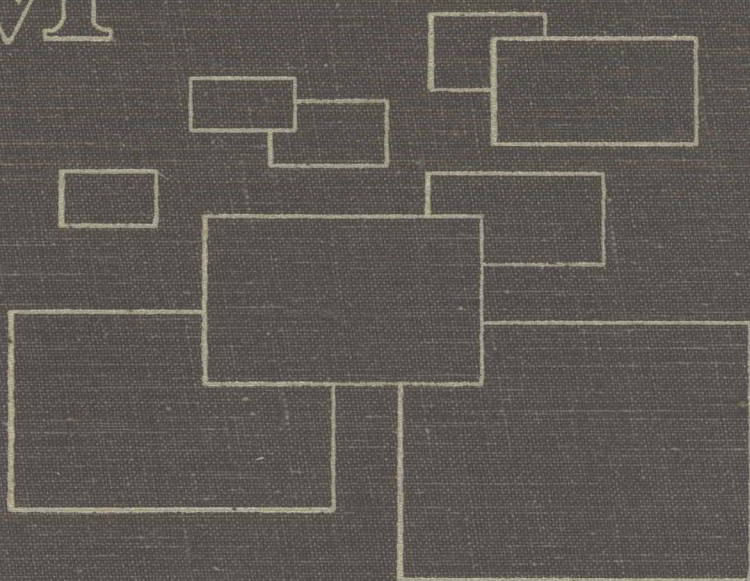


ENGINEERING MANAGEMENT



Concepts, Procedures and Models

B. S. Dhillon

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LANCASTER • BASEL

Published in the Western Hemisphere by
Technomic Publishing Company, Inc.
851 New Holland Avenue
Box 3535
Lancaster, Pennsylvania 17604 U.S.A.

Distributed in the Rest of the World by
Technomic Publishing AG

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Printed in the United States of America
10 9 8 7 6 5 4 3 2

Main entry under title:
Engineering Management: Concepts, Procedures and Models

A Technomic Publishing Company book
Bibliography: p.
Includes index p. 349

Library of Congress Card No. 87-71933
ISBN No. 87762-532-8

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.

Table of Contents

Preface xvii

About the Author xxi

1 INTRODUCTION	1
1.1 A Brief History of Management	1
1.2 Definition of Management	3
1.3 The Functions of Management	4
1.4 Types of Managerial Skills	4
1.5 Management by Objectives (MBO)	5
1.6 Goals of Managers	6
1.7 Management Levels	6
1.8 Management Characteristics	7
1.9 Useful Information on Engineering Management	7
1.9.1 <i>Engineering Management Journals</i>	8
1.9.2 <i>Books on Engineering Management</i>	8
1.10 Need for Engineering Management	8
1.11 Summary	9
1.12 Exercises	9
1.13 References	10
2 ORGANIZING	11
2.1 Introduction	11
2.2 Useful Guidelines for Planning an Organization	11
2.3 Designing an Organizational Structure of a Company	12
2.3.1 <i>Reasons for Having an Organizational Chart</i>	13
2.4 Fundamental Relationships in Organizational Structures of Companies	13
2.5 Span of Control	14
2.5.1 <i>Lockheed's Span of Control Model</i>	17
2.6 Delegation	17
2.6.1 <i>Managerial Obstacles to Delegation</i>	17
2.6.2 <i>Subordinate's Obstacles to Delegation</i>	18
2.6.3 <i>Useful Guidelines to Delegate Authority Effectively</i>	18
2.7 Centralization and Decentralization of Organizations	19

