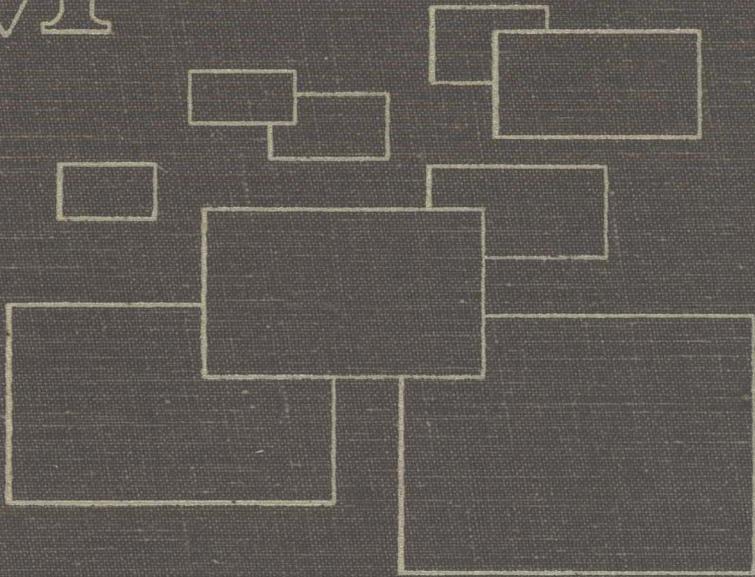


ENGINEERING MANAGEMENT



Concepts, Procedures and Models

B. S. Dhillon

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Engineering Management

Preface

In recent years interest in engineering management has been growing at a significant rate. This trend is clearly evidenced by the increase in published literature and the university programs on the subject. For example, in 1950 there was only one graduate level program in engineering management in the United States, but this number grew to six, sixteen and seventy in 1960, 1970 and 1980, respectively. In addition, today there are at least three professional journals which are specifically concerned with the discipline of engineering management.

A very high percentage of engineers move into supervisory positions between 3 and 7 years after their graduation which requires a considerable knowledge of management. So far to the author's knowledge only a few books have been written on the subject in the recent years. In addition, all of these books emphasize on the general management rather than on technical aspects of engineering management.

On the subject of general management, a vast number of textbooks are already available in the market. Therefore, an engineer requiring the knowledge of general management concepts can easily filter through these books which are written by some of the outstanding experts of management. Nevertheless, an engineer and others performing his or her job in the age of high technology not only have to have a knowledge of general management concepts but a vast knowledge of technical management concepts as well. These concepts are virtually unknown in the general management textbooks.

Basically, this book is based on author's course notes used to teach a large number of senior engineering undergraduate and graduate students over the past years. Most of the graduate students were senior practicing engineers from Department of National Defense, Chalk River Nuclear Laboratories and various other industrial organizations. Thus the material contained in this book was modified at various occasions after receiving the feedback information from both undergraduates and practicing engineers. Therefore, the emphasis of this book is on the technical aspect of the management. This is the area where most of the supervisory engineers are concerned with in their day to day operations.

For the first time to the author's knowledge this book is written to integrate the diverse areas of the technical and general management into a single

volume. Topics of the book are of day to day interest to engineers and others, and are treated in such a manner that no prior knowledge is needed to negotiate contents.

The book is divided into twenty chapters.

Chapter 1 briefly discusses the various aspects of management such as history, management definition, functions of management, managerial goals and skills, management by objectives (MBO), levels of management, characteristic of management, useful information on engineering management and need for engineering management. Organizing is the subject of Chapter 2. Thus, this chapter probes into the organizational aspects of the management. The topics covered are the useful guidelines for planning an organization, design of an organizational structure, fundamental relationships in organizational structures, span of control, delegation, centralization and decentralization of organizations, methods of organization and functions of an engineering department.

Chapter 3 concentrates on human element in engineering management. Thus it discusses the needs of an engineer, routes open to an engineer for managerial positions, transition from engineer to a managerial position, activities and qualities of a manager, hints to relieve tensions, motivating engineering manpower, staff meetings, the committees and displacing managers.

Creativity is the theme of Chapter 4. This chapter covers the selective factors in creativity, creative problem solving steps, ways to develop creativity, characteristics of creative engineers and managers, climate for creativity, attributes of a manager of creative people, barriers to creative thinking; generation, presentation and evaluation of new ideas; ways to kill ideas and techniques for creativity.

Chapter 5 is concerned with manpower planning and control. Four mathematical models which will directly or indirectly aid in making useful manpower planning and control decisions are presented. A list of selected references is presented at the end of the chapter.

Chapter 6 considers the important topic of selecting engineering projects. The areas such as project selection factors, procedures for engineering project selection, feasibility analysis and project selection models are covered.

Chapter 7 studies the various aspects of project management. The topics discussed in this chapter are the need for project management, characteristics of a project management procedure, responsibilities of a project organization, actions to stimulate project success, the project manager, critical path scheduling techniques and advantages and disadvantages of the critical path method.

