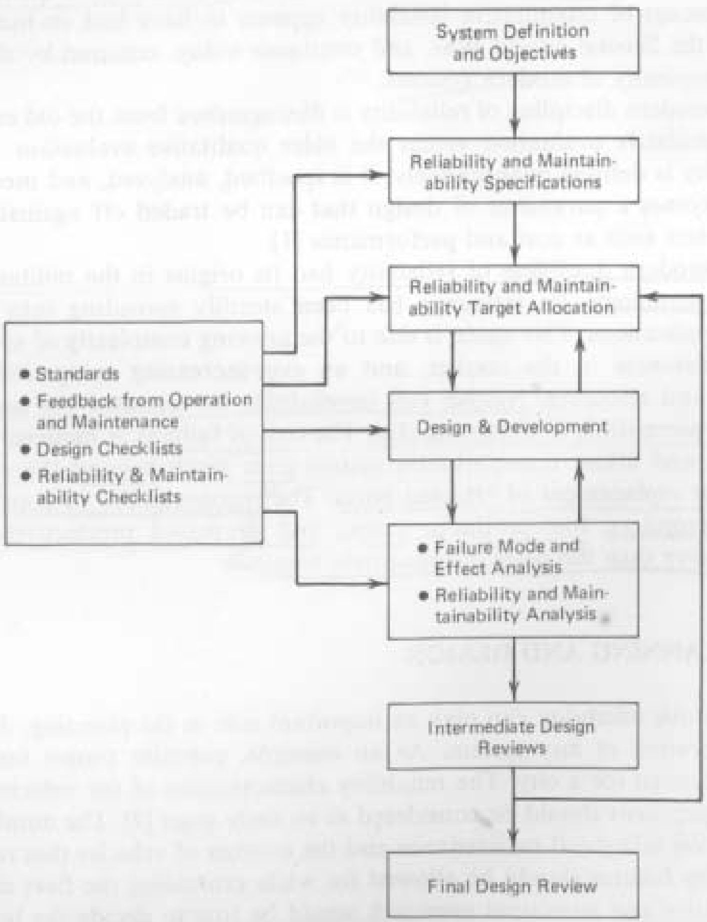

Figure 1.1 Reliability during system design. (Reproduced from Reference 2)

The inherent level of reliability is built into a system during its design phase [3]. Lack of control and direction during this period can result in costly retrofits or poor service reliability during the life cycle of the system [2]. The role of reliability engineering during the design process [2] is indicated in Figure 1.1.

1.3 TECHNIQUES AND APPLICATIONS

The body of knowledge regarding the theory and practice of reliability has been steadily growing. Not only has the basic reliability theory [3] become more sophisticated, but relatively new techniques have been developed and the areas of application considerably expanded. Techniques like fault trees have found applications across various disciplines. The topic of three-state devices is of great interest to reliability engineers in various disciplines. Software reliability, mechanical reliability, and human reliability may have borrowed some concepts from traditional hardware reliability but have distinguishing characteristics and concepts of their own. The concept of an error or a bug, for example, is different from the hardware failures and mechanical reliability is uniquely based on interference models. The areas of application like computers, power systems, and transit systems have developed their own definitions, concepts, and techniques. There is a certain commonality of concepts but great diversity in definitions, models, and methods. The forced outage rate, for example, when applied to generating units means the unavailability of the unit. The degree of growth of knowledge in particular areas can be seen by the fact that there are at present three books in English alone on power system reliability.

1.4 SCOPE

Engineers today dealing with large and diverse projects require information on reliability as it affects differing systems. These topics are discussed either in various technical papers or in specialized books and are presently not treated within the framework of a single book. An engineer needing information in these areas generally faces a great deal of difficulty. This book is an attempt to fulfill this need by treating these diverse topics in a single volume. Previous knowledge is not necessary to understand the contents, since two chapters on basic reliability theory are provided to give enough background. This book will find application in many disciplines and will be especially useful to reliability engineers, system engineers, and students of reliability.

REFERENCES

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3. Singh, C., and R. Billinton, *System Reliability Modelling and Evaluation*, Hutchinson Educational, London, 1977.