2.7.1	<i>Determining Factors for the Decentralization of Authority</i>	19
2.7.2	<i>Benefits of Centralization and Decentralization</i>	19
2.8	Methods of Organization	20
2.8.1	<i>Organization by Function</i>	20
2.8.2	<i>Organization by Product</i>	22
2.8.3	<i>Organization by Territory</i>	22
2.8.4	<i>Organization by Project</i>	25
2.8.5	<i>Matrix Organization</i>	27
2.9	Functions of an Engineering Department	27
2.10	Summary	28
2.11	Exercises	29
2.12	References	30
3	HUMAN ELEMENT IN ENGINEERING MANAGEMENT	31
3.1	Introduction	31
3.2	Needs of an Engineer	31
3.3	Routes Open to an Engineer for Managerial Positions	32
3.4	From Engineer to a Managerial Position	33
3.5	Activities and Qualities of a Manager	34
3.5.1	<i>Activities of a Manager</i>	35
3.5.2	<i>Qualities of a Manager</i>	35
3.6	Hints to Relieve Tensions	37
3.7	Motivating Engineering Manpower	38
3.7.1	<i>Motivators for Managers</i>	39
3.8	Staff Meetings	39
3.8.1	<i>Benefits of a Staff Meeting</i>	40
3.8.2	<i>Useful Guidelines to Hold Staff Meetings Effectively</i>	40
3.9	The Committees	41
3.9.1	<i>Why Have Committees?</i>	42
3.9.2	<i>Drawbacks of Committees</i>	42
3.10	Displacing Managers	43
3.11	Summary	45
3.12	Exercises	46
3.13	References	46
4	CREATIVITY	49
4.1	Introduction	49
4.2	Examination of Selective Factors in Creativity	50
4.3	Creative Problem-Solving Steps	50
4.4	Ways to Develop Creativity	51
4.5	Characteristics of Creative Engineers and Managers	52

4.5.1	<i>Highly Creative Engineers</i>	52
4.5.2	<i>Creative Managers</i>	52
4.6	Climate for Creativity	53
4.7	Attributes of a Manager of Creative People	54
4.8	Barriers to Creative Thinking	54
4.9	Generation, Presentation and Evaluation of New Ideas	56
4.9.1	<i>Generation of New Ideas</i>	56
4.9.2	<i>Presentation of New Ideas</i>	56
4.9.3	<i>Evaluation of New Ideas</i>	58
4.10	Ways to Kill Ideas	58
4.11	Creativity Techniques	59
4.11.1	<i>Technique I</i>	59
4.11.2	<i>Technique II</i>	59
4.11.3	<i>Technique III</i>	60
4.11.4	<i>Technique IV</i>	60
4.11.5	<i>Technique V</i>	61
4.11.6	<i>Technique VI</i>	62
4.11.7	<i>Technique VII</i>	62
4.11.8	<i>Technique VIII</i>	62
4.12	Summary	62
4.13	Exercises	63
4.14	References	64
5	MANPOWER PLANNING AND CONTROL	65
5.1	Introduction	65
5.2	Classification of Published Literature on Manpower Planning and Control	65
5.3	Manpower Planning and Control	66
5.3.1	<i>Approaches for Manpower Planning</i>	67
5.4	Selective Mathematical Models	68
5.4.1	<i>Model I—Span of Control</i>	68
5.4.2	<i>Model II—Labour Stability</i>	70
5.4.3	<i>Model III—Organization Size and Efficiency</i>	71
5.4.4	<i>Model IV—The Learning Curve</i>	72
5.5	Summary	75
5.6	Exercises	75
5.7	References	76
6	SELECTING ENGINEERING PROJECTS	79
6.1	Introduction	79
6.2	Project Selection Factors	79
6.3	Procedures for Engineering Project Selection and Feasibility Analysis	81
6.3.1	<i>Procedure I</i>	81
6.3.2	<i>Procedure II</i>	86

6.4	Project Selection Models	88
6.5	Summary	102
6.6	Exercises	103
6.7	References	103

7 INTRODUCTION TO PROJECT MANAGEMENT 105

7.1	Introduction	105
7.2	Need for Project Management	106
7.3	Characteristics of a Project Management Procedure	106
7.4	Responsibilities of a Project Organization	107
7.5	Life Cycle Phases of the Project Organization and Functions of Project Management	107
7.5.1	<i>Life Cycle Phases of the Project Organization</i>	107
7.5.2	<i>Functions of Project Management</i>	107
7.6	Actions to Stimulate Project Success	109
7.7	The Project Manager	109
7.7.1	<i>Basic Responsibilities of a Project Manager</i>	110
7.7.2	<i>Qualifications of Successful Project Manager</i>	110
7.8	Critical Path Scheduling Techniques	110
7.8.1	<i>Steps to Develop and Analyse a PERT Network</i>	111
7.8.2	<i>Steps to Develop and Analyse a CPM Network</i>	116
7.9	Symbols and Definitions used to Construct and Solve a CPM or a PERT Network	116
7.10	Essential Formulas and a Procedure for Determining the Critical Path of a Network	121
7.10.1	<i>Essential Formulas</i>	121
7.10.2	<i>A Procedure for Determining the Critical Path of a Network</i>	122
7.11	Benefits and Drawbacks of the Critical Path Method	127
7.12	Summary	128
7.13	Exercises	128
7.14	References	130