Management of technical proposals and specifications is the theme of Chapter 8. The chapter describes the types of technical proposals, upper management considerations in the development of a proposal, a procedure to prepare effective engineering proposals, format of a proposal, customer relations in proposal preparation, engineering specification classifications, hints for

writing specifications, specification layout, military specification documents, and advantages and disadvantages of engineering specifications.

Chapter 9 explores the vital topic of management of engineering contracts. The topics such as essential provisions of a contract, contract documents, classifications of contracts, selecting a contractor for a project, types of tender, determining the progress of a contract, contract negotiation procedure, attributes of a negotiator, bids and formulas for determining escalation in price are briefly described.

Chapter 10 consists of techniques to make engineering management decisions. These techniques are the optimization approaches, business operation analysis, forecasting models, discounted cash flow analysis, depreciation methods, decision trees and fault trees. The chapter contains 22 examples with their solutions.

Mathematical models for engineering management decision making are covered in Chapter 11. Thus various mathematical models for large plant investment, general investment and equipment repair facility are presented.

Another important topic which usually interests every engineer is product developing and costing. This is described in Chapter 12. The chapter is divided into two parts, i.e., product developing and product costing. Under the product developing the topics such as reasons for developing new products, tasks to manage the development of new products, product manager and causes of product failures are discussed. The product costing aspect of the chapter covers topics such as reasons for product costing, system cost estimation procedure, life cycle costing, cost-effectiveness analysis, new product pricing and maintenance cost formulas.

Chapters 13 and 14 are concerned with management of engineering design and engineering drawings, respectively. Both these topics are explored in a fair depth.

Value engineering and configuration management are briefly explored in Chapter 15. Both topics are discussed separately in the chapter.

Chapter 16 studies the management and product assurance sciences. This chapter covers basics of reliability, quality control, system safety and maintainability management.

Engineering maintenance management is covered in Chapter 17. The chapter summarizes procedures and models to manage the maintenance function.

Marketing is the theme of Chapter 18. Various important aspects of marketing along with several mathematical models are presented.

Chapter 19 is concerned with product warranties and liabilities. Important aspects of these two topics are explained.

Chapter 20 describes the topic of work study. The chapter briefly covers both the managerial and technical aspects of the work study topic.

The book is intended for the following people:

- (i) Senior undergraduate and graduate students of industrial engineering and engineering management, respectively
- (ii) Practicing engineers, managers and others
- (iii) Senior undergraduate and graduate students of engineering and general management

Some of the chapters of the book may be of interest more to one group of people than another. Therefore the instructor has to use his or her judgement to select chapters of the book for the teaching purposes by taking into consideration the background of the students, their interest, outline of the course and so on. Each chapter consists of lists of exercises and source references. In all the chapters of the book, whenever a new concept is introduced usually the source reference is given. In addition, throughout the book whenever a mathematical concept is introduced, it is usually supported by example(s) along with their solutions. The book contains about 70 examples.

I would like to thank my friends, former students and leading professionals who, through discussions, have influenced my thoughts on various areas of this text. I would also like to thank Dr. S. N. Rayapati for preparing diagrams for this book. I wish to express my thanks to my family, relatives and friends for their interest and constant encouragement. In particular, I am grateful to my relatives Dr. R. S. Grewal, Mr. J. S. Grewal and Mrs. Raj Grewal for their encouragement at the moment of need. And last but not least, I thank my wife, Rosy, for her patience and tolerance as well as for typing the entire manuscript.

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Ottawa, Ontario
May 1987

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Dr. Dhillon is a full professor of Engineering Management in the Department of Mechanical Engineering, University of Ottawa, and teaches engineering management courses to engineering undergraduate and graduate students and professionals. He has several years of industrial experience in business administration and design.

Dr. Dhillon attended the University of Wales where he received a B.Sc. in Electrical and Electronic Engineering and M.Sc. in Industrial and Systems Engineering. He received the Ph.D. in Industrial Engineering from the University of Windsor. He is advisory Editor of *Microelectronics and Reliability: An International Journal*, and Associate Editor of *International Journal of Energy Systems*. He served as an associate editor of the *10th–13th Annual Modeling and Simulation Proceedings*, Pittsburgh, U.S.A. Dr. Dhillon is on the Editorial Board of *International Journal of Reliability Engineering and Safety*. He has published over 180 articles as well as 10 books on various aspects of Engineering Reliability and reliability and maintainability management. Some of his books are translated or accepted for translation into Russian, Chinese, German, etc. He serves as a referee to many national and international journals, book publishers and other bodies. He has presented keynote and invited lectures at various national and international conferences. Recently he served as General Chairman of two international conferences on Reliability and Quality Control held in Paris and Los Angeles.

He is recipient of the Society of Reliability Engineers' Merit Award and the American society for Quality Control's Austin J. Bonis Education Award. Professor Dhillon is a registered Professional Engineer in Ontario, and is listed in the *American Men and Women of Science*, *Dictionary of International Biography*, *Men of Achievement*, *Who's Who in International Intellectuals* and *Who's Who in Technology Today*, etc.

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