8 MANAGEMENT OF TECHNICAL PROPOSALS AND SPECIFICATIONS 131

8.1	Introduction	131
8.2	Technical Proposals	131
8.2.1	<i>Types of Technical Proposals</i>	132
8.2.2	<i>Upper Management Considerations in the Development of a Proposal</i>	133

8.2.3	<i>A Procedure for Preparing Effective Engineering Proposals</i>	133
8.2.4	<i>Pertinent Items for Inclusion in Proposals</i>	136
8.2.5	<i>Typical Format of a Proposal</i>	136
8.2.6	<i>Role of Customer Relations in Proposal Preparation</i>	137
8.3	Engineering Specifications	138
8.3.1	<i>Engineering Specifications Classifications</i>	138
8.3.2	<i>Specification Writing Hints</i>	138
8.3.3	<i>Engineering Specifications Layout</i>	138
8.3.4	<i>Specification Documents Developed by Military</i>	140
8.3.5	<i>Advantages and Disadvantages of Engineering Specifications</i>	140
8.4	Summary	141
8.5	Exercises	142
8.6	References	142

9 MANAGEMENT OF ENGINEERING CONTRACTS 145

9.1	Introduction	145
9.2	Essential Provisions of a Contract	146
9.3	Engineering Contract Documents	146
9.4	Classifications of Contracts	148
9.4.1	<i>Contracts Classification Determining Factors</i>	148
9.4.2	<i>Types of Contract</i>	149
9.5	Selecting a Contractor for a Project	151
9.6	Types of Tender and Determining the Progress of a Contract	152
9.6.1	<i>Types of Tender</i>	153
9.6.2	<i>Determining the Progress of a Contract</i>	153
9.7	A Contract Negotiation Procedure	153
9.8	Attributes of a Contract Negotiator and Useful Key Points for Successful Negotiation	155
9.8.1	<i>Attributes of a Negotiator</i>	155
9.8.2	<i>Useful Key Points for a Successful Negotiation</i>	156
9.9	Management of Bids	157
9.9.1	<i>Advertisement for Invitation to Bid</i>	157
9.9.2	<i>Information for Bidders</i>	158
9.9.3	<i>Bid Preparation Procedure</i>	158
9.10	Formulas for Determining Escalation in Price	159
9.10.1	<i>Formula I</i>	159
9.10.2	<i>Formula II</i>	160
9.11	Summary	161

9.12	Exercises	162
9.13	References	163

10 TECHNIQUES FOR MAKING BETTER ENGINEERING MANAGEMENT DECISIONS165

10.1	Introduction	165
10.2	Optimization Techniques	165
10.2.1	<i>Lagrangian Multiplier</i>	165
10.2.2	<i>Linear Programming</i>	167
10.3	Discounted Cash Flow Analysis	171
10.3.1	<i>Simple Interest</i>	171
10.3.2	<i>Compound Interest</i>	172
10.3.3	<i>Present Worth</i>	173
10.3.4	<i>Formula for Uniform Periodic Payments</i>	174
10.3.5	<i>Present Value of Uniform Periodic Payments</i>	175
10.4	Depreciation Techniques	177
10.4.1	<i>Declining-Balance Depreciation Method</i>	177
10.4.2	<i>Straight-Line Depreciation Method</i>	178
10.4.3	<i>Sum-of-Digits Depreciation Method</i>	179
10.5	Business Operations Analysis	180
10.6	Forecasting	183
10.6.1	<i>Forecasting Techniques</i>	183
10.7	Decision Trees	192
10.8	Fault Trees	195
10.8.1	<i>Fault Tree Symbology</i>	195
10.8.2	<i>Fault Tree Construction</i>	197
10.8.3	<i>Quantitative Analysis of Fault Trees</i>	198
10.9	Summary	202
10.10	Exercises	203
10.11	References	205

11 MATHEMATICAL MODELS FOR ENGINEERING MANAGEMENT DECISION MAKING 207

11.1	Introduction	207
11.2	Large Plant Investment Decision Models	207
11.2.1	<i>Model I</i>	207
11.2.2	<i>Model II</i>	208
11.3	Financial Investment Modeling	210
11.4	Engineering Equipment Repair Facility Decision Models	211
11.5	Summary	214
11.6	Exercises	214
11.7	References	215

12	ENGINEERING PRODUCT DEVELOPING AND COSTING	217
12.1	Introduction	217
12.2	Product Developing	217
12.2.1	<i>Important Reasons for Developing New Engineering Products</i>	218
12.2.2	<i>Steps Involved in New Engineering Product Development</i>	219
12.2.3	<i>Tasks Useful in Effectively Managing the New Engineering Product Development</i>	220
12.2.4	<i>Product Manager</i>	220
12.2.5	<i>Causes of Newly Developed Product Failures in the Market</i>	223
12.2.6	<i>Hints to Avoid Product Failure</i>	223
12.2.7	<i>A List of Useful Information for Product Development</i>	223
12.3	Product Costing	224
12.3.1	<i>Reasons for Product Costing</i>	224
12.3.2	<i>System Cost Estimation Procedure</i>	225
12.3.3	<i>Cost Estimation</i>	226
12.3.4	<i>Life Cycle Cost of a Product</i>	227
12.3.5	<i>An Approach to Performing Cost-effectiveness Analysis</i>	229
12.3.6	<i>Pricing of a New Product</i>	229
12.3.7	<i>Maintenance Cost Formulas</i>	234
12.4	Summary	235
12.5	Exercises	235
12.6	References	236
13	MANAGEMENT OF ENGINEERING DESIGN	239
13.1	Introduction	239
13.2	Demand for Design	239
13.3	Types of Design Work	241
13.4	Eight-Step Procedure Used in Designing	242
13.5	Design Information Sources	247
13.6	Design Specification	248
13.7	Management Expectations from an Engineering Design Department and the Points Associated with Design Requiring Decision	249
13.7.1	<i>Points Associated with Product Design Requiring Decision</i>	249
13.8	Attributes of an Engineering Designer	250
13.9	Management of Design Reviews	251
13.9.1	<i>Design Review Team</i>	252

13.9.2	<i>Design Review Team Chairman</i>	252
13.9.3	<i>Areas of Design Review Questions</i>	253
13.10	Summary	254
13.11	Exercises	255
13.12	References	255

14 MANAGEMENT OF ENGINEERING

DRAWINGS257

14.1	Introduction	257
14.2	Types of Technical Illustrations and Drawings	257
14.3	Users of Drawings	258
14.4	Uses of Engineering Drawings	259
14.5	Drawing Office	259
14.5.1	<i>Drawing Office Liaison with Other Departments</i>	260
14.5.2	<i>Drawing Office Supervision</i>	260
14.5.3	<i>Common Drawing Office Efficiency Problems</i>	261
14.5.4	<i>Omissions and Frequently-Occurring Errors in Working Drawings</i>	261
14.5.5	<i>Common-Sense Drafting Time-Saving Practices</i>	262
14.5.6	<i>Estimation of Drafting Time</i>	263
14.6	Simple Rules for the Drafting Manager When Producing Original Drawings	263
14.7	Ways to Reduce Drafting Costs	264
14.8	An Approach for Releasing Engineering Drawings	266
14.9	Management of Drawing Changes	267
14.10	Engineering Drawing Check List	268
14.11	Summary	268
14.12	Exercises	269
14.13	References	269

15 VALUE ENGINEERING AND CONFIGURATION

MANAGEMENT271

15.1	Introduction	271
15.2	Value Engineering	272
15.2.1	<i>Poor Value Factors</i>	272
15.2.2	<i>Tasks of a Value Engineer</i>	273
15.2.3	<i>Phases of Value Engineering</i>	274
15.3	Configuration Management	275
15.3.1	<i>Configuration Management Achievements</i>	276
15.3.2	<i>Problem Areas for Configuration Management Application</i>	276
15.3.3	<i>Configuration Management Plan</i>	277
15.4	Summary